



OpenShift Container Platform 3.10

Upgrading Clusters

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Abstract

Upgrade your OpenShift Container Platform 3.10 cluster with this guide

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CHAPTER 1. UPGRADE METHODS AND STRATEGIES

1.1. INTRODUCTION TO UPGRADING CLUSTERS

When new versions of OpenShift Container Platform are released, you can upgrade your existing cluster to apply the latest enhancements and bug fixes. This includes upgrading from previous minor versions, such as release 3.7 to 3.9, and applying asynchronous errata updates within a minor version (3.9.z releases). See the [OpenShift Container Platform 3.10 Release Notes](#) to review the latest changes.



NOTE

Due to the [core architectural changes](#) between the major versions, OpenShift Enterprise 2 environments cannot be upgraded to OpenShift Container Platform 3 and require a fresh installation.

The OpenShift Container Platform upgrade process uses Ansible playbooks to automate the tasks needed to upgrade your cluster. You must use the [inventory file](#) that you used during initial installation or during the last time that the upgrade was successful to run the upgrade playbook. Using this method allows you to choose between either upgrade strategy: in-place upgrades or blue-green deployments.

Unless noted otherwise, node and masters within a major version are forward and backward compatible [across one minor version](#), so upgrading your cluster should go smoothly. However, you should not run mismatched versions longer than necessary to upgrade the entire cluster.

Before upgrading, ensure that all OpenShift Container Platform services are running well. In the event of a control plane upgrade failure, check the versions of your masters to ensure that all versions are the same. If your masters are all the same version, re-run the upgrade. If they differ, downgrade the masters to match the lower versioned master, then re-run the upgrade.

1.2. UPGRADE STRATEGIES

There are two strategies you can take for performing the OpenShift Container Platform cluster upgrade: in-place upgrades or blue-green deployments.

1.2.1. In-place Upgrades

With in-place upgrades, the cluster upgrade is performed on all hosts in a single, running cluster: first masters and then nodes. Pods are evacuated off of nodes and recreated on other running nodes before a node upgrade begins; this helps reduce downtime of user applications.

1.2.2. Blue-green Deployments

The [blue-green deployment](#) upgrade method follows a similar flow to the in-place method: masters and etcd servers are still upgraded first, however a parallel environment is created for new nodes instead of upgrading them in-place.

This method allows administrators to switch traffic from the old set of nodes (e.g., the "blue" deployment) to the new set (e.g., the "green" deployment) after the new deployment has been verified. If a problem is detected, it is also then easy to rollback to the old deployment quickly.

CHAPTER 2. PERFORMING AUTOMATED IN-PLACE CLUSTER UPGRADES

2.1. ABOUT THIS UPGRADE

If you installed using the standard [cluster installation](#) process, and the inventory file that was used is available, you can use upgrade playbooks to automate the OpenShift cluster upgrade process.

OpenShift Container Platform 3.10 involves significant changes to the architecture of the cluster, which are discussed further in the [OpenShift Container Platform 3.10 Release Notes](#). The following sections detail how these notable technical changes affect the upgrade process from OpenShift Container Platform 3.9.

2.1.1. Defining Node Groups and Host Mappings

Starting in OpenShift Container Platform 3.10, node configurations are now [bootstrapped](#) from the master. When node services are started, the node checks if a **kubeconfig** and other node configuration files exist before joining the cluster. If they do not, the node pulls the configuration from the master, then joins the cluster.

This process replaces administrators having to manually maintain the node configuration uniquely on each node host. Instead, the contents of a node host's **/etc/origin/node/node-config.yaml** file are now provided by ConfigMaps sourced from the master.

To map which ConfigMap to use for which node host, *node groups* must be defined and then set for each host in the inventory file. These procedures are handled during the [Preparing for an Automated Upgrade](#) section.

2.1.2. Updating Host Name Parameters

In OpenShift Container Platform version 3.10, the **openshift_hostname** parameter was removed. If you used the **openshift_hostname** parameter in your inventory file in OpenShift Container Platform version 3.9, you must remove that parameter from your inventory file. Before you upgrade, you must set the **openshift_kubelet_name_override** parameter to the **openshift_hostname** that you used in previous versions.



IMPORTANT

You must not remove the **openshift_kubelet_name_override** parameter from your inventory file after you upgrade.

Node ConfigMaps

The Configmaps for defining the node configurations must be available in the **openshift-node** project. ConfigMaps are also now the authoritative definition for node labels; the old **openshift_node_labels** value is effectively ignored.

The installer provides a playbook for creating the following default ConfigMaps:

- **node-config-master**
- **node-config-infra**
- **node-config-compute**

The following ConfigMaps are also created, which label nodes into multiple roles:

- **node-config-all-in-one**
- **node-config-master-infra**



IMPORTANT

Changes should not be made to a node host's `/etc/origin/node/node-config.yaml` file. They will be overwritten by the configuration defined in the ConfigMap used by the node.

Node Group Definitions

After updating the **openshift-ansible** package, you can view what the default set of node group definitions looks like in YAML format in the `/usr/share/ansible/openshift-ansible/roles/openshift_facts/defaults/main.yml` file:

```
openshift_node_groups:
  - name: node-config-master ❶
    labels:
      - 'node-role.kubernetes.io/master=true' ❷
    edits: [] ❸
  - name: node-config-infra
    labels:
      - 'node-role.kubernetes.io/infra=true'
    edits: []
  - name: node-config-compute
    labels:
      - 'node-role.kubernetes.io/compute=true'
    edits: []
  - name: node-config-master-infra
    labels:
      - 'node-role.kubernetes.io/infra=true,node-
role.kubernetes.io/master=true'
    edits: []
  - name: node-config-all-in-one
    labels:
      - 'node-role.kubernetes.io/infra=true,node-
role.kubernetes.io/master=true,node-role.kubernetes.io/compute=true'
    edits: []
```

- ❶ Node group name.
- ❷ List of node labels associated with the node group.
- ❸ Any edits to the node group's configuration.

If you do not set the **openshift_node_groups** variable in your inventory file's `[OSEv3:vars]` group, the defaults defined above will be used. However, if you want to deviate from these defaults, you must define the entire **openshift_node_groups** structure (including all desired node groups) in your inventory file.

The **openshift_node_groups** value is not merged with the defaults, and the YAML definition must first be translated into a Python dictionary. You can then use the **edits** field to modify any node configuration variables as desired by specifying the key-value pairs.

**NOTE**

See [Master and Node Configuration Files](#) for reference on configurable node variables.

For example, the following entry in an inventory file defines groups named **node-config-master**, **node-config-infra**, and **node-config-compute**, and edits the ConfigMap for **node-config-compute** to set `kubeletArguments.pods-per-core` to **20**:

```
openshift_node_groups=[{'name': 'node-config-master', 'labels': ['node-
role.kubernetes.io/master=true']}, {'name': 'node-config-infra', 'labels':
['node-role.kubernetes.io/infra=true',]}, {'name': 'node-config-compute',
'labels': ['node-role.kubernetes.io/compute=true'], 'edits': [{ 'key':
'kubeletArguments.pods-per-core', 'value': ['20']}]}]
```

Whenever the *openshift_node_group.yml* playbook is run, the changes defined in the **edits** field will update the related ConfigMap (**node-config-compute** in this example), which will ultimately affect the node's configuration file on the host.

2.1.3. Upgrade Workflow

The 3.9 to 3.10 control plane upgrade performs the following steps for you:

- A backup of all etcd data is taken for recovery purposes.
- The API and controllers are updated from 3.9 to 3.10.
- Internal data structures are updated to 3.10.
- The default router, if one exists, is updated from 3.9 to 3.10.
- The default registry, if one exists, is updated from 3.9 to 3.10.
- The default image streams and InstantApp templates are updated.

The 3.9 to 3.10 node upgrade performs a rolling update of nodes, which:

- Marks a subset of nodes unschedulable and drains them of pods.
- Updates node components from 3.9 to 3.10.
- Converts from local configuration to bootstrapped TLS and Config.
- Converts SDN components from **systemd** services to DaemonSets.
- Returns those nodes to service.



