



OpenShift Container Platform 3.11

Day Two Operations Guide

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Abstract

While the OpenShift Container Platform Cluster administration guide is focused more on configuration, this guide will describe an overview of common daily maintenance tasks.

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CHAPTER 1. OVERVIEW

This section is built for OpenShift Container Platform administrators with a fresh installation.

While the [OpenShift Container Platform Cluster administration guide](#) is focused more on configuration, this guide describes an overview of common daily maintenance tasks.

CHAPTER 2. RUN-ONCE TASKS

After installing OpenShift Container Platform, your system might need extra configuration to ensure your hosts consistently run smoothly.

While these are classified as run-once tasks, you can perform any of these at any time if any circumstances change.

2.1. NTP SYNCHRONIZATION

NTP (Network Time Protocol) is for keeping hosts in sync with the world clock. Time synchronization is important for time sensitive operations, such as log keeping and time stamps, and is highly recommended for Kubernetes, which OpenShift Container Platform is built on. OpenShift Container Platform operations include etcd leader election, health checks for pods and some other issues, and helps prevent time skew problems.



NOTE

The OpenShift Container Platform installation playbooks install, enable, and configure the **ntp** package to provide NTP service by default. To disable this behavior, set **openshift_clock_enabled=false** in the inventory file. If a host has the **chrony** package already installed, it is configured to provide NTP service instead of using the **ntp** package.

Depending on your instance, NTP might not be enabled by default. To verify that a host is configured to use NTP:

```
$ timedatectl
  Local time: Thu 2017-12-21 14:58:34 UTC
  Universal time: Thu 2017-12-21 14:58:34 UTC
     RTC time: Thu 2017-12-21 14:58:34
   Time zone: Etc/UTC (UTC, +0000)
  NTP enabled: yes
  NTP synchronized: yes
  RTC in local TZ: no
    DST active: n/a
```

If both **NTP enabled** and **NTP synchronized** are **yes**, then NTP synchronization is active.

If **no**, install and enable the **ntp** or **chrony** RPM package.

To install the **ntp** package, run the following command:

```
# timedatectl set-ntp true
```

To install the **chrony** package, run the following commands:

```
# yum install chrony
# systemctl enable chronyd --now
```



IMPORTANT

Time synchronization should be enabled on all hosts in the cluster, whether using NTP or any other method.

For more information about the **timedatectl** command, timezones, and clock configuration, see [Configuring the date and time](#) and [UTC, Timezones, and DST](#).

2.2. ENTROPY

OpenShift Container Platform uses entropy to generate random numbers for objects such as IDs or SSL traffic. These operations wait until there is enough entropy to complete the task. Without enough entropy, the kernel is not able to generate these random numbers with sufficient speed, which can lead to timeouts and the refusal of secure connections.

To check available entropy:

```
$ cat /proc/sys/kernel/random/entropy_avail
2683
```

The available entropy should be verified on all node hosts in the cluster. Ideally, this value should be above **1000**.



NOTE

Red Hat recommends monitoring this value and issuing an alert if the value is under **800**.

Alternatively, you can use the **rngtest** command to check not only the available entropy, but if your system can *feed* enough entropy as well:

```
$ cat /dev/random | rngtest -c 100
```

The **rngtest** command is available from the **rng-tools**

If the above takes around 30 seconds to complete, then there is not enough entropy available.

Depending on your environment, entropy can be increased in multiple ways. For more information, see the following blog post: <https://developers.redhat.com/blog/2017/10/05/entropy-rhel-based-cloud-instances/>.

Generally, you can increase entropy by installing the **rng-tools** package and enabling the **rngd** service:

```
# yum install rng-tools
# systemctl enable --now rngd
```

Once the **rngd** service has started, entropy should increase to a sufficient level.

2.3. CHECKING THE DEFAULT STORAGE CLASS

For proper functionality of dynamically provisioned persistent storage, the default storage class needs to be defined. During the installation, this default storage class is defined for common cloud providers, such as Amazon Web Services (AWS), Google Cloud Platform (GCP), and more.

To verify that the default storage class is defined:

```
$ oc get storageclass
NAME          TYPE
ssd           kubernetes.io/gce-pd
```

```
standard (default) kubernetes.io/gce-pd
```

The above output is taken from an OpenShift Container Platform instance running on GCP, where two kinds of persistent storage are available: standard (HDD) and SSD. Notice the standard storage class is configured as the default. If there is no storage class defined, or none is set as a default, see the [Dynamic Provisioning and Creating Storage Classes](#) section for instructions on how to set up a storage class as suggested.

CHAPTER 3. ENVIRONMENT HEALTH CHECKS

This topic contains steps to verify the overall health of the OpenShift Container Platform cluster and the various components, as well as describing the intended behavior.

Knowing the verification process for the various components is the first step to troubleshooting issues. If experiencing issues, you can use the checks provided in this section to diagnose any problems.

3.1. CHECKING COMPLETE ENVIRONMENT HEALTH

To verify the end-to-end functionality of an OpenShift Container Platform cluster, build and deploy an example application.

Procedure

1. Create a new project named **validate**, as well as an example application from the **cakephp-mysql-example** template:

```
$ oc new-project validate
$ oc new-app cakephp-mysql-example
```

You can check the logs to follow the build:

```
$ oc logs -f bc/cakephp-mysql-example
```

2. Once the build is complete, two pods should be running: a database and an application:

```
$ oc get pods
NAME                                READY   STATUS    RESTARTS   AGE
cakephp-mysql-example-1-build       0/1     Completed 0           1m
cakephp-mysql-example-2-247xm      1/1     Running   0           39s
mysql-1-hbk46                       1/1     Running   0           1m
```

3. Visit the application URL. The Cake PHP framework welcome page should be visible. The URL should have the following format **cakephp-mysql-example-validate.<app_domain>**.
4. Once the functionality has been verified, the **validate** project can be deleted:

```
$ oc delete project validate
```

All resources within the project will be deleted as well.

3.2. CREATING ALERTS USING PROMETHEUS

You can integrate OpenShift Container Platform with Prometheus to create visuals and alerts to help diagnose any environment issues before they arise. These issues can include if a node goes down, if a pod is consuming too much CPU or memory, and more.

See the [Prometheus on OpenShift Container Platform section in the Installation and configuration guide](#) for more information.

