

# Oracle Cloud Native Environment

## Oracle Container Host for Kubernetes Image Builder for Release 2



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# Contents

## Preface

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Documentation License	iv
Conventions	iv
Documentation Accessibility	iv
Access to Oracle Support for Accessibility	iv
Diversity and Inclusion	iv

## 1 Introduction

---

## 2 Installation

---

## 3 Command Reference

---

## 4 Build OCK Images

---

The ock-forge Script	4-1
Configuration Files	4-1
Destination Devices	4-2
Partition Layout	4-2
Building OCK Images Examples	4-3

## 5 OCK Builder Utilities

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# Preface

This document includes information on the Oracle Container Host for Kubernetes Image Builder (OCK Image Builder). This is a tool that builds bootable media for Oracle Container Host for Kubernetes (OCK), based on a treefile configuration.

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The following text conventions are used in this document:

Convention	Meaning
<b>boldface</b>	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
<i>italic</i>	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
<code>monospace</code>	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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mindful of the necessity to maintain compatibility with our customers' existing technologies and the need to ensure continuity of service as Oracle's offerings and industry standards evolve. Because of these technical constraints, our effort to remove insensitive terms is ongoing and will take time and external cooperation.

# 1

## Introduction

Describes the Oracle Container Host for Kubernetes Image Builder utility.

The Oracle Container Host for Kubernetes Image Builder (OCK Image Builder) is a tool that builds Oracle Container Host for Kubernetes (OCK) images for Oracle Cloud Native Environment (Oracle CNE) deployments.

For more information about OCK images, see [Oracle Cloud Native Environment: Kubernetes Clusters](#).

Use OCK Image Builder to build custom OCK images for situations where the standard OCK image isn't adequate. For example, consider creating a custom OCK image if you require:

- A different partition layout to the standard OCK image partition layout.
- Extra packages not included in the standard OCK image.
- Device drivers for devices that aren't available in the standard OCK image.

OCK Image Builder consists of a set of shell scripts, the main one of which is `ock-forge`, and image-specific configuration files that can be used and edited as necessary.

For a specific configuration, OCK Image Builder can generate:

- A bootable Qcow2 image, to create cluster nodes.
- An OSTree container image, which Oracle CNE uses to update nodes in a running cluster.

OCK images are configured using rpm-ostree treefiles and therefore require knowledge of [OSTree](#) and [rpm-ostree](#).

For more information about OCK Image Builder, see the [OCK Image Builder GitHub repository](#).

# 2

## Installation

Describes how to install the OCK Image Builder utility.

OCK Image Builder must be installed on Oracle Linux 9, from the OCK Image Builder GitHub repository. The prerequisites are Podman, and the `qemu-img` utility.

1. Install Podman.

For information on installing Podman, see the [Oracle Linux: Podman User's Guide](#).

2. Install `qemu-img`.

The `qemu-img` utility is used to manipulate Qcow2 images. Install `qemu-img` from the `ol9_kvm_utils` repository.

First, enable the repository:

```
sudo dnf config-manager --enable ol9_kvm_utils
```

Then, install `qemu-img`:

```
sudo dnf install qemu-img
```

3. Install Git.

Install the Git client:

```
sudo dnf install git -y
```

4. Install OCK Image Builder.

Clone the OCK Image Builder GitHub repository:

```
git clone https://github.com/oracle-cne/ock-forge
```

5. Install the OCK Configuration files:

Clone the OCK Configuration GitHub repository. The examples in this guide assume that the configuration files are in the `configs` directory within the OCK Image Builder installation, so perform the clone from within the `ock-forge` directory.

```
cd ock-forge
git clone https://github.com/oracle-cne/ock
```

# 3

## Command Reference

Command reference for the `ock-forge` utility.