IMPORTANT

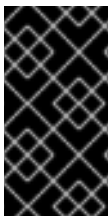
- Ensure that you have met all [prerequisites](#) before proceeding with an upgrade. Failure to do so can result in a failed upgrade.
- If you are using GlusterFS, see [Special Considerations When Using Containerized GlusterFS](#) before proceeding.
- If you are using GCE Persistent Disk (gcePD), see [Special Considerations When Using gcePD](#) before proceeding.
- The day before the upgrade, validate OpenShift Container Platform storage migration to ensure potential issues are resolved prior to the outage window:

```
$ oc adm migrate storage --include=* --loglevel=2 --
confirm --config /etc/origin/master/admin.kubeconfig
```

Automated upgrade playbooks are run via Ansible directly using the **ansible-playbook** command with an inventory file, similar to the advanced installation method. The same **v3_10** upgrade playbooks can be used for either of the following scenarios:

- Upgrading existing OpenShift Container Platform 3.9 clusters to 3.10
- Upgrading existing OpenShift Container Platform 3.10 clusters to the latest [asynchronous errata updates](#)

2.2. PREPARING FOR AN AUTOMATED UPGRADE



IMPORTANT

Before upgrading your cluster to OpenShift Container Platform 3.10, the cluster must be already upgraded to the [latest asynchronous release of version 3.9](#). If your cluster is at a version earlier than 3.9, you must first upgrade incrementally. For example, upgrade from 3.6 to 3.7, then 3.7 to 3.9 (the 3.8 version was [skipped](#)).



NOTE

Before attempting the upgrade, follow the guidance in [Environment health checks](#) to verify the cluster's health. This will confirm that nodes are in the **Ready** state, running the expected starting version, and will ensure that there are no diagnostic errors or warnings.

To prepare for an automated upgrade:

1. Pull the latest subscription data from RHSM:

```
# subscription-manager refresh
```

2. If you are upgrading from OpenShift Container Platform 3.9 to 3.10:

- a. Back up the following files that would be required should you later need to downgrade back to OpenShift Container Platform 3.9:
 - i. On master hosts, back up the following files:

```
/usr/lib/systemd/system/atomic-openshift-master-api.service
/usr/lib/systemd/system/atomic-openshift-master-
controllers.service
/etc/sysconfig/atomic-openshift-master-api
/etc/sysconfig/atomic-openshift-master-controllers
/etc/origin/master/master-config.yaml
/etc/origin/master/scheduler.json
```

The **systemd** files are removed during the upgrade due to the changes to the control plane static pod architecture.

- ii. On node hosts (including masters, which have the node component on them), back up the following files:

```
/usr/lib/systemd/system/atomic-openshift-*.service
/etc/origin/node/node-config.yaml
```

- iii. On etcd hosts (including masters that have etcd co-located on them), back up the following files:

```
/etc/etcd/etcd.conf
```

- b. The upgrade process will create a backup of all etcd data for recovery purposes, but ensure that you have a recent etcd backup at **/backup/etcd-xxxxxx/backup.db** before continuing. Manual etcd backup steps are described in the [Day Two Operations Guide](#).



NOTE

When you upgrade OpenShift Container Platform, your etcd configuration does not change. Whether you run etcd as static pods on master hosts or as a separate service on master hosts or separate hosts does not change after you upgrade.

- c. Manually disable the 3.9 repository and enable the 3.10 repository on each master and node host. You must also enable the **rhel-7-server-ansible-2.4-rpms** repository, if it is not already:

```
# subscription-manager repos --disable="rhel-7-server-ose-3.9-
rpms" \
    --enable="rhel-7-server-ose-3.10-rpms" \
    --enable="rhel-7-server-rpms" \
    --enable="rhel-7-server-extras-rpms" \
    --enable="rhel-7-server-ansible-2.4-rpms" \
# yum clean all
```

- d. Ensure that you have the latest version of the **openshift-ansible** package on the host you run the upgrade playbooks on:

```
# yum update -y openshift-ansible
```

**NOTE**

In previous OpenShift Container Platform releases, the **atomic-openshift-utils** package was installed for this step. However, starting with OpenShift Container Platform 3.10, that package is removed, and the **openshift-ansible** package provides all requirements.

- e. If you do not set the **openshift_node_groups** variable in the inventory file's **[OSEv3:vars]** group, the default set of node groups and ConfigMaps will be created when the **openshift_node_group.yml** playbook is run. If you want to deviate from the defaults, define the entire node group set using a Python dictionary format as outlined in [Defining Node Groups and Host Mappings](#), specifying their **name**, **labels**, and any **edits** to modify the ConfigMaps. For example:

```
[OSEv3:vars]

openshift_node_groups=[{'name': 'node-config-master', 'labels':
['node-role.kubernetes.io/master=true']}, {'name': 'node-config-
infra', 'labels': ['node-role.kubernetes.io/infra=true',]},
{'name': 'node-config-compute', 'labels': ['node-
role.kubernetes.io/compute=true'], 'edits': [{ 'key':
'kubeletArguments.pods-per-core', 'value': ['20']}]}]
```

- f. In order to convert a OpenShift Container Platform 3.9 cluster to using the new node group definitions and mappings, all hosts previously defined in the **[nodes]** inventory group must be assigned an **openshift_node_group_name**. This value is used to select the ConfigMap that configures each node. For example:

```
[nodes]
master[1:3].example.com openshift_node_group_name='node-config-
master'
infra-node1.example.com openshift_node_group_name='node-config-
infra'
infra-node2.example.com openshift_node_group_name='node-config-
infra'
node1.example.com openshift_node_group_name='node-config-compute'
node2.example.com openshift_node_group_name='node-config-compute'
```

In addition, remove the **openshift_node_labels** setting from any existing host entries **[nodes]** group if they are set. Node labels should now be defined in the ConfigMap associated with the host's **openshift_node_group_name** instead.

- g. The upgrade process will be blocked until you have the newly required ConfigMaps for bootstrapping nodes in the **openshift-node** project. Run the following playbook to have the defaults created (or if you defined the **openshift_node_groups** structure in the previous step, your custom sets will be created):

```
# ansible-playbook -i </path/to/inventory/file> \
    /usr/share/ansible/openshift-ansible/playbooks/openshift-
    master/openshift_node_group.yml
```

- h. Carefully verify that each ConfigMap has created and defined as expected. Get your list of all ConfigMaps in the **openshift-node** project:

```
$ oc get configmaps -n openshift-node
```

Then use **oc describe** to inspect them individually:

```
$ oc describe configmaps -n openshift-node <configmap_name>
```

3. If you have applied manual configuration changes to your master or node configuration files since your last Ansible playbook run (whether that was initial installation or your most recent cluster upgrade), and you have not yet made the equivalent changes to your inventory file, review [Configuring Your Inventory File](#). For any variables that are relevant to the manual changes you made, apply the equivalent appropriate changes to your inventory files before running the upgrade. Otherwise, your manual changes may be overwritten by default values during the upgrade, which could cause pods to not run properly or other cluster stability issues. In particular, if you made any changes to **admissionConfig** settings in your master configuration files, review the **openshift_master_admission_plugin_config** variable in [Configuring Your Inventory File](#). Failure to do so could cause pods to get stuck in **Pending** state if you had **ClusterResourceOverride** settings manually configured previously (as described in [Configuring Masters for Overcommitment](#)).

After satisfying these steps, you can review the following sections for more information on how the upgrade process works and make decisions on additional upgrade customization options if you so choose. When you are prepared to run the upgrade, you can continue to [Upgrading to the Latest OpenShift Container Platform 3.10 Release](#).

2.2.1. Updating Policy Definitions

During a cluster upgrade, and on every restart of any master, the [default cluster roles](#) are automatically reconciled to restore any missing permissions.

1. If you customized default cluster roles and want to ensure a role reconciliation does not modify them, protect each role from reconciliation:

```
$ oc annotate clusterrole.rbac <role_name> --overwrite
rbac.authorization.kubernetes.io/autoupdate=false
```



WARNING

You must manually update the roles that contain this setting to include any new or required permissions after upgrading.

2. Generate a default bootstrap policy template file:

```
$ oc adm create-bootstrap-policy-file --filename=policy.json
```



NOTE

The contents of the file vary based on the OpenShift Container Platform version, but the file contains only the default policies.