3.3. HOST HEALTH

To verify that the cluster is up and running, connect to a master instance, and run the following:

```
$ oc get nodes
NAME                STATUS      AGE   VERSION
ocp-infra-node-1clj Ready       1h    v1.6.1+5115d708d7
ocp-infra-node-86qr Ready       1h    v1.6.1+5115d708d7
ocp-infra-node-g8qw Ready       1h    v1.6.1+5115d708d7
ocp-master-94zd    Ready       1h    v1.6.1+5115d708d7
ocp-master-gjkm    Ready       1h    v1.6.1+5115d708d7
ocp-master-wc8w    Ready       1h    v1.6.1+5115d708d7
ocp-node-c5dg      Ready       1h    v1.6.1+5115d708d7
ocp-node-ghxn      Ready       1h    v1.6.1+5115d708d7
ocp-node-w135      Ready       1h    v1.6.1+5115d708d7
```

The above cluster example consists of three master hosts, three infrastructure node hosts, and three node hosts. All of them are running. All hosts in the cluster should be visible in this output.

The **Ready** status means that master hosts can communicate with node hosts and that the nodes are ready to run pods (excluding the nodes in which scheduling is disabled).

Before you run etcd commands, source the **etcd.conf** file:

```
# source /etc/etcd/etcd.conf
```

You can check the basic etcd health status from any master instance with the **etcdctl** command:

```
# etcdctl --cert-file=$ETCD_PEER_CERT_FILE --key-file=$ETCD_PEER_KEY_FILE \
  --ca-file=/etc/etcd/ca.crt --endpoints=$ETCD_LISTEN_CLIENT_URLS cluster-health
member 59df5107484b84df is healthy: got healthy result from https://10.156.0.5:2379
member 6df7221a03f65299 is healthy: got healthy result from https://10.156.0.6:2379
member fea6dfedf3eeca3 is healthy: got healthy result from https://10.156.0.9:2379
cluster is healthy
```

However, to get more information about etcd hosts, including the associated master host:

```
# etcdctl --cert-file=$ETCD_PEER_CERT_FILE --key-file=$ETCD_PEER_KEY_FILE \
  --ca-file=/etc/etcd/ca.crt --endpoints=$ETCD_LISTEN_CLIENT_URLS member list
295750b7103123e0: name=ocp-master-zh8d peerURLs=https://10.156.0.7:2380
clientURLs=https://10.156.0.7:2379 isLeader=true
b097a72f2610aea5: name=ocp-master-qcg3 peerURLs=https://10.156.0.11:2380
clientURLs=https://10.156.0.11:2379 isLeader=false
fea6dfedf3eeca3: name=ocp-master-j338 peerURLs=https://10.156.0.9:2380
clientURLs=https://10.156.0.9:2379 isLeader=false
```

All etcd hosts should contain the master host name if the etcd cluster is co-located with master services, or all etcd instances should be visible if etcd is running separately.



NOTE

etcdctl2 is an alias for the **etcdctl** tool that contains the proper flags to query the etcd cluster in v2 data model, as well as, **etcdctl3** for v3 data model.

3.4. ROUTER AND REGISTRY HEALTH

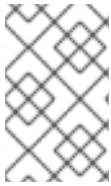
To check if a router service is running:

```
$ oc -n default get deploymentconfigs/router
NAME      REVISION  DESIRED  CURRENT  TRIGGERED BY
router    1         3        3        config
```

The values in the **DESIRED** and **CURRENT** columns should match the number of nodes hosts.

Use the same command to check the registry status:

```
$ oc -n default get deploymentconfigs/docker-registry
NAME          REVISION  DESIRED  CURRENT  TRIGGERED BY
docker-registry 1         3        3        config
```



NOTE

Multiple running instances of the container image registry require backend storage supporting writes by multiple processes. If the chosen infrastructure provider does not contain this ability, running a single instance of a container image registry is acceptable.

To verify that all pods are running and on which hosts:

```
$ oc -n default get pods -o wide
NAME                READY  STATUS   RESTARTS  AGE  IP           NODE
docker-registry-1-54nhl  1/1    Running  0         2d   172.16.2.3   ocp-infra-node-tl47
docker-registry-1-jsm2t  1/1    Running  0         2d   172.16.8.2   ocp-infra-node-62rc
docker-registry-1-qbt4g  1/1    Running  0         2d   172.16.14.3  ocp-infra-node-xrtz
registry-console-2-gbhcz 1/1    Running  0         2d   172.16.8.4   ocp-infra-node-62rc
router-1-6zfh8         1/1    Running  0         2d   10.156.0.4   ocp-infra-node-62rc
router-1-ffq4g         1/1    Running  0         2d   10.156.0.10  ocp-infra-node-tl47
router-1-zqxbl         1/1    Running  0         2d   10.156.0.8   ocp-infra-node-xrtz
```



NOTE

If OpenShift Container Platform is using an external container image registry, the internal registry service does not need to be running.

3.5. NETWORK CONNECTIVITY

Network connectivity has two main networking layers: the cluster network for node interaction, and the software defined network (SDN) for pod interaction. OpenShift Container Platform supports multiple network configurations, often optimized for a specific infrastructure provider.



NOTE

Due to the complexity of networking, not all verification scenarios are covered in this section.

3.5.1. Connectivity on master hosts

etcd and master hosts

Master services keep their state synchronized using the etcd key-value store. Communication between master and etcd services is important, whether those etcd services are collocated on master hosts, or running on hosts designated only for the etcd service. This communication happens on TCP ports **2379** and **2380**. See the [Host health](#) section for methods to check this communication.

SkyDNS

SkyDNS provides name resolution of local services running in OpenShift Container Platform. This service uses **TCP** and **UDP** port **8053**.

To verify the name resolution:

```
$ dig +short docker-registry.default.svc.cluster.local
172.30.150.7
```

If the answer matches the output of the following, **SkyDNS** service is working correctly:

```
$ oc get svc/docker-registry -n default
NAME          CLUSTER-IP   EXTERNAL-IP  PORT(S)  AGE
docker-registry 172.30.150.7 <none>      5000/TCP 3d
```

API service and web console

Both the API service and web console share the same port, usually **TCP 8443** or **443**, depending on the setup. This port needs to be available within the cluster and to everyone who needs to work with the deployed environment. The URLs under which this port is reachable may differ for internal cluster and for external clients.

In the following example, the <https://internal-master.example.com:443> URL is used by the internal cluster, and the <https://master.example.com:443> URL is used by external clients. On any node host:

```
$ curl -k https://internal-master.example.com:443/version
{
  "major": "1",
  "minor": "6",
  "gitVersion": "v1.6.1+5115d708d7",
  "gitCommit": "fff65cf",
  "gitTreeState": "clean",
  "buildDate": "2017-10-11T22:44:25Z",
  "goVersion": "go1.7.6",
  "compiler": "gc",
  "platform": "linux/amd64"
}
```

This must be reachable from client's network:

```
$ curl -k https://master.example.com:443/healthz
ok
```

3.5.2. Connectivity on node instances

The SDN connecting pod communication on nodes uses **UDP** port **4789** by default.