The `ock-forge` utility builds bootable media and OSTree container images for OCK, based on an `rpm-ostree` treefile configuration.

```
ock-forge
[{-s|--source} URI]
[{-b|--branch} branch-name]
[{-d|--device} block-device]
[{-D|--disk} image-path]
[{-f|--filesystem} filesystem]
[{-i|--image} container-image]
[{-s|--source} URI]
[{-b|--branch}]
[{-C|--configs-dir} path]
[{-c|--config-dir} path]
[{-o|--os-name} name]
[{-O|--ostree-image-path} path]
[{-n|--no-clean}]
[{-P|--partition}]
[{-p|--provider} ignition-provider]
[{-I|--ignition} path]
[{-B|--build-image} container-image]
[--karg key=value]...
[--karg-append key=value]...
[--karg-delete key=value]...
```

Where:

**{-s|--source} *URI***

The path to either a Git repository or a directory. The contents of the location is copied to the build directory. If this option is omitted, the default configuration is used.

**{-b|--branch} *branch-name***

The name of a Git branch. If this option is provided, the indicated branch is cloned. Without this option, the default branch is cloned.

**{-d|--device} *block-device***

The path to an existing block device. This device is the installation target. All operations performed by OCK Image Builder are run against this device.

**{-D|--disk} *image-path***

The path to a disk image file. This value is only necessary if the installation target is a file rather than a raw device. The disk image file is attached to the device specified with the `--device` option.

**{-f|--filesystem} *filesystem***

The file system to use when formatting the root partition. This must be `xfs`.



**{-i|--image} *container-image***

A fully qualified container image name, including a tag. This argument is used in several ways. If provided alone, this container image is used as the base image to deploy the OS. In this case, building the OSTree is skipped entirely. If provided with the `--config-dir` option, and the `--ostree-image-path` option, it generates an OSTree container image that can be used for later installations or upgrades.

**{-s|--source} *URI***

The URI of an OCK configuration. The configuration is copied from this location into the value of the `--configs-dir` argument. If the URI ends with `.git`, the assumption is that it refers to a Git repository. Otherwise, the URI is assumed to be a directory on the local file system.

**{-b|--branch}**

If `--source` refers to a Git repository, the specified branch is checked out after cloning.

**{-C|--configs-dir} *path***

A directory containing a set of rpm-ostree configurations.

**{-c|--config-dir} *path***

A directory containing the rpm-ostree configuration to build. This must be a subdirectory of `--configs-dir`, at whatever depth is required to ensure all symlinks can be resolved. If this option is specified, a complete rpm-ostree build is performed and optionally packaged into an Open Container Initiative (OCI) archive.

**{-o|--os-name} *name***

The name of the OSTree deployment.

**{-O|--ostree-image-path} *path***

The path to write the Open Container Initiative (OCI) archive generated by the installation process. If this value isn't specified, no archive is generated. If the `--config-dir` option isn't provided, this option is ignored. If the `--image` option is provided and points to a valid OSTree container image, it's used as the reference for generating a chunked image.

**{-n|--no-clean}**

If this option is provided, don't perform any post install cleanup steps such as unmounting partitions, or detaching virtual block devices.

**{-P|--partition}**

If this option is provided, the block device specified using the `--device` option has its partition table wiped and repopulated with the default geometry.

**{-p|--provider} *ignition-provider***

Sets the ignition provider. The default value is `qemu`, unless the `--ignition` option is used, in which case the default value is `file`.

This can also be set to `oci` when creating images for OCI. The `oci` provider reads Ignition information from the `metadata user_data` key/value pair in the **Instance metadata service**, when creating a compute instance.

**{-I|--ignition} *path***

The path to an ignition file, which `ock-forge` can install directly to the boot disk. This is the complete ignition file from the output of an `ocne cluster start` or `ocne cluster join` command. The file is embedded into the initramfs on the deployment. If the `--provider` option isn't specified, the `--provider` option is set to `file`.

**{-B|--build-image} *container-image***

The name of a container image to use when building the OCK boot media. The default value is `ock-builder:latest`.

**--karg *key=value***

Set a kernel argument to pass to the `ostree` command. This overrides any existing argument with the same *key*. See the `ostree-admin-deploy(1)` man page for usage. Each kernel argument requires a separate `--karg` option.