3. Update the ***policy.json*** file to include any cluster role customizations.
4. Use the policy file to automatically reconcile roles and role bindings that are not reconcile protected:

```
$ oc auth reconcile -f policy.json
```

5. Reconcile security context constraints:

```
# oc adm policy reconcile-sccs \
  --additive-only=true \
  --confirm
```

2.2.2. Upgrading the Control Plane and Nodes in Separate Phases

An OpenShift Container Platform cluster can be upgraded in one or more phases. You can choose whether to upgrade all hosts in one phase by running a single Ansible playbook, or upgrade the *control plane* (master components) and nodes in multiple phases using separate playbooks.

Instructions on the full upgrade process and when to call these playbooks are described in [Upgrading to the Latest OpenShift Container Platform 3.10 Release](#).



NOTE

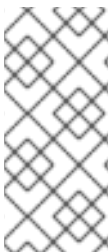
If your OpenShift Container Platform cluster uses GlusterFS pods, you must perform the upgrade in multiple phases. See [Special Considerations When Using Containerized GlusterFS](#) for details on how to upgrade with GlusterFS.

When upgrading in separate phases, the control plane phase includes upgrading:

- master components
- node services running on masters
- Docker or CRI-O running on masters
- Docker or CRI-O running on any stand-alone etcd hosts

When upgrading only the nodes, the control plane must already be upgraded. The node phase includes upgrading:

- node services running on stand-alone nodes
- Docker or CRI-O running on stand-alone nodes



NOTE

Nodes running master components are not included during the node upgrade phase, even though they have node services and Docker running on them. Instead, they are upgraded as part of the control plane upgrade phase. This ensures node services and Docker on masters are not upgraded twice (once during the control plane phase and again during the node phase).

2.2.3. Customizing Node Upgrades

Whether upgrading in a single or multiple phases, you can customize how the node portion of the upgrade progresses by passing certain Ansible variables to an upgrade playbook using the **-e** option.



NOTE

Instructions on the full upgrade process and when to call these playbooks are described in [Upgrading to the Latest OpenShift Container Platform 3.10 Release](#).

The **openshift_upgrade_nodes_serial** variable can be set to an integer or percentage to control how many node hosts are upgraded at the same time. The default is **1**, upgrading nodes one at a time.

For example, to upgrade 20 percent of the total number of detected nodes at a time:

```
$ ansible-playbook -i <path/to/inventory/file> \
    </path/to/upgrade/playbook> \
    -e openshift_upgrade_nodes_serial="20%"
```

The **openshift_upgrade_nodes_label** variable allows you to specify that only nodes with a certain label are upgraded. This can also be combined with the **openshift_upgrade_nodes_serial** variable.

For example, to only upgrade nodes in the **group1** region, two at a time:

```
$ ansible-playbook -i <path/to/inventory/file> \
    </path/to/upgrade/playbook> \
    -e openshift_upgrade_nodes_serial="2" \
    -e openshift_upgrade_nodes_label="region=group1"
```



NOTE

See [Managing Nodes](#) for more on node labels.

The **openshift_upgrade_nodes_max_fail_percentage** variable allows you to specify how many nodes may fail in each batch. The percentage of failure must exceed your value before the playbook aborts the upgrade.

The **openshift_upgrade_nodes_drain_timeout** variable allows you to specify the length of time to wait before giving up.

In this example, 10 nodes are upgraded at a time, the upgrade will abort if more than 20 percent of the nodes fail, and there is a 600-second wait to drain the node:

```
$ ansible-playbook -i <path/to/inventory/file> \
    </path/to/upgrade/playbook> \
    -e openshift_upgrade_nodes_serial=10 \
    -e openshift_upgrade_nodes_max_fail_percentage=20 \
    -e openshift_upgrade_nodes_drain_timeout=600
```

2.2.4. Customizing Upgrades With Ansible Hooks

When upgrading OpenShift Container Platform, you can execute custom tasks during specific operations through a system called *hooks*. Hooks allow cluster administrators to provide files defining

tasks to execute before and/or after specific areas during upgrades. This can be very helpful to validate or modify custom infrastructure when upgrading OpenShift Container Platform.

It is important to remember that when a hook fails, the operation fails. This means a good hook can run multiple times and provide the same results. A great hook is idempotent.

2.2.4.1. Limitations

- Hooks have no defined or versioned interface. They can use internal **openshift-ansible** variables, but there is no guarantee these will remain in future releases. In the future, hooks may be versioned, giving you advance warning that your hook needs to be updated to work with the latest **openshift-ansible**.
- Hooks have no error handling, so an error in a hook will halt the upgrade process. The problem will need to be addressed and the upgrade re-run.

2.2.4.2. Using Hooks

Hooks are defined in the **hosts** inventory file under the **OSEv3:vars** section.

Each hook must point to a YAML file which defines Ansible tasks. This file will be used as an *include*, meaning that the file cannot be a playbook, but a set of tasks. Best practice suggests using absolute paths to the hook file to avoid any ambiguity.

Example Hook Definitions in an Inventory File

```
[OSEv3:vars]
openshift_master_upgrade_pre_hook=/usr/share/custom/pre_master.yml
openshift_master_upgrade_hook=/usr/share/custom/master.yml
openshift_master_upgrade_post_hook=/usr/share/custom/post_master.yml

openshift_node_upgrade_pre_hook=/usr/share/custom/pre_node.yml
openshift_node_upgrade_hook=/usr/share/custom/node.yml
openshift_node_upgrade_post_hook=/usr/share/custom/post_node.yml
```

Example *pre_master.yml* Task

```
---
# Trivial example forcing an operator to ack the start of an upgrade
# file=/usr/share/custom/pre_master.yml

- name: note the start of a master upgrade
  debug:
    msg: "Master upgrade of {{ inventory_hostname }} is about to start"

- name: require an operator agree to start an upgrade
  pause:
    prompt: "Hit enter to start the master upgrade"
```

2.2.4.3. Available Upgrade Hooks

Table 2.1. Master Upgrade Hooks

Hook Name	Description
openshift_master_upgrade_pre_hook	<ul style="list-style-type: none"> • Runs <i>before</i> each master is upgraded. • This hook runs against <i>each master</i> in serial. • If a task must run against a different host, said task must use delegate_to or local_action.
openshift_master_upgrade_hook	<ul style="list-style-type: none"> • Runs <i>after</i> each master is upgraded, but <i>before</i> its service or system restart. • This hook runs against <i>each master</i> in serial. • If a task must run against a different host, said task must use delegate_to or local_action.
openshift_master_upgrade_post_hook	<ul style="list-style-type: none"> • Runs <i>after</i> each master is upgraded and has had its service or system restart. • This hook runs against <i>each master</i> in serial. • If a task must run against a different host, said task must use delegate_to or local_action.

Table 2.2. Node Upgrade Hooks

Hook Name	Description
openshift_node_upgrade_pre_hook	<ul style="list-style-type: none"> • Runs <i>before</i> each node is upgraded. • This hook runs against <i>each node</i> in serial. • If a task must run against a different host, said task must use delegate_to or local_action.

Hook Name	Description
openshift_node_upgrade_hook	<ul style="list-style-type: none"> Runs <i>after</i> each node is upgraded, but <i>before</i> it's marked schedulable again. This hook runs against <i>each node</i> in serial. If a task must run against a different host, said task must use delegate_to or local_action.
openshift_node_upgrade_post_hook	<ul style="list-style-type: none"> Runs <i>after</i> each node is upgraded; it's the <i>last</i> node upgrade action. This hook runs against <i>each node</i> in serial. If a task must run against a different host, said task must use delegate_to or local_action.