To verify node host functionality, create a new application. The following example ensures the node reaches the container image registry, which is running on an infrastructure node:

Procedure

1. Create a new project:

```
$ oc new-project sdn-test
```

2. Deploy an httpd application:

```
$ oc new-app centos/httpd-24-centos7~https://github.com/sclorg/httpd-ex
```

Wait until the build is complete:

```
$ oc get pods
NAME          READY   STATUS    RESTARTS   AGE
httpd-ex-1-205hz 1/1     Running   0           34s
httpd-ex-1-build 0/1     Completed 0           1m
```

3. Connect to the running pod:

```
$ oc rsh po/<pod-name>
```

For example:

```
$ oc rsh po/httpd-ex-1-205hz
```

4. Check the **healthz** path of the internal registry service:

```
$ curl -kv https://docker-registry.default.svc.cluster.local:5000/healthz
* About to connect() to docker-registry.default.svc.cluster.local port 5000 (#0)
* Trying 172.30.150.7...
* Connected to docker-registry.default.svc.cluster.local (172.30.150.7) port 5000 (#0)
* Initializing NSS with certpath: sql:/etc/pki/nssdb
* skipping SSL peer certificate verification
* SSL connection using TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
* Server certificate:
* subject: CN=172.30.150.7
* start date: Nov 30 17:21:51 2017 GMT
* expire date: Nov 30 17:21:52 2019 GMT
* common name: 172.30.150.7
* issuer: CN=openshift-signer@1512059618
> GET /healthz HTTP/1.1
> User-Agent: curl/7.29.0
> Host: docker-registry.default.svc.cluster.local:5000
> Accept: */*
>
< HTTP/1.1 200 OK
< Cache-Control: no-cache
< Date: Mon, 04 Dec 2017 16:26:49 GMT
< Content-Length: 0
< Content-Type: text/plain; charset=utf-8
<
```

```
* Connection #0 to host docker-registry.default.svc.cluster.local left intact
```

```
sh-4.2$ *exit*
```

The **HTTP/1.1 200 OK** response means the node is correctly connecting.

- Clean up the test project:

```
$ oc delete project sdn-test
project "sdn-test" deleted
```

- The node host is listening on **TCP** port **10250**. This port needs to be reachable by all master hosts on any node, and if monitoring is deployed in the cluster, the infrastructure nodes must have access to this port on all instances as well. Broken communication on this port can be detected with the following command:

```
$ oc get nodes
NAME                STATUS              AGE      VERSION
ocp-infra-node-1clj Ready              4d       v1.6.1+5115d708d7
ocp-infra-node-86qr Ready              4d       v1.6.1+5115d708d7
ocp-infra-node-g8qw Ready              4d       v1.6.1+5115d708d7
ocp-master-94zd     Ready,SchedulingDisabled 4d       v1.6.1+5115d708d7
ocp-master-gjkm     Ready,SchedulingDisabled 4d       v1.6.1+5115d708d7
ocp-master-wc8w     Ready,SchedulingDisabled 4d       v1.6.1+5115d708d7
ocp-node-c5dg       Ready              4d       v1.6.1+5115d708d7
ocp-node-ghxn       Ready              4d       v1.6.1+5115d708d7
ocp-node-w135       NotReady           4d       v1.6.1+5115d708d7
```

In the output above, the node service on the **ocp-node-w135** node is not reachable by the master services, which is represented by its **NotReady** status.

- The last service is the router, which is responsible for routing connections to the correct services running in the OpenShift Container Platform cluster. Routers listen on **TCP** ports **80** and **443** on infrastructure nodes for ingress traffic. Before routers can start working, DNS must be configured:

```
$ dig *.apps.example.com

;<<>> DiG 9.11.1-P3-RedHat-9.11.1-8.P3.fc27 <<>> *.apps.example.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45790
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;*apps.example.com. IN A

;; ANSWER SECTION:
*.apps.example.com. 3571 IN CNAME apps.example.com.
apps.example.com. 3561 IN A 35.xx.xx.92

;; Query time: 0 msec
```

```
;; SERVER: 127.0.0.1#53(127.0.0.1)
;; WHEN: Tue Dec 05 16:03:52 CET 2017
;; MSG SIZE rcvd: 105
```

The IP address, in this case **35.xx.xx.92**, should be pointing to the load balancer distributing ingress traffic to all infrastructure nodes. To verify the functionality of the routers, check the registry service once more, but this time from outside the cluster:

```
$ curl -kv https://docker-registry-default.apps.example.com/healthz
* Trying 35.xx.xx.92...
* TCP_NODELAY set
* Connected to docker-registry-default.apps.example.com (35.xx.xx.92) port 443 (#0)
...
< HTTP/2 200
< cache-control: no-cache
< content-type: text/plain; charset=utf-8
< content-length: 0
< date: Tue, 05 Dec 2017 15:13:27 GMT
<
* Connection #0 to host docker-registry-default.apps.example.com left intact
```

3.6. STORAGE

Master instances need at least 40 GB of hard disk space for the **/var** directory. Check the disk usage of a master host using the **df** command:

```
$ df -hT
Filesystem      Type      Size  Used Avail Use% Mounted on
/dev/sda1       xfs       45G   2.8G  43G   7% /
devtmpfs        devtmpfs  3.6G   0   3.6G   0% /dev
tmpfs           tmpfs     3.6G   0   3.6G   0% /dev/shm
tmpfs           tmpfs     3.6G   63M   3.6G   2% /run
tmpfs           tmpfs     3.6G   0   3.6G   0% /sys/fs/cgroup
tmpfs           tmpfs     732M   0   732M   0% /run/user/1000
tmpfs           tmpfs     732M   0   732M   0% /run/user/0
```

Node instances need at least 15 GB space for the **/var** directory, and at least another 15 GB for Docker storage (**/var/lib/docker** in this case). Depending on the size of the cluster and the amount of ephemeral storage desired for pods, a separate partition should be created for **/var/lib/origin/openshift.local.volumes** on the nodes.

```
$ df -hT
Filesystem      Type      Size  Used Avail Use% Mounted on
/dev/sda1       xfs       25G   2.4G  23G  10% /
devtmpfs        devtmpfs  3.6G   0   3.6G   0% /dev
tmpfs           tmpfs     3.6G   0   3.6G   0% /dev/shm
tmpfs           tmpfs     3.6G  147M   3.5G   4% /run
tmpfs           tmpfs     3.6G   0   3.6G   0% /sys/fs/cgroup
/dev/sdb        xfs       25G   2.7G  23G  11% /var/lib/docker
/dev/sdc        xfs       50G   33M   50G   1% /var/lib/origin/openshift.local.volumes
tmpfs           tmpfs     732M   0   732M   0% /run/user/1000
```

Persistent storage for pods should be handled outside of the instances running the OpenShift Container Platform cluster. Persistent volumes for pods can be provisioned by the infrastructure provider, or with the use of container native storage or container ready storage.