**--karg-append *key=value***

Append a kernel argument to pass to the `ostree` command. See the `ostree-admin-deploy(1)` man page for usage. Each kernel argument appended requires a separate `--karg-append` option.

**--karg-delete *key=value***

Delete an existing kernel argument to the `ostree` command. See the `ostree-admin-deploy(1)` man page for usage. Each kernel argument deleted requires a separate `--karg-delete` option.

# 4

## Build OCK Images

Learn how to use the OCK Image Builder's `ock-forge` utility to build custom images.

This chapter contains information and examples for building OCK images with the `ock-forge` utility.

### The `ock-forge` Script

Describes the capabilities of the `ock-forge` shell script.

The primary component of OCK Image Builder is the `ock-forge` script. The `ock-forge` script generates a bootable OCK image from an rpm-ostree treefile. It requires that the target is a single block device using the standard partition layout. For more information, see [Partition Layout](#).



#### **NOT\_SUPPORTED:**

Although the `ock-forge` script can build an image from any arbitrary treefile, it's only intended for use with OCK images.

The `ock-forge` script can output generated images in three different formats:

- A Qcow2 image.
- A Raw ISO image.
- To a block device (physical disk).

In addition to generating the bootable image, `ock-forge` creates an OSTree container image. This container image is used by Oracle CNE to update nodes in a running cluster.

### Configuration Files

Describes OCK image configuration files.

The `ock-forge` script requires an rpm-ostree treefile configuration that specifies what the generated image contains. Because the script generates OCK images that are intended for Oracle CNE deployments, the treefile must contain the base configuration that's required to work in that environment. These configuration files are available for different target Kubernetes versions in the [OCK Configuration GitHub repository](#).

We recommend that you don't edit these configuration files directly, but include any custom configuration in separate files. This prevents custom configuration from being overwritten by future updates to the OCK image configuration files.

The initial configuration file that the `ock-forge` script reads is called `manifest.yaml`. Use an existing configuration for the target Kubernetes version and customize it by including extra configuration files in the `manifest.yaml` file as follows:

```
# manifest.yaml
include:
- base.yaml
- ux.yaml
- ocne.yaml
- removals.yaml
- custom/myconfig.yaml
...
```

For example, to make the Vim editor available in the custom OCK image, add the following to the `myconfig.yaml` file:

```
packages:
- vim
```

For more information on the available parameters in an rpm-ostree treefile, see the [rpm-ostree Treefile reference](#).

## Destination Devices

Describes the devices that OCK images can be written to.

OCK Image Builder can generate a bootable OCK image in Qcow2 format, or as a raw disk image, or directly to a physical disk. The utility mounts Qcow2 images on a Network Block Device (NBD). Raw disk images are mounted either to a physical disk, or a loopback device, depending on the options specified.

So that OCK Image Builder can mount Qcow2 images to an NBD, you must first load the `nbd` kernel module, using the following syntax, where `max_partitions` is the maximum number of partitions that the resulting Qcow2 image requires. The default is 8, which is enough for most images:

```
sudo modprobe nbd max_part=max_partitions
```

## Partition Layout

Describes the standard partition layout required by OCK images.

Installing to a disk with existing partitions requires at least the following partitions:

- An EFI partition.
- A boot partition labelled `boot`.
- A root partition labelled `root`.

We recommend the disk contains only these three partitions and that the root partition is the last partition on the disk. The root partition must be last so that the partition can be automatically expanded to fill the entire disk when the OS boots for the first time. Other layouts are possible, but these have limited applicability and require a good understanding of how partitions are laid out and used.

## Building OCK Images Examples

Provides examples of using the `ock-forge` script to build OCK images.