2.3. UPGRADING TO THE LATEST OPENSIFT CONTAINER PLATFORM 3.10 RELEASE

To upgrade an existing OpenShift Container Platform 3.9 or 3.10 cluster to the latest 3.10 release:

1. Satisfy the steps in [Preparing for an Automated Upgrade](#) to ensure you are using the latest upgrade playbooks.
2. Ensure the **openshift_deployment_type** parameter in your inventory file is set to **openshift-enterprise**.
3. If you want to enable rolling, full system restarts of the hosts, you can set the **openshift_rolling_restart_mode** parameter in your inventory file to **system**. Otherwise, the default value **services** performs rolling service restarts on HA masters, but does not reboot the systems. See [Configuring Cluster Variables](#) for details.
4. At this point, you can choose to run the upgrade in a single or multiple phases. See [Upgrading the Control Plane and Nodes in Separate Phases](#) for more details which components are upgraded in each phase.
If your inventory file is located somewhere other than the default **/etc/ansible/hosts**, add the **-i** flag to specify its location. If you previously used the **atomic-openshift-installer** command to run your installation, you can check **~/config/openshift/hosts** for the last inventory file that was used, if needed.
 - **Option A)** Upgrade control plane and nodes in a single phase.
Run the **upgrade.yml** playbook to upgrade the cluster in a single phase using one playbook; the control plane is still upgraded first, then nodes in-place:

```
# ansible-playbook -i </path/to/inventory/file> \
    /usr/share/ansible/openshift-ansible/playbooks/byo/openshift-
    cluster/upgrades/v3_10/upgrade.yml
```

- **Option B)** Upgrade the control plane and nodes in separate phases.

a. To upgrade only the control plane, run the ***upgrade_control_plane.yml*** playbook:

```
# ansible-playbook -i </path/to/inventory/file> \
  /usr/share/ansible/openshift-
ansible/playbooks/byo/openshift-
cluster/upgrades/v3_10/upgrade_control_plane.yml
```

b. To upgrade only the nodes, run the ***upgrade_nodes.yml*** playbook:

```
# ansible-playbook -i </path/to/inventory/file> \
  /usr/share/ansible/openshift-
ansible/playbooks/byo/openshift-
cluster/upgrades/v3_10/upgrade_nodes.yml \
  [-e <customized_node_upgrade_variables>] 1
```

- 1** See [Customizing Node Upgrades](#) for any desired **<customized_node_upgrade_variables>**.

If you are upgrading the nodes in groups as described in [Customizing Node Upgrades](#), continue invoking the ***upgrade_nodes.yml*** playbook until all nodes have been successfully upgraded.

5. After all master and node upgrades have completed, reboot all hosts. After rebooting, if there are no additional features enabled, you can [verify the upgrade](#). Otherwise, the next step depends on what additional features you have previously enabled.

Feature	Next Step
Aggregated Logging	Upgrade the EFK logging stack.
Cluster Metrics	Upgrade cluster metrics.

2.4. UPGRADING THE EFK LOGGING STACK

To upgrade an existing EFK logging stack deployment, you must use the provided ***/usr/share/ansible/openshift-ansible/playbooks/openshift-logging/config.yml*** Ansible playbook. This is the playbook to use if you were deploying logging for the first time on an existing cluster, but is also used to upgrade existing logging deployments.

1. If you have not already done so, see [Specifying Logging Ansible Variables](#) in the [Aggregating Container Logs](#) topic and update your Ansible inventory file to at least set the following required variable within the **[OSEv3:vars]** section:

```
[OSEv3:vars]

openshift_logging_install_logging=true 1
```

- 1** Enables the ability to upgrade the logging stack.

2. Add any other **openshift_logging_*** variables that you want to specify to override the defaults, as described in [Specifying Logging Ansible Variables](#).
3. When you have finished updating your inventory file, follow the instructions in [Deploying the EFK Stack](#) to run the **openshift-logging/config.yml** playbook and complete the logging deployment upgrade.

NOTE

If your Fluentd DeploymentConfig and DaemonSet for the EFK components are already set with:

```
image: <image_name>:<vX.Y>
imagePullPolicy: IfNotPresent
```

The latest version **<image_name>** might not be pulled if there is already one with the same **<image_name>:vX.Y** stored locally on the node where the pod is being re-deployed. If so, manually change the DeploymentConfig and DaemonSet to **imagePullPolicy: Always** to make sure it is re-pulled.

2.5. UPGRADING CLUSTER METRICS

To upgrade an existing cluster metrics deployment, you must use the provided **/usr/share/ansible/openshift-ansible/playbooks/openshift-metrics/config.yml** Ansible playbook. This is the playbook to use if you were deploying metrics for the first time on an existing cluster, but is also used to upgrade existing metrics deployments.

1. If you have not already done so, see [Specifying Metrics Ansible Variables](#) in the [Enabling Cluster Metrics](#) topic and update your Ansible inventory file to at least set the following required variables within the **[OSEv3:vars]** section:

```
[OSEv3:vars]
```

```
openshift_metrics_install_metrics=true ❶
openshift_metrics_hawkular_hostname=<fqdn> ❷
openshift_metrics_cassandra_storage_type=(emptydir|pv|dynamic) ❸
```

- ❶ Enables the ability to upgrade the metrics deployment.
- ❷ Used for the Hawkular Metrics route. Specify a fully qualified domain name.
- ❸ Choose the same type as the previous deployment.

2. Add any other **openshift_metrics_*** variables that you want to specify to override the defaults, as described in [Specifying Metrics Ansible Variables](#).
3. When you have finished updating your inventory file, follow the instructions in [Deploying the Metrics Deployment](#) to run the **openshift-metrics/config.yml** playbook and complete the metrics deployment upgrade.

2.6. SPECIAL CONSIDERATIONS FOR MIXED ENVIRONMENTS

Mixed environment upgrades (for example, those with Red Hat Enterprise Linux and Red Hat Enterprise

Linux Atomic Host) require setting both **openshift_pkg_version** and **openshift_image_tag**. In mixed environments, if you only specify **openshift_pkg_version**, then that number is used for the packages for Red Hat Enterprise Linux and the image for Red Hat Enterprise Linux Atomic Host.

2.7. SPECIAL CONSIDERATIONS WHEN USING CONTAINERIZED GLUSTERFS

When upgrading OpenShift Container Platform, you must upgrade the set of nodes where GlusterFS pods are running.

Special consideration must be taken when upgrading these nodes, as **drain** and **unschedule** will not terminate and evacuate the GlusterFS pods because they are running as part of a daemonset.

There is also the potential for someone to run an upgrade on multiple nodes at the same time, which would lead to data availability issues if more than one was hosting GlusterFS pods.

Even if a serial upgrade is running, there is no guarantee sufficient time will be given for GlusterFS to complete all of its healing operations before GlusterFS on the next node is terminated. This could leave the cluster in a bad or unknown state. Therefore, the following procedure is recommended.

1. [Upgrade the control plane](#) (the master nodes and etcd nodes).
2. Upgrade standard **infra** nodes (router, registry, logging, and metrics).



NOTE

If any of the nodes in those groups are running GlusterFS, perform step 4 of this procedure at the same time. GlusterFS nodes must be upgraded along with other nodes in their class (**app** versus **infra**), one at a time.

3. Upgrade standard nodes running application containers.



NOTE

If any of the nodes in those groups are running GlusterFS, perform step 4 of this procedure at the same time. GlusterFS nodes must be upgraded along with other nodes in their class (**app** versus **infra**), one at a time.

4. Upgrade the OpenShift Container Platform nodes running GlusterFS one at a time.
 - a. Add a label to the node you want to upgrade:


```
$ oc label node <node_name> type=upgrade
```
 - b. To run the upgrade playbook on the single node where you terminated GlusterFS, use **-e openshift_upgrade_nodes_label="type=upgrade"**.
 - c. Wait for the GlusterFS pod to respawn and appear.
 - d. **oc rsh** into the pod and verify all volumes are healed:

```
$ oc rsh <GlusterFS_pod_name>
$ for vol in `gluster volume list`; do gluster volume heal $vol
info; done
```

Ensure all of the volumes are healed and there are no outstanding tasks. The **heal info** command lists all pending entries for a given volume's heal process. A volume is considered healed when **Number of entries** for that volume is **0**.

- e. Remove the upgrade label and go to the next GlusterFS node.

```
$ oc label node <node_name> type-
```

2.8. SPECIAL CONSIDERATIONS WHEN USING GCEPD

Because the default gcePD storage provider uses an RWO (Read-Write Only) access mode, you cannot perform a rolling upgrade on the registry or scale the registry to multiple pods. Therefore, when upgrading OpenShift Container Platform, you must specify the following environment variables in your Ansible inventory file:

```
[OSEv3:vars]
```

```
openshift_hosted_registry_storage_provider=gcs
openshift_hosted_registry_storage_gcs_bucket=bucket01
openshift_hosted_registry_storage_gcs_keyfile=test.key
openshift_hosted_registry_storage_gcs_rootdirectory=/registry
```

2.9. VERIFYING THE UPGRADE

Ensure that the:

- cluster is healthy,
- master, node, and etcd services or static pods are running well,
- the OpenShift Container Platform, **docker-registry**, and router versions are correct,
- the original applications are still available and the new application can be created, and
- running **oc adm diagnostics** produces no errors.