3.7. DOCKER STORAGE

Docker Storage can be backed by one of two options. The first is a thin pool logical volume with device mapper, the second, since Red Hat Enterprise Linux version 7.4, is an overlay2 file system. The overlay2 file system is generally recommended due to the ease of setup and increased performance.

The Docker storage disk is mounted as **/var/lib/docker** and formatted with **xfs** file system. Docker storage is configured to use overlay2 filesystem:

```
$ cat /etc/sysconfig/docker-storage
DOCKER_STORAGE_OPTIONS='--storage-driver overlay2'
```

To verify this storage driver is used by Docker:

```
# docker info
Containers: 4
  Running: 4
  Paused: 0
  Stopped: 0
Images: 4
Server Version: 1.12.6
Storage Driver: overlay2
  Backing Filesystem: xfs
Logging Driver: journald
Cgroup Driver: systemd
Plugins:
  Volume: local
  Network: overlay host bridge null
  Authorization: rhel-push-plugin
Swarm: inactive
Runtimes: docker-runc runc
Default Runtime: docker-runc
Security Options: seccomp selinux
Kernel Version: 3.10.0-693.11.1.el7.x86_64
Operating System: Employee SKU
OSType: linux
Architecture: x86_64
Number of Docker Hooks: 3
CPUs: 2
Total Memory: 7.147 GiB
Name: ocp-infra-node-1clj
ID: T7T6:IQTG:WTUX:7BRU:5FI4:XUL5:PAAM:4SLW:NWKL:WU2V:NQOW:JPHC
Docker Root Dir: /var/lib/docker
Debug Mode (client): false
Debug Mode (server): false
Registry: https://registry.redhat.io/v1/
WARNING: bridge-nf-call-iptables is disabled
WARNING: bridge-nf-call-ip6tables is disabled
Insecure Registries:
  127.0.0.0/8
Registries: registry.redhat.io (secure), registry.redhat.io (secure), docker.io (secure)
```

3.8. API SERVICE STATUS

The OpenShift API service runs on all master instances. To see the status of the service, view the master-api pods in the **kube-system** project:

```
oc get pod -n kube-system -l openshift.io/component=api
```

NAME	READY	STATUS	RESTARTS	AGE
master-api-myserver.com	1/1	Running	0	56d

The API service exposes a health check, which can be queried externally using the API host name:

```
oc get pod -n kube-system -o wide
```

NAME	READY	STATUS	RESTARTS	AGE	IP	NODE
master-api-myserver.com	1/1	Running	0	7h	10.240.0.16	
myserver.com/healthz						

```
$ curl -k https://myserver.com/healthz
ok
```

3.9. CONTROLLER ROLE VERIFICATION

The OpenShift Container Platform controller service, is available across all master hosts. The service runs in active/passive mode, meaning it should only be running on one master at any time.

The OpenShift Container Platform controllers execute a procedure to choose which host runs the service. The current running value is stored in an annotation in a special **configmap** stored in the **kube-system** project.

Verify the master host running the controller service as a **cluster-admin** user:

```
$ oc get -n kube-system cm openshift-master-controllers -o yaml
```

```
apiVersion: v1
kind: ConfigMap
metadata:
  annotations:
    control-plane.alpha.kubernetes.io/leader: '{"holderIdentity":"master-ose-master-0.example.com-10.19.115.212-dnwrcl4","leaseDurationSeconds":15,"acquireTime":"2018-02-17T18:16:54Z","renewTime":"2018-02-19T13:50:33Z","leaderTransitions":16}'
  creationTimestamp: 2018-02-02T10:30:04Z
  name: openshift-master-controllers
  namespace: kube-system
  resourceVersion: "17349662"
  selfLink: /api/v1/namespaces/kube-system/configmaps/openshift-master-controllers
  uid: 08636843-0804-11e8-8580-fa163eb934f0
```

The command outputs the current master controller in the **control-plane.alpha.kubernetes.io/leader** annotation, within the **holderIdentity** property as:

```
master-<hostname>-<ip>-<8_random_characters>
```

Find the hostname of the master host by filtering the output using the following:

```
$ oc get -n kube-system cm openshift-master-controllers -o json | jq -r '.metadata.annotations[] |
fromjson.holderIdentity | match("^master-(.*)-[0-9.]*-[0-9a-z]{8}$") | .captures[0].string'
ose-master-0.example.com
```

3.10. VERIFYING CORRECT MAXIMUM TRANSMISSION UNIT (MTU) SIZE

Verifying the maximum transmission unit (MTU) prevents a possible networking misconfiguration that can masquerade as an SSL certificate issue.

When a packet is larger than the MTU size that is transmitted over HTTP, the physical network router is able to break the packet into multiple packets to transmit the data. However, when a packet is larger than the MTU size is that transmitted over HTTPS, the router is forced to drop the packet.

Installation produces certificates that provide secure connections to multiple components that include:

- master hosts
- node hosts
- infrastructure nodes
- registry
- router

These certificates can be found within the **/etc/origin/master** directory for the master nodes and **/etc/origin/node** directory for the infra and app nodes.

After installation, you can verify connectivity to the **REGISTRY_OPENSIFT_SERVER_ADDR** using the process outlined in the [Network connectivity](#) section.

Prerequisites

1. From a master host, get the HTTPS address:

```
$ oc -n default get dc docker-registry -o jsonpath='{.spec.template.spec.containers[].env[?
(@.name=="REGISTRY_OPENSIFT_SERVER_ADDR")].value}'
docker-registry.default.svc:5000
```

The above gives the output of **docker-registry.default.svc:5000**.

2. Append **/healthz** to the value given above, use it to check on all hosts (master, infrastructure, node):

```
$ curl -v https://docker-registry.default.svc:5000/healthz
* About to connect() to docker-registry.default.svc port 5000 (#0)
* Trying 172.30.11.171...
* Connected to docker-registry.default.svc (172.30.11.171) port 5000 (#0)
* Initializing NSS with certpath: sql:/etc/pki/nssdb
* CAfile: /etc/pki/tls/certs/ca-bundle.crt
  CApath: none
* SSL connection using TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
* Server certificate:
* subject: CN=172.30.11.171
```

```
* start date: Oct 18 05:30:10 2017 GMT
* expire date: Oct 18 05:30:11 2019 GMT
* common name: 172.30.11.171
* issuer: CN=openshift-signer@1508303629
> GET /healthz HTTP/1.1
> User-Agent: curl/7.29.0
> Host: docker-registry.default.svc:5000
> Accept: */*
>
< HTTP/1.1 200 OK
< Cache-Control: no-cache
< Date: Tue, 24 Oct 2017 19:42:35 GMT
< Content-Length: 0
< Content-Type: text/plain; charset=utf-8
<
* Connection #0 to host docker-registry.default.svc left intact
```

The above example output shows the MTU size being used to ensure the SSL connection is correct. The attempt to connect is successful, followed by connectivity being established and completes with initializing the NSS with the certpath and all the server certificate information regarding the *docker-registry*.