### Example 4-1 Building a typical Qcow2 image

A typical invocation builds Qcow2 images. The `ock-forge` script does all the work required. This example generates a new Qcow2 image, attaches it as a block device, partitions the disk, formats the partitions, installs the OS, and generates an OSTree archive:

```
sudo ./ock-forge -d /dev/nbd0 -D out/1.31/boot.qcow2 \  
-i container-registry.oracle.com/olcne/ock-ostree:1.31 \  
-O ./out/1.31/archive.tar \  
-C ./ock -c configs/config-1.31 -P
```

### Example 4-2 Building a Qcow2 image from GitHub

The `ock-forge` script can copy configurations from inconvenient places to more convenient places. This example builds a Qcow2 and OSTree image from scratch, using the OCK GitHub repository as a source of truth. The clone of the repository is retained and can be reused in later invocations:

```
sudo ./ock-forge -d /dev/nbd0 -D out/1.31/boot.qcow2 \  
-i container-registry.oracle.com/olcne/ock-ostree:1.31 \  
-O ./out/1.31/archive.tar \  
-C ./ock -c configs/config-1.31 \  
-s https://github.com/oracle-cne/ock.git -P
```

### Example 4-3 Build a raw disk image

This example generates a raw disk image, rather than a Qcow2 image. The generated image can be dd'ed onto a physical disk, and used to boot a system directly:

```
sudo ./ock-forge -d /dev/loop0 -D out/1.31/boot.iso \  
-i container-registry.oracle.com/olcne/ock-ostree:1.31 \  
-O ./out/1.31/archive.tar \  
-C ./ock -c configs/config-1.31 -P
```

### Example 4-4 Install to a physical disk

This example installs the image to a physical block device, creating the necessary partitions:

```
sudo ./ock-forge -d /dev/sdb \  
-i container-registry.oracle.com/olcne/ock-ostree:1.31 \  
-O ./out/1.31/archive.tar \  
-C ./ock -c configs/config-1.31 -P
```

### Example 4-5 Install but don't generate OSTree archive

This example performs a fresh installation of the OS, but doesn't store the contents in an OSTree container image archive:

```
sudo ./ock-forge -d /dev/nbd0 -C ./ock -c configs/config-1.31 -P
```

### Example 4-6 Install from a container image

This example installs the OS using an existing OSTree container image as the source:

```
sudo ./ock-forge -d /dev/nbd0 -d /dev/loop0 -D out/1.31/boot.iso \  
-i container-registry.oracle.com/olcne/ock-ostree:1.31 -P
```

# 5

## OCK Builder Utilities

Lists the individual scripts that the OCK Image Builder tool consists of.

The `ock-forge` utility is a shell script that relies on other shell scripts to do its work. Each of the shell scripts can be useful by itself, but probably requires editing to make it so.



### WARNING:

Ensure that you understand how these scripts function before changing them. These utility scripts can be destructive if used incorrectly.

The shell scripts that make up the OCK Image Builder tool are listed in the following table.

**Table 5-1 OCK Image Builder Utility Scripts**

Script	Options	Notes
<code>setup-vm-disk.sh</code>	<code>-d network-block-device</code> <code>-D path-to-new-image</code>	Creates a Qcow2 image and attaches it to a network block device.
<code>sparsify-image.sh</code>	<code>-D path-to-image</code>	Re-sparsifies and compresses a Qcow2 image. It does part of the job of <code>virt-sparsify</code> and the result isn't as good. However, it has the advantage of not requiring a VM and can be used in environments where starting a VM isn't an option. For example, building an image inside an ARM VM. It requires several gigabytes of storage while running. That space is released by the time the script ends.
<code>make-partitions.sh</code>	<code>-d path-to-device</code> <code>-f filesystem</code>	Partitions a disk using a standard layout. It creates a small EFI partition as partition 1, a small boot partition as partition 2, and a root partition with the rest of the disk as the last partition.

### Example 5-1 Creating and attaching Qcow2 images

To create a Qcow2 image and attach it to `/dev/nbd0`:

```
sudo ./setup-vm-disk -d /dev/nbd0 -D mydisk.qcow2
```

**Example 5-2 Sparsify a Qcow2 image**

To sparsify and compress an existing Qcow2 image:

```
sudo ./sparsify-image.sh -D mydisk.qcow2
```

**Example 5-3 Partition a disk**

To partition a physical block device using XFS:

```
sudo ./make-partitions.sh -d /dev/sdb -f xfs
```