To verify the upgrade:

1. Check that all nodes are marked as **Ready**:

```
# oc get nodes
```

NAME	STATUS	ROLES	AGE	VERSION
master1.example.com	Ready	master	47d	
v1.10.0+b81c8f8				
master2.example.com	Ready	master	47d	
v1.10.0+b81c8f8				
master3.example.com	Ready	master	47d	
v1.10.0+b81c8f8				
infra-node1.example.com	Ready	infra	47d	
v1.10.0+b81c8f8				


```

infra-node2.example.com Ready      infra      47d
v1.10.0+b81c8f8
node1.example.com      Ready      compute    47d
v1.10.0+b81c8f8
node2.example.com      Ready      compute    47d
v1.10.0+b81c8f8

```

2. Verify the static pods for the control plane are running:

```

# oc get pods -n kube-system
NAME                                READY    STATUS    RESTARTS
AGE
master-api-master1.example.com      1/1      Running   4
1h
master-controllers-master1.example.com 1/1      Running   3
1h
master-etcd-master1.example.com      1/1      Running   6
5d
[...]

```

3. Verify that you are running the expected versions of the **docker-registry** and **router** images, if deployed.

```

# oc get -n default dc/docker-registry -o json | grep "\"image\""
"image": "openshift3/ose-docker-registry:v3.10",
# oc get -n default dc/router -o json | grep "\"image\""
"image": "openshift3/ose-haproxy-router:v3.10",

```

4. Use the diagnostics tool on the master to look for common issues:

```

# oc adm diagnostics
...
[Note] Summary of diagnostics execution:
[Note] Completed with no errors or warnings seen.

```

CHAPTER 3. BLUE-GREEN DEPLOYMENTS

3.1. OVERVIEW



NOTE

This topic serves as an alternative approach for node host upgrades to the in-place upgrade method.

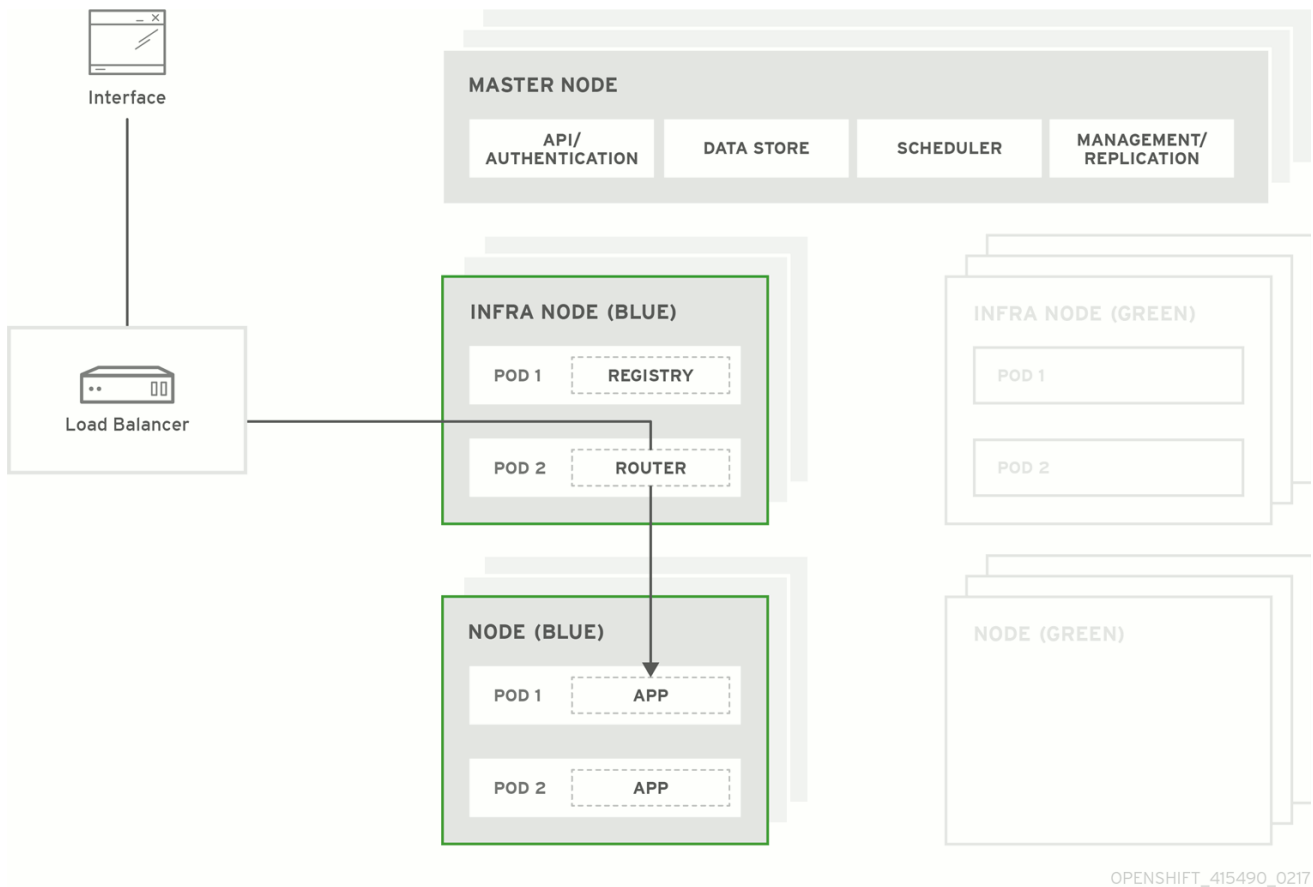
The *blue-green deployment* upgrade method follows a similar flow to the in-place method: masters and etcd servers are still upgraded first, however a parallel environment is created for new node hosts instead of upgrading them in-place.

This method allows administrators to switch traffic from the old set of node hosts (e.g., the *blue* deployment) to the new set (e.g., the *green* deployment) after the new deployment has been verified. If a problem is detected, it is also then easy to rollback to the old deployment quickly.

While blue-green is a proven and valid strategy for deploying just about any software, there are always trade-offs. Not all environments have the same uptime requirements or the resources to properly perform blue-green deployments.

In an OpenShift Container Platform environment, the most suitable candidate for blue-green deployments are the node hosts. All user processes run on these systems and even critical pieces of OpenShift Container Platform infrastructure are self-hosted on these resources. Uptime is most important for these workloads and the additional complexity of blue-green deployments can be justified.

The exact implementation of this approach varies based on your requirements. Often the main challenge is having the excess capacity to facilitate such an approach.

Figure 3.1. Blue-Green Deployment

3.2. PREPARING FOR A BLUE-GREEN UPGRADE

After you have upgraded your master and etcd hosts using method described for [In-place Upgrades](#), use the following sections to prepare your environment for a blue-green upgrade of the remaining node hosts.

3.2.1. Sharing Software Entitlements

Administrators must temporarily share the Red Hat software entitlements between the blue-green deployments or provide access to the installation content by means of a system such as Red Hat Satellite. This can be accomplished by sharing the consumer ID from the previous node host:

1. On each old node host that will be upgraded, note its **system identity** value, which is the consumer ID:

```
# subscription-manager identity | grep system
system identity: 6699375b-06db-48c4-941e-689efd6ce3aa
```

2. On each new RHEL 7 or RHEL Atomic Host 7 system that will replace an old node host, register using the respective consumer ID from the previous step:

```
# subscription-manager register --consumerid=6699375b-06db-48c4-941e-689efd6ce3aa
```

3.2.2. Labeling Blue Nodes

You must ensure that your current node hosts in production are labeled either **blue** or **green**. In this example, the current production environment is **blue**, and the new environment is **green**.