An improper MTU size results in a timeout:

```
$ curl -v https://docker-registry.default.svc:5000/healthz
* About to connect() to docker-registry.default.svc port 5000 (#0)
* Trying 172.30.11.171...
* Connected to docker-registry.default.svc (172.30.11.171) port 5000 (#0)
* Initializing NSS with certpath: sql:/etc/pki/nssdb
```

The above example shows that the connection is established, but it cannot finish initializing NSS with certpath. The issue deals with improper MTU size set within the appropriate [node configuration map](#).

To fix this issue, adjust the MTU size within the node configuration map to 50 bytes smaller than the MTU size that the OpenShift SDN Ethernet device uses.

3. View the MTU size of the desired Ethernet device (i.e. **eth0**):

```
$ ip link show eth0
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
mode DEFAULT qlen 1000
link/ether fa:16:3e:92:6a:86 brd ff:ff:ff:ff:ff:ff
```

The above shows MTU set to 1500.

4. To change the MTU size, modify the appropriate [node configuration map](#) and set a value that is 50 bytes smaller than output provided by the **ip** command. For example, if the MTU size is set to 1500, adjust the MTU size to 1450 within the node configuraton map:

```
networkConfig:
  mtu: 1450
```

5. Save the changes and reboot the node:

**NOTE**

You must change the MTU size on all masters and nodes that are part of the OpenShift Container Platform SDN. Also, the MTU size of the tun0 interface must be the same across all nodes that are part of the cluster.

6. Once the node is back online, confirm the issue no longer exists by re-running the original **curl** command.

```
$ curl -v https://docker-registry.default.svc:5000/healthz
```

If the timeout persists, continue to adjust the MTU size in increments of 50 bytes and repeat the process.

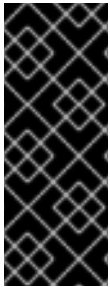
CHAPTER 4. CREATING AN ENVIRONMENT-WIDE BACKUP

Creating an environment-wide backup involves copying important data to assist with restoration in the case of crashing instances, or corrupt data. After backups have been created, they can be restored onto a newly installed version of the relevant component.

In OpenShift Container Platform, you can *back up*, saving state to separate storage, at the cluster level. The full state of an environment backup includes:

- Cluster data files
- etcd data on each master
- API objects
- Registry storage
- Volume storage

Perform a back up on a regular basis to prevent data loss.



IMPORTANT

The following process describes a generic way of backing up applications and the OpenShift Container Platform cluster. It cannot take into account custom requirements. Use these steps as a foundation for a full backup and restoration procedure for your cluster. You must take all necessary precautions to prevent data loss.

Backup and restore is not guaranteed. You are responsible for backing up your own data.

4.1. CREATING A MASTER HOST BACKUP

Perform this backup process before any change to the OpenShift Container Platform infrastructure, such as a system update, upgrade, or any other significant modification. Back up data regularly to ensure that recent data is available if a failure occurs.

OpenShift Container Platform files

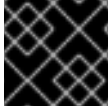
The master instances run important services, such as the API, controllers. The **/etc/origin/master** directory stores many important files:

- The configuration, the API, controllers, services, and more
- Certificates generated by the installation
- All cloud provider-related configuration
- Keys and other authentication files, such as **htpasswd** if you use `htpasswd`
- And more

You can customize OpenShift Container Platform services, such as increasing the log level or using proxies. The configuration files are stored in the **/etc/sysconfig** directory.

Because the masters are also nodes, back up the entire **/etc/origin** directory.

Procedure

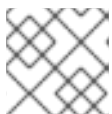


IMPORTANT

You must perform the following steps on each master node.

1. Create a backup of the pod definitions, located [here](#).
2. Create a backup of the master host configuration files:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo cp -aR /etc/origin ${MYBACKUPDIR}/etc
$ sudo cp -aR /etc/sysconfig/ ${MYBACKUPDIR}/etc/sysconfig/
```



NOTE

The master configuration file is `/etc/origin/master/master-config.yaml`.



WARNING

The `/etc/origin/master/ca.serial.txt` file is generated on only the first master listed in the Ansible host inventory. If you deprecate the first master host, copy the `/etc/origin/master/ca.serial.txt` file to the rest of master hosts before the process.

3. Other important files that need to be considered when planning a backup include:

File	Description
<code>/etc/cni/*</code>	Container Network Interface configuration (if used)
<code>/etc/sysconfig/iptables</code>	Where the iptables rules are stored
<code>/etc/sysconfig/docker-storage-setup</code>	The input file for container-storage-setup command
<code>/etc/sysconfig/docker</code>	The docker configuration file
<code>/etc/sysconfig/docker-network</code>	docker networking configuration (i.e. MTU)
<code>/etc/sysconfig/docker-storage</code>	docker storage configuration (generated by container-storage-setup)
<code>/etc/dnsmasq.conf</code>	Main configuration file for dnsmasq

<code>/etc/dnsmasq.d/*</code>	Different dnsmasq configuration files
<code>/etc/sysconfig/flanneld</code>	flannel configuration file (if used)
<code>/etc/pki/ca-trust/source/anchors/</code>	Certificates added to the system (i.e. for external registries)

Create a backup of those files:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo mkdir -p ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors
$ sudo cp -aR /etc/sysconfig/{iptables,docker-*,flanneld} \
  ${MYBACKUPDIR}/etc/sysconfig/
$ sudo cp -aR /etc/dnsmasq* /etc/cni ${MYBACKUPDIR}/etc/
$ sudo cp -aR /etc/pki/ca-trust/source/anchors/* \
  ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors/
```

- If a package is accidentally removed or you need to restore a file that is included in an **rpm** package, having a list of **rhel** packages installed on the system can be useful.



NOTE

If you use Red Hat Satellite features, such as content views or the facts store, provide a proper mechanism to reinstall the missing packages and a historical data of packages installed in the systems.