1. Get the current list of node names known to the cluster:

```
$ oc get nodes
```

2. Label all non-master node hosts (compute nodes) and dedicated infrastructure nodes in your current production environment with **color=blue**:

```
$ oc label node --selector=node-role.kubernetes.io/compute=true
color=blue

$ oc label node --selector=node-role.kubernetes.io/infra=true
color=blue
```

In the previous command, the **--selector** flag is used to match a subset of the cluster using the relevant node labels, and all matches are labeled with **color=blue**.

3.2.3. Creating and Labeling Green Nodes

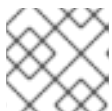
Create the green environment by adding an equal number of new node hosts to the existing cluster:

1. Add the new node hosts using the procedure as described in [Adding Hosts to an Existing Cluster](#). When updating your inventory file with the **[new_nodes]** group in that procedure, ensure these variables are set:
 - In order to delay workload scheduling until the nodes are deemed **healthy**, which you verify in later steps, set the **openshift_schedulable=false** variable for each new node host to ensure they are unschedulable initially.
 - Because the new hosts run OpenShift Container Platform version 3.10, they must now use the **openshift_node_group_name** variable to set a node group per host entry. See [Defining Node Groups and Host Mappings](#) for details.

The new node host group resembles the following example:

Example [new_nodes] Host Group

```
[new_nodes]
node4.example.com openshift_node_group_name='node-config-compute'
openshift_schedulable=false
node5.example.com openshift_node_group_name='node-config-compute'
openshift_schedulable=false
node6.example.com openshift_node_group_name='node-config-compute'
openshift_schedulable=false
infra-node3.example.com openshift_node_group_name='node-config-
infra' openshift_schedulable=false
infra-node4.example.com openshift_node_group_name='node-config-
infra' openshift_schedulable=false
```



NOTE

Do not remove or modify your existing node groups.

2. After the new nodes deploy, apply the **color=green** label to each new node:

```
$ oc label node <node_name> color=green
```

3.2.4. Verifying Green Nodes

Verify that your new green nodes are in a healthy state:

1. Verify that new nodes are detected in the cluster and are in **Ready,SchedulingDisabled** state:

```
$ oc get nodes
```

NAME	STATUS	ROLES	AGE
node4.example.com	Ready,SchedulingDisabled	compute	1d

2. Verify that the green nodes have proper labels:

```
$ oc get nodes --show-labels
```

NAME	STATUS	ROLES	AGE
node4.example.com	Ready,SchedulingDisabled	compute	1d
beta.kubernetes.io/arch=amd64,beta.kubernetes.io/os=linux,color=green, kubernetes.io/hostname=m01.example.com,node- role.kubernetes.io/compute=true			

3. Perform a diagnostic check for the cluster:

```
$ oc adm diagnostics
```

```
[Note] Determining if client configuration exists for client/cluster
diagnostics
```

```
Info: Successfully read a client config file at
'/root/.kube/config'
```

```
Info: Using context for cluster-admin access: 'default/m01-example-
com:8443/system:admin'
```

```
[Note] Performing systemd discovery
```

```
[Note] Running diagnostic: ConfigContexts[default/m01-example-
com:8443/system:admin]
```

```
Description: Validate client config context is complete and
has connectivity
```

```
...
```

```
[Note] Running diagnostic: CheckExternalNetwork
```

```
Description: Check that external network is
accessible within a pod
```

```
[Note] Running diagnostic: CheckNodeNetwork
```

```
Description: Check that pods in the cluster can
access its own node.
```

```
[Note] Running diagnostic: CheckPodNetwork
```

```
Description: Check pod to pod communication in the
cluster. In case of ovs-subnet network plugin, all pods
```

should be able to communicate with each other and in case of multitenant network plugin, pods in non-global projects should be isolated and pods in global projects should be able to access any pod in the cluster and vice versa.

[Note] Running diagnostic: CheckServiceNetwork

Description: Check pod to service communication in the cluster. In case of ovs-subnet network plugin, all pods should be able to communicate with all services and in case of multitenant network plugin, services in non-global projects should be isolated and pods in global projects should be able to access any service in the cluster.

...

3.3. PREPARING THE GREEN NODES

To migrate pods from the blue environment to the green, you must pull the required container images.

Network latency and load on the registry can cause delays if the environment does not have sufficient capacity. You can minimize impact to the running system by importing new image streams to trigger new pod deployments to the new nodes.

Major releases of OpenShift Container Platform, and sometimes asynchronous errata updates, introduce new image streams for builder images for users of Source-to-Image (S2I). Upon import, any builds or deployments configured with [image change triggers](#) are automatically created.

Another benefit of triggering the builds is that it fetches the majority of the ancillary images to all node hosts, such as the various builder images, the pod infrastructure image, and deployers. The green nodes are then prepared for the expected load increase, and the remaining images more quickly migrated during node evacuation.

When you are ready to continue with the upgrade process, follow these steps to warm the green nodes:

1. Set the green nodes to schedulable so that new pods are deployed to them:

```
$ oc adm manage-node --schedulable=true --selector=color=green
```

2. Set the blue nodes to unschedulable so that no new pods run on them:

```
$ oc adm manage-node --schedulable=false --selector=color=blue
```

3. Update the node selectors for the registry and router deployment configurations to use the **node-role.kubernetes.io/infra=true** label. This change starts new deployments that place the registry and router pods on your new infrastructure nodes.

- a. Edit the **docker-registry** deployment configuration:

```
$ oc edit -n default dc/docker-registry
```

- b. Update the **nodeSelector** parameter to use the following value, with **"true"** in quotation marks, and save your changes:

```
nodeSelector:
  node-role.kubernetes.io/infra: "true"
```

- c. Edit the **router** deployment configuration:

```
$ oc edit -n default dc/router
```

- d. Update the **nodeSelector** parameter to use the following value, with **"true"** in quotation marks, and save your changes:

```
nodeSelector:
  node-role.kubernetes.io/infra: "true"
```

- e. Verify that the **docker-registry** and **router** pods are running and in ready state on the new infrastructure nodes:

```
$ oc get pods -n default -o wide
```

NAME		READY	STATUS	RESTARTS	AGE
IP	NODE				
docker-registry-2-b7xbn	10.128.0.188	1/1	Running	0	18m
	infra-node3.example.com				
router-2-mvq6p	192.168.122.184	1/1	Running	0	6m
	infra-node4.example.com				

- Update the default image streams and templates.
- Import the latest images. This process can trigger a large number of builds, but the builds are performed on the green nodes and, therefore, do not impact any traffic on the blue deployment.
- To monitor build progress across all namespaces (projects) in the cluster:

```
$ oc get events -w --all-namespaces
```

In large environments, builds rarely completely stop. However, you should see a large increase and decrease caused by the administrative image import.

3.4. EVACUATING AND DECOMMISSIONING BLUE NODES

For larger deployments, it is possible to have other labels that help determine how evacuation can be coordinated. The most conservative approach for avoiding downtime is to evacuate one node host at a time.

If services are composed of pods using zone anti-affinity, you can evacuate an entire zone at one time. You must ensure that the storage volumes used are available in the new zone. Follow the directions in your cloud provider's documentation.

In OpenShift Container Platform 3.2 and later, a node host evacuation is triggered whenever the node service is stopped. Node labeling is very important and can cause issues if nodes are mislabeled or commands are run on nodes with generalized labels. Exercise caution if master hosts are also labeled with **color=blue**.

When you are ready to continue with the upgrade process, follow these steps.

- Evacuate and delete all blue nodes with the following commands:

```
$ oc adm manage-node --selector=color=blue --evacuate  
$ oc delete node --selector=color=blue
```

2. After the blue node hosts no longer contain pods and have been removed from OpenShift Container Platform, they are safe to power off. As a safety precaution, confirm that there are no issues with the upgrade before you power off the hosts.

- a. Unregister each old host:

```
# subscription-manager clean
```

- b. Back up any useful scripts or required files that are stored on the hosts.
- c. After you are comfortable that the upgrade succeeded, remove these hosts.

CHAPTER 4. UPDATING OPERATING SYSTEMS

Updating the operating system (OS) on a host, by either upgrading across major releases or updating the system software for a minor release, can impact the OpenShift Container Platform software running on those machines. In particular, these updates can affect the **iptables** rules or **ovs** flows that OpenShift Container Platform requires to operate.

4.1. UPDATING THE OPERATING SYSTEM ON A HOST

To safely upgrade the OS on a host:

1. Drain the node in preparation for maintenance:

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

2. In order to protect sensitive packages that do not need to be updated, apply the exclude rules to the host:

```
# atomic-openshift-docker-excluder exclude
# atomic-openshift-excluder exclude
```

3. Update the host packages and reboot the host. A reboot ensures that the host is running the newest versions and means that the **docker** and OpenShift Container Platform processes have been restarted, which forces them to check that all of the rules in other services are correct.

```
# yum update
# reboot
```

However, instead of rebooting a node host, you can restart the services that are affected or preserve the **iptables** state. Both processes are described in the [OpenShift Container Platform iptables](#) topic. The **ovs** flow rules do not need to be saved, but restarting the OpenShift Container Platform node software fixes the flow rules.

4. Configure the host to be schedulable again:

```
$ oc adm uncordon <node_name>
```

4.1.1. Upgrading Nodes Running OpenShift Container Storage

If using OpenShift Container Storage, upgrade the OpenShift Container Platform nodes running OpenShift Container Storage one at a time.

1. Run **oc get daemonset -n <project_name>** to verify the label found under **NODE-SELECTOR**. The default value is **glusterfs=storage-host**. To determine what the pod is, run **oc get pods -n <project_name> --selectors=glusterfs=**.
2. Remove the daemonset label from the node:

```
$ oc label node <node_name> <daemonset_label> -n <project_name>
```

This will cause the OpenShift Container Storage pod to terminate on that node. To overwrite the existing label, use the **--overwrite** flag.

3. To run the upgrade playbook on the single node where you terminated OpenShift Container Storage , use **-e openshift_upgrade_nodes_label="type=upgrade"**.
4. When the upgrade completes, relabel the node with the daemonset label:

```
$ oc label node <node_name> <daemonset_label> -n <project_name>
```

5. Wait for the OpenShift Container Storage pod to respawn and appear.
6. **oc rsh** into the gluster pod to check the volume heal:

```
$ oc rsh <pod_name>
$ for vol in `gluster volume list`; do gluster volume heal $vol
info; done
$ exit
```

Ensure all of the volumes are healed and there are no outstanding tasks. The **heal info** command lists all pending entries for a given volume's heal process. A volume is considered healed when **Number of entries** for that volume is **0**. Use **gluster volume status <volume_name>** for additional details about the volume. The **Online** state should be marked **Y** for all bricks.

CHAPTER 5. DOWNGRADING OPENSIFT

5.1. OVERVIEW

Following an OpenShift Container Platform [upgrade](#), it may be desirable in extreme cases to downgrade your cluster to a previous version. The following sections outline the required steps for each system in a cluster to perform such a downgrade for the OpenShift Container Platform 3.10 to 3.9 downgrade path.



IMPORTANT

These steps are currently only supported for [RPM-based installations](#) of OpenShift Container Platform and assumes downtime of the entire cluster.

5.2. VERIFYING BACKUPS

1. The Ansible playbook used during the [upgrade process](#) should have created a backup of the ***master-config.yaml*** file. Ensure this and the ***scheduler.json*** file exist on your masters:

```
/etc/origin/master/master-config.yaml.<timestamp>
/etc/origin/master/scheduler.json
```

2. The procedure in [Preparing for an Automated Upgrade](#) instructed you to back up the following files before proceeding with an upgrade from OpenShift Container Platform 3.9 to 3.10; ensure that you still have these files available.

On master hosts:

```
/usr/lib/systemd/system/atomic-openshift-master-api.service
/usr/lib/systemd/system/atomic-openshift-master-controllers.service
/etc/sysconfig/atomic-openshift-master-api
/etc/sysconfig/atomic-openshift-master-controllers
```

On node and master hosts:

```
/usr/lib/systemd/system/atomic-openshift-*.service
/etc/origin/node/node-config.yaml
```

On etcd hosts, including masters that have etcd co-located on them:

```
/etc/etcd/etcd.conf
/backup/etcd-xxxxxx/backup.db
```

5.3. SHUTTING DOWN THE CLUSTER

1. On all master and node hosts, stop the master and node services by removing the pod definition and rebooting the host:

```
# mkdir -p /etc/origin/node/pods-stopped
# mv /etc/origin/node/pods/* /etc/origin/node/pods-stopped/
# reboot
```

5.4. REMOVING RPMS AND STATIC PODS

The ***-excluder** packages add entries to the exclude directive in the host's **/etc/yum.conf** file when installed.

1. On all masters, nodes, and etcd members (if using a dedicated etcd cluster), remove the following packages:

```
# yum remove atomic-openshift \
    atomic-openshift-clients \
    atomic-openshift-node \
    atomic-openshift-master \
    atomic-openshift-sdn-ovs \
    atomic-openshift-excluder \
    atomic-openshift-docker-excluder \
    atomic-openshift-hyperkube
```

2. Verify the packages were removed successfully:

```
# rpm -qa | grep atomic-openshift
```

3. On control plane hosts (master and etcd hosts), move the static pod definitions:

```
# mkdir /etc/origin/node/pods-backup
# mv /etc/origin/node/pods/* /etc/origin/node/pods-backup/
```

4. Reboot each host:

```
# reboot
```

5.5. DOWNGRADING DOCKER

Both OpenShift Container Platform 3.9 and 3.10 require Docker 1.13, so Docker does not need to be downgraded.

5.6. REINSTALLING RPMS

1. Disable the OpenShift Container Platform 3.10 repositories, and re-enable the 3.9 repositories:

```
# subscription-manager repos \
    --disable=rhel-7-server-ose-3.10-rpms \
    --enable=rhel-7-server-ose-3.9-rpms
```

2. On each master, install the following packages:

```
# yum install atomic-openshift \
    atomic-openshift-clients \
    atomic-openshift-node \
    atomic-openshift-master \
    openvswitch \
    atomic-openshift-sdn-ovs \
```

```
tuned-profiles-atomic-openshift-node \
atomic-openshift-excluder \
atomic-openshift-docker-excluder
```

3. On each node, install the following packages:

```
# yum install atomic-openshift \
  atomic-openshift-node \
  openvswitch \
  atomic-openshift-sdn-ovs \
  tuned-profiles-atomic-openshift-node \
  atomic-openshift-excluder \
  atomic-openshift-docker-excluder
```

4. On each host, verify the packages were installed successfully:

```
# rpm -qa | grep atomic-openshift
# rpm -q openvswitch
```

5.7. RESTORING ETCD

The restore procedure for etcd configuration files replaces the appropriate files, then restarts the service or static pod.

If an etcd host has become corrupted and the `/etc/etcd/etcd.conf` file is lost, restore it using:

```
$ ssh master-0
# cp /backup/yesterday/master-0-files/etcd.conf /etc/etcd/etcd.conf
# restorecon -Rv /etc/etcd/etcd.conf
```

In this example, the backup file is stored in the `/backup/yesterday/master-0-files/etcd.conf` path where it can be used as an external NFS share, S3 bucket, or other storage solution.

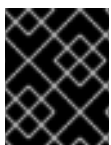


NOTE

If you run etcd as a static pod, follow only the steps in that section. If you run etcd as a separate service on either master or standalone nodes, follow the steps to restore v2 or v3 data as required.

5.7.1. Restoring etcd v3 snapshot

Snapshot integrity may be optionally verified at restore time. If the snapshot is taken with `etcdctl snapshot save`, it will have an integrity hash that is checked by `etcdctl snapshot restore`. If the snapshot is copied from the data directory, there is no integrity hash and it will only restore by using `--skip-hash-check`.



IMPORTANT

The procedure to restore the data must be performed on a single etcd host. You can then add the rest of the nodes to the cluster.