To create a list of the current **rhel** packages installed in the system:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}
$ rpm -qa | sort | sudo tee ${MYBACKUPDIR}/packages.txt
```

- If you used the previous steps, the following files are present in the backup directory:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo find ${MYBACKUPDIR} -mindepth 1 -type f -printf '%P\n'
etc/sysconfig/flanneld
etc/sysconfig/iptables
etc/sysconfig/docker-network
etc/sysconfig/docker-storage
etc/sysconfig/docker-storage-setup
etc/sysconfig/docker-storage-setup.rpmnew
etc/origin/master/ca.crt
etc/origin/master/ca.key
etc/origin/master/ca.serial.txt
etc/origin/master/ca-bundle.crt
etc/origin/master/master.proxy-client.crt
etc/origin/master/master.proxy-client.key
etc/origin/master/service-signer.crt
etc/origin/master/service-signer.key
etc/origin/master/serviceaccounts.private.key
```

```

etc/origin/master/serviceaccounts.public.key
etc/origin/master/openshift-master.crt
etc/origin/master/openshift-master.key
etc/origin/master/openshift-master.kubeconfig
etc/origin/master/master.server.crt
etc/origin/master/master.server.key
etc/origin/master/master.kubelet-client.crt
etc/origin/master/master.kubelet-client.key
etc/origin/master/admin.crt
etc/origin/master/admin.key
etc/origin/master/admin.kubeconfig
etc/origin/master/etcd.server.crt
etc/origin/master/etcd.server.key
etc/origin/master/master.etcd-client.key
etc/origin/master/master.etcd-client.csr
etc/origin/master/master.etcd-client.crt
etc/origin/master/master.etcd-ca.crt
etc/origin/master/policy.json
etc/origin/master/scheduler.json
etc/origin/master/htpasswd
etc/origin/master/session-secrets.yaml
etc/origin/master/openshift-router.crt
etc/origin/master/openshift-router.key
etc/origin/master/registry.crt
etc/origin/master/registry.key
etc/origin/master/master-config.yaml
etc/origin/generated-configs/master-master-1.example.com/master.server.crt
...[OUTPUT OMITTED]...
etc/origin/cloudprovider/openstack.conf
etc/origin/node/system:node:master-0.example.com.crt
etc/origin/node/system:node:master-0.example.com.key
etc/origin/node/ca.crt
etc/origin/node/system:node:master-0.example.com.kubeconfig
etc/origin/node/server.crt
etc/origin/node/server.key
etc/origin/node/node-dnsmasq.conf
etc/origin/node/resolv.conf
etc/origin/node/node-config.yaml
etc/origin/node/flannel.etcd-client.key
etc/origin/node/flannel.etcd-client.csr
etc/origin/node/flannel.etcd-client.crt
etc/origin/node/flannel.etcd-ca.crt
etc/pki/ca-trust/source/anchors/openshift-ca.crt
etc/pki/ca-trust/source/anchors/registry-ca.crt
etc/dnsmasq.conf
etc/dnsmasq.d/origin-dns.conf
etc/dnsmasq.d/origin-upstream-dns.conf
etc/dnsmasq.d/node-dnsmasq.conf
packages.txt

```

If needed, you can compress the files to save space:

```

$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo tar -zcvf /backup/$(hostname)-$(date +%Y%m%d).tar.gz $MYBACKUPDIR
$ sudo rm -Rf ${MYBACKUPDIR}

```

To create any of these files from scratch, the **openshift-ansible-contrib** repository contains the **backup_master_node.sh** script, which performs the previous steps. The script creates a directory on the host where you run the script and copies all the files previously mentioned.



NOTE

The **openshift-ansible-contrib** script is not supported by Red Hat, but the reference architecture team performs testing to ensure the code operates as defined and is secure.

You can run the script on every master host with:

```
$ mkdir ~/git
$ cd ~/git
$ git clone https://github.com/openshift/openshift-ansible-contrib.git
$ cd openshift-ansible-contrib/reference-architecture/day2ops/scripts
$ ./backup_master_node.sh -h
```

4.2. CREATING A NODE HOST BACKUP

Creating a backup of a node host is a different use case from backing up a master host. Because master hosts contain many important files, creating a backup is highly recommended. However, the nature of nodes is that anything special is replicated over the nodes in case of failover, and they typically do not contain data that is necessary to run an environment. If a backup of a node contains something necessary to run an environment, then a creating a backup is recommended.

The backup process is to be performed before any change to the infrastructure, such as a system update, upgrade, or any other significant modification. Backups should be performed on a regular basis to ensure the most recent data is available if a failure occurs.

OpenShift Container Platform files

Node instances run applications in the form of pods, which are based on containers. The **/etc/origin/** and **/etc/origin/node** directories house important files, such as:

- The configuration of the node services
- Certificates generated by the installation
- Cloud provider-related configuration
- Keys and other authentication files, such as the **dnsmasq** configuration

The OpenShift Container Platform services can be customized to increase the log level, use proxies, and more, and the configuration files are stored in the **/etc/sysconfig** directory.

Procedure

1. Create a backup of the node configuration files:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo cp -aR /etc/origin ${MYBACKUPDIR}/etc
$ sudo cp -aR /etc/sysconfig/atomic-openshift-node ${MYBACKUPDIR}/etc/sysconfig/
```

- OpenShift Container Platform uses specific files that must be taken into account when planning the backup policy, including:

File	Description
/etc/cni/*	Container Network Interface configuration (if used)
/etc/sysconfig/iptables	Where the iptables rules are stored
/etc/sysconfig/docker-storage-setup	The input file for container-storage-setup command
/etc/sysconfig/docker	The docker configuration file
/etc/sysconfig/docker-network	docker networking configuration (i.e. MTU)
/etc/sysconfig/docker-storage	docker storage configuration (generated by container-storage-setup)
/etc/dnsmasq.conf	Main configuration file for dnsmasq
/etc/dnsmasq.d/*	Different dnsmasq configuration files
/etc/sysconfig/flanneld	flannel configuration file (if used)
/etc/pki/ca-trust/source/anchors/	Certificates added to the system (i.e. for external registries)

To create those files:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo mkdir -p ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors
$ sudo cp -aR /etc/sysconfig/{iptables,docker-*,flanneld} \
  ${MYBACKUPDIR}/etc/sysconfig/
$ sudo cp -aR /etc/dnsmasq* /etc/cni ${MYBACKUPDIR}/etc/
$ sudo cp -aR /etc/pki/ca-trust/source/anchors/* \
  ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors/
```

- If a package is accidentally removed, or a file included in an **rpm** package should be restored, having a list of **rhel** packages installed on the system can be useful.



NOTE

If using Red Hat Satellite features, such as content views or the facts store, provide a proper mechanism to reinstall the missing packages and a historical data of packages installed in the systems.

To create a list of the current **rhel** packages installed in the system:

-

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}
$ rpm -qa | sort | sudo tee $MYBACKUPDIR/packages.txt
```

4. The following files should now be present in the backup directory:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo find ${MYBACKUPDIR} -mindepth 1 -type f -printf '%P\n'
etc/sysconfig/atomic-openshift-node
etc/sysconfig/flannel
etc/sysconfig/iptables
etc/sysconfig/docker-network
etc/sysconfig/docker-storage
etc/sysconfig/docker-storage-setup
etc/sysconfig/docker-storage-setup.rpmnew
etc/origin/node/system:node:app-node-0.example.com.crt
etc/origin/node/system:node:app-node-0.example.com.key
etc/origin/node/ca.crt
etc/origin/node/system:node:app-node-0.example.com.kubeconfig
etc/origin/node/server.crt
etc/origin/node/server.key
etc/origin/node/node-dnsmasq.conf
etc/origin/node/resolv.conf
etc/origin/node/node-config.yaml
etc/origin/node/flannel.etcd-client.key
etc/origin/node/flannel.etcd-client.csr
etc/origin/node/flannel.etcd-client.crt
etc/origin/node/flannel.etcd-ca.crt
etc/origin/cloudprovider/openstack.conf
etc/pki/ca-trust/source/anchors/openshift-ca.crt
etc/pki/ca-trust/source/anchors/registry-ca.crt
etc/dnsmasq.conf
etc/dnsmasq.d/origin-dns.conf
etc/dnsmasq.d/origin-upstream-dns.conf
etc/dnsmasq.d/node-dnsmasq.conf
packages.txt
```

If needed, the files can be compressed to save space:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo tar -zcvf /backup/$(hostname)-$(date +%Y%m%d).tar.gz $MYBACKUPDIR
$ sudo rm -Rf ${MYBACKUPDIR}
```

To create any of these files from scratch, the **openshift-ansible-contrib** repository contains the **backup_master_node.sh** script, which performs the previous steps. The script creates a directory on the host running the script and copies all the files previously mentioned.



NOTE

The **openshift-ansible-contrib** script is not supported by Red Hat, but the reference architecture team performs testing to ensure the code operates as defined and is secure.

The script can be executed on every master host with:

```
$ mkdir ~/git
$ cd ~/git
$ git clone https://github.com/openshift/openshift-ansible-contrib.git
$ cd openshift-ansible-contrib/reference-architecture/day2ops/scripts
$ ./backup_master_node.sh -h
```

4.3. BACKING UP REGISTRY CERTIFICATES

If you use an [external secured registry](#), you must save all the registry certificates. The registry is secured by default.



IMPORTANT

You must perform the following steps on each cluster node.

Procedure

1. Back up the registry certificates:

```
# cd /etc/docker/certs.d/
# tar cf /tmp/docker-registry-certs-$(hostname).tar *
```

2. Move the backup to an external location.



NOTE

When working with one or more [external secured registry](#), any host that pulls or pushes images must trust the registry certificates to run pods.

4.4. BACKING UP OTHER INSTALLATION FILES

Back up the files that you used to install OpenShift Container Platform.

Procedure

1. Because the restoration procedure involves a complete reinstallation, save all the files used in the initial installation. These files might include:
 - Ansible playbooks and inventory files from the [cluster installation](#)
 - `/etc/yum.repos.d/ose.repo` from the [disconnected installation](#) method
2. Backup the procedures for post-installation steps. Some installations might involve steps that are not included in the installer. These steps might include changes to the services outside of the control of OpenShift Container Platform or the installation of extra services like monitoring agents. Additional configuration that is not yet supported by the advanced installer might also be affected, such as using multiple authentication providers.

4.5. BACKING UP APPLICATION DATA

In many cases, you can back up application data by using the `oc rsync` command, assuming `rsync` is installed within the container image. The Red Hat `rhel7` base image contains `rsync`. Therefore, all images that are based on `rhel7` contain it as well. See [Troubleshooting and Debugging CLI Operations -](#)

rsync.



WARNING

This is a *generic* backup of application data and does not take into account application-specific backup procedures, for example, special export and import procedures for database systems.

Other means of backup might exist depending on the type of the persistent volume you use, for example, Cinder, NFS, or Gluster.

The paths to back up are also *application specific*. You can determine what path to back up by looking at the **mountPath** for volumes in the **deploymentconfig**.



NOTE

You can perform this type of application data backup only while the application pod is running.

Procedure

Example of backing up a Jenkins deployment's application data

1. Get the application data **mountPath** from the **deploymentconfig**:

```
$ oc get dc/jenkins -o jsonpath='{ .spec.template.spec.containers[? (@.name=="jenkins")].volumeMounts[?(@.name=="jenkins-data")].mountPath }'
/var/lib/jenkins
```

2. Get the name of the pod that is currently running:

```
$ oc get pod --selector=deploymentconfig=jenkins -o jsonpath='{ .metadata.name }'
jenkins-1-37nux
```

3. Use the **oc rsync** command to copy application data:

```
$ oc rsync jenkins-1-37nux:/var/lib/jenkins /tmp/
```

4.6. ETCD BACKUP

etcd is the key value store for all object definitions, as well as the persistent master state. Other components watch for changes, then bring themselves into the desired state.

OpenShift Container Platform versions prior to 3.5 use etcd version 2 (v2), while 3.5 and later use version 3 (v3). The data model between the two versions of etcd is different. etcd v3 can use both the v2 and v3 data models, whereas etcd v2 can only use the v2 data model. In an etcd v3 server, the v2 and v3 data stores exist in parallel and are independent.

For both v2 and v3 operations, you can use the **ETCDCTL_API** environment variable to use the correct API:

```
$ etcdctl -v
etcdctl version: 3.2.5
API version: 2
$ ETCDCTL_API=3 etcdctl version
etcdctl version: 3.2.5
API version: 3.2
```

See [Migrating etcd Data \(v2 to v3\) section](#) in the OpenShift Container Platform 3.7 documentation for information about how to migrate to v3.

In OpenShift Container Platform version 3.10 and later, you can either install etcd on separate hosts or run it as a static pod on your master hosts. If you do not specify separate etcd hosts, etcd runs as a static pod on master hosts. Because of this difference, the backup process is different if you use static pods.

The etcd backup process is composed of two different procedures:

- Configuration backup: Including the required etcd configuration and certificates
- Data backup: Including both v2 and v3 data model.

You can perform the data backup process on any host that has connectivity to the etcd cluster, where the proper certificates are provided, and where the **etcdctl** tool is installed.



NOTE

The backup files must be copied to an external system, ideally outside the OpenShift Container Platform environment, and then encrypted.

Note that the etcd backup still has all the references to current storage volumes. When you restore etcd, OpenShift Container Platform starts launching the previous pods on nodes and reattaching the same storage. This process is no different than the process of when you remove a node from the cluster and add a new one back in its place. Anything attached to that node is reattached to the pods on whatever nodes they are rescheduled to.

4.6.1. Backing up etcd

When you back up etcd, you must back up both the etcd configuration files and the etcd data.

You can use either etcd v2 or v3 API versions to back up etcd because both versions contain commands to back up the v2 and v3 data.

4.6.1.1. Backing up etcd configuration files

The etcd configuration files to be preserved are all stored in the **/etc/etcd** directory of the instances where etcd is running. This includes the etcd configuration file (**/etc/etcd/etcd.conf**) and the required certificates for cluster communication. All those files are generated at installation time by the Ansible installer.

Procedure

For each etcd member of the cluster, back up the etcd configuration.

```
$ ssh master-0
# mkdir -p /backup/etcd-config-$(date +%Y%m%d)/
# cp -R /etc/etcd/ /backup/etcd-config-$(date +%Y%m%d)/
```

**NOTE**

The certificates and configuration files on each etcd cluster member are unique.

4.6.1.2. Backing up etcd data**Prerequisites****NOTE**

The OpenShift Container Platform installer creates aliases to avoid typing all the flags named **etcdctl2** for etcd v2 tasks and **etcdctl3** for etcd v3 tasks.

However, the **etcdctl3** alias does not provide the full endpoint list to the **etcdctl** command, so you must specify the **--endpoints** option and list all the endpoints.

Before backing up etcd:

- **etcdctl** binaries must be available or, in containerized installations, the **rhel7/etcd** container must be available.
 - Ensure that the OpenShift Container Platform API service is running.
 - Ensure connectivity with the etcd cluster (port 2379/tcp).
 - Ensure the proper certificates to connect to the etcd cluster.
 - Ensure **go** is installed.
1. To ensure the etcd cluster is working, check its health. Because the etcd node information is the same with API v2 and v3, you can use either to run health checks and member-related operations.
 - If you use the etcd v2 API, run the following command:

```
# etcdctl --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key \
  --ca-file=/etc/etcd/ca.crt \
  --peers="https://*master-0.example.com*:2379,\
  https://*master-1.example.com*:2379,\
  https://*master-2.example.com*:2379\"
  cluster-health
member 5ee217d19001 is healthy: got healthy result from
https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from
https://192.168.55.8:2379
member ed4f0efd277d7599 is healthy: got healthy result from
https://192.168.55.13:2379
cluster is healthy
```

- If you use the etcd v3 API, run the following command:

```
# ETCDCCTL_API=3 etcdctl --cert="/etc/etcd/peer.crt" \
  --key="/etc/etcd/peer.key" \
  --cacert="/etc/etcd/ca.crt" \
  --endpoints="https://*master-0.example.com*:2379,\
  https://*master-1.example.com*:2379,\
  https://*master-2.example.com*:2379"
  endpoint health
https://master-0.example.com:2379 is healthy: successfully committed proposal: took
= 5.011358ms
https://master-1.example.com:2379 is healthy: successfully committed proposal: took
= 1.305173ms
https://master-2.example.com:2379 is healthy: successfully committed proposal: took
= 1.388772ms
```

2. Check the member list.

- If you use the etcd v2 API, run the following command:

```
# etcdctl2 member list
2a371dd20f21ca8d: name=master-1.example.com
peerURLs=https://192.168.55.12:2380 clientURLs=https://192.168.55.12:2379
isLeader=false
40bef1f6c79b3163: name=master-0.example.com
peerURLs=https://192.168.55.8:2380 clientURLs=https://192.168.55.8:2379
isLeader=false
95dc17ffcce8ee29: name=master-2.example.com
peerURLs=https://192.168.55.13:2380 clientURLs=https://192.168.55.13:2379
isLeader=true
```

- If you use the etcd v3 API, run the following command:

```
# etcdctl3 member list
2a371dd20f21ca8d, started, master-1.example.com, https://192.168.55.12:2380,
https://192.168.55.12:2379
40bef1f6c79b3163, started, master-0.example.com, https://192.168.55.8:2380,
https://192.168.55.8:2379
95dc17ffcce8ee29, started, master-2.example.com, https://192.168.55.13:2380,
https://192.168.55.13:2379
```

Procedure



NOTE

While the **etcdctl backup** command is used to perform the backup, etcd v3 has no concept of a *backup*. Instead, you either take a *snapshot* from a live member with the **etcdctl snapshot save** command or copy the **member/snap/db** file from an etcd data directory.

The **etcdctl backup** command rewrites some of the metadata contained in the backup, specifically, the node ID and cluster ID, which means that in the backup, the node loses its former identity. To recreate a cluster from the backup, you create a new, single-node cluster, then add the rest of the nodes to the cluster. The metadata is rewritten to prevent the new node from joining an existing cluster.

Back up the etcd data:

- If you run etcd on standalone hosts and use the v2 API, take the following actions:
 - a. Stop all etcd services by removing the etcd pod definition:

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

- b. Create the etcd data backup and copy the etcd **db** file:

```
# mkdir -p /backup/etcd-$(date +%Y%m%d)
# etcdctl2 backup \
  --data-dir /var/lib/etcd \
  --backup-dir /backup/etcd-$(date +%Y%m%d)
# cp /var/lib/etcd/member/snap/db /backup/etcd-$(date +%Y%m%d)
```

A **/backup/etcd-<date>/** directory is created, where **<date>** represents the current date, which must be an external NFS share, S3 bucket, or any external storage location.

In the case of an all-in-one cluster, the etcd data directory is located in the **/var/lib/origin/openshift.local.etcd** directory.

- c. Reboot the node to restart the etcd service.

```
# reboot
```

- If you run etcd on standalone hosts and use the v3 API, run the following commands:



IMPORTANT

Clusters upgraded from previous versions of OpenShift Container Platform might contain v2 data stores. Back up all etcd data stores.

- a. Back up etcd v3 data:
- b. Make a snapshot of the etcd node:

```
# systemctl show etcd --property=ActiveState,SubState
# mkdir -p /backup/etcd-$(date +%Y%m%d)
# etcdctl3 snapshot save /backup/etcd-$(date +%Y%m%d)/db
```



NOTE

The **etcdctl snapshot save** command requires the etcd service to be running.

- c. 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/
```

- d. Create the etcd data backup and copy the etcd **db** file:

```
# etcdctl backup \
  --data-dir /var/lib/etcd \
  --backup-dir /backup/etcd-$(date +%Y%m%d)
```

A **/backup/etcd-<date>/** directory is created, where **<date>** represents the current date, which must be an external NFS share, S3 bucket, or any external storage location.

In the case of an all-in-one cluster, the etcd data directory is located in the **/var/lib/origin/openshift.local.etcd** directory.

- If etcd runs as a static pod, run the following commands:



IMPORTANT

If you use static pods, use the v3 API.

- Obtain the etcd endpoint IP address from the static pod manifest:

```
$ export ETCD_POD_MANIFEST="/etc/origin/node/pods/etcd.yaml"
$ export ETCD_EP=$(grep https ${ETCD_POD_MANIFEST} | cut -d '/' -f3)
```

- Obtain the etcd pod name:

```
$ oc login -u system:admin
$ export ETCD_POD=$(oc get pods -n kube-system | grep -o -m 1 '\S*etcd\S*')
```

- Take a snapshot of the etcd data in the pod and store it locally:

```
$ oc project kube-system
$ oc exec ${ETCD_POD} -c etcd -- /bin/bash -c "ETCDCTL_API=3 etcdctl \
  --cert /etc/