Procedure

1. Unmask the etcd service:

```
# systemctl unmask etcd
```

2. Stop all etcd services by removing the etcd pod definition and rebooting the host:

```
# mkdir -p /etc/origin/node/pods-stopped
# mv /etc/origin/node/pods/* /etc/origin/node/pods-stopped/
# reboot
```

3. Clear all old data, because **etcdctl** recreates it in the node where the restore procedure is going to be performed:

```
# rm -Rf /var/lib/etcd
```

4. Run the **snapshot restore** command, substituting the values from the **/etc/etcd/etcd.conf** file:

```
# etcdctl3 snapshot restore /backup/etcd-xxxxxx/backup.db \
--data-dir /var/lib/etcd \
--name master-0.example.com \
--initial-cluster "master-0.example.com=https://192.168.55.8:2380" \
--initial-cluster-token "etcd-cluster-1" \
--initial-advertise-peer-urls https://192.168.55.8:2380 \
--skip-hash-check=true

2017-10-03 08:55:32.440779 I | mvcc: restore compact to 1041269
2017-10-03 08:55:32.468244 I | etcdserver/membership: added member
40bef1f6c79b3163 [https://192.168.55.8:2380] to cluster
26841ebcf610583c
```

5. Restore permissions and **selinux** context to the restored files:

```
# chown -R etcd.etcd /var/lib/etcd/
# restorecon -Rv /var/lib/etcd
```

6. Start the etcd service:

```
# systemctl start etcd
```

7. Check for any error messages:

```
# journalctl -fu etcd.service
```

5.7.2. Restoring etcd on a static pod

Before restoring etcd on a static pod:

- **etcdctl** binaries must be available or, in containerized installations, the **rhel7/etcd** container must be available.
You can obtain etcd by running the following commands:

```
$ git clone https://github.com/coreos/etcd.git
$ cd etcd
$ ./build
```

To restore etcd on a static pod:

1. If the pod is running, stop the etcd pod by moving the pod manifest YAML file to another directory:

```
$ mv /etc/origin/node/pods/etcd.yaml .
```

2. Clear all old data:

```
$ rm -rf /var/lib/etcd
```

You use the `etcdctl` to recreate the data in the node where you restore the pod.

3. Restore the etcd snapshot to the mount path for the etcd pod:

```
$ export ETCDCTL_API=3
$ etcdctl snapshot restore /etc/etcd/backup/etcd/snapshot.db
  --data-dir /var/lib/etcd/
  --name ip-172-18-3-48.ec2.internal
  --initial-cluster "ip-172-18-3-48.ec2.internal=https://172.18.3.48:2380"
  --initial-cluster-token "etcd-cluster-1"
  --initial-advertise-peer-urls https://172.18.3.48:2380
  --skip-hash-check=true
```

Obtain the values for your cluster from the `$/backup_files/etcd.conf` file.

4. Set required permissions and selinux context on the data directory:

```
$ chown -R etcd.etcd /var/lib/etcd/
$ restorecon -Rv /var/lib/etcd/
```

5. Restart the etcd pod by moving the pod manifest YAML file to the required directory:

```
$ mv etcd.yaml /etc/origin/node/pods/.
```

5.7.3. Adding etcd nodes after restoring

After the first instance is running, you can add multiple etcd servers to your cluster.

Procedure

1. Get the etcd name for the instance in the **ETCD_NAME** variable:

```
# grep ETCD_NAME /etc/etcd/etcd.conf
```

2. Get the IP address where etcd listens for peer communication:

```
# grep ETCD_INITIAL_ADVERTISE_PEER_URLS /etc/etcd/etcd.conf
```

3. If the node was previously part of a etcd cluster, delete the previous etcd data:

```
# rm -Rf /var/lib/etcd/*
```

4. On the etcd host where etcd is properly running, add the new member:

```
# etcdctl member add *<name>* \  
--peer-urls="*<advertise_peer_urls>*"
```

The command outputs some variables. For example:

```
ETCD_NAME="master2"  
ETCD_INITIAL_CLUSTER="master-  
0.example.com=https://192.168.55.8:2380"  
ETCD_INITIAL_CLUSTER_STATE="existing"
```

5. Add the values from the previous command to the `/etc/etcd/etcd.conf` file of the new host:

```
# vi /etc/etcd/etcd.conf
```

6. Start the etcd service in the node joining the cluster:

```
# systemctl start etcd.service
```

7. Check for error messages:

```
# journalctl -fu etcd.service
```

8. Repeat the previous steps for every etcd node to be added.

9. Once you add all the nodes, verify the cluster status and cluster health:

```
# etcdctl endpoint health --  
endpoints="https://<etcd_host1>:2379,https://<etcd_host2>:2379,https  
://<etcd_host3>:2379"  
https://master-0.example.com:2379 is healthy: successfully committed  
proposal: took = 1.423459ms  
https://master-1.example.com:2379 is healthy: successfully committed  
proposal: took = 1.767481ms  
https://master-2.example.com:2379 is healthy: successfully committed  
proposal: took = 1.599694ms  
  
# etcdctl endpoint status --  
endpoints="https://<etcd_host1>:2379,https://<etcd_host2>:2379,https  
://<etcd_host3>:2379"  
https://master-0.example.com:2379, 40bef1f6c79b3163, 3.2.5, 28 MB,  
true, 9, 2878  
https://master-1.example.com:2379, 1ea57201a3ff620a, 3.2.5, 28 MB,  
false, 9, 2878  
https://master-2.example.com:2379, 59229711e4bc65c8, 3.2.5, 28 MB,  
false, 9, 2878
```


5.8. BRINGING OPENSIFT CONTAINER PLATFORM SERVICES BACK ONLINE

After you finish your changes, bring OpenShift Container Platform back online.

Procedure

1. On each OpenShift Container Platform master, restore your master and node configuration from backup and enable and restart all relevant services:

```
# cp ${MYBACKUPDIR}/etc/origin/node/pods/* /etc/origin/node/pods/
# cp ${MYBACKUPDIR}/etc/origin/master/master.env
/etc/origin/master/master.env
# cp ${MYBACKUPDIR}/etc/origin/master/master-config.yaml.<timestamp>
/etc/origin/master/master-config.yaml
# cp ${MYBACKUPDIR}/etc/origin/node/node-config.yaml.<timestamp>
/etc/origin/node/node-config.yaml
# cp ${MYBACKUPDIR}/etc/origin/master/scheduler.json.<timestamp>
/etc/origin/master/scheduler.json
# cp ${MYBACKUPDIR}/usr/lib/systemd/system/atomic-openshift-master-
api.service /usr/lib/systemd/system/atomic-openshift-master-
api.service
# cp ${MYBACKUPDIR}/usr/lib/systemd/system/atomic-openshift-master-
controllers.service /usr/lib/systemd/system/atomic-openshift-master-
controllers.service
# rm /etc/systemd/system/atomic-openshift-node.service
# systemctl daemon-reload
# master-restart api
# master-restart controllers
```

2. On each OpenShift Container Platform node, update the [node configuration maps](#) as needed, and enable and restart the **atomic-openshift-node** service:

```
# cp /etc/origin/node/node-config.yaml.<timestamp>
/etc/origin/node/node-config.yaml
# rm /etc/systemd/system/atomic-openshift-node.service
# systemctl daemon-reload
# systemctl enable atomic-openshift-node
# systemctl start atomic-openshift-node
```

5.9. VERIFYING THE DOWNGRADE

1. To verify the downgrade, first check that all nodes are marked as **Ready**:

```
# oc get nodes
```

NAME	STATUS	AGE
master.example.com	Ready,SchedulingDisabled	165d
node1.example.com	Ready	165d
node2.example.com	Ready	165d

2. Verify the successful downgrade of the registry and router, if deployed:
 - a. Verify you are running the **v3.9** versions of the **docker-registry** and **router** images:

```
# oc get -n default dc/docker-registry -o json | grep \"image\"
  \"image\": \"openshift3/ose-docker-registry:v3.9\",
# oc get -n default dc/router -o json | grep \"image\"
  \"image\": \"openshift3/ose-haproxy-router:v3.9\",
```

- b. Verify that **docker-registry** and **router** pods are running and in ready state:

```
# oc get pods -n default
```

NAME	READY	STATUS	RESTARTS	AGE
docker-registry-2-b7xbn	1/1	Running	0	18m
router-2-mvq6p	1/1	Running	0	6m

3. Use the [diagnostics tool](#) on the master to look for common issues and provide suggestions:

```
# oc adm diagnostics
```

```
...
```

```
[Note] Summary of diagnostics execution:
```

```
[Note] Completed with no errors or warnings seen.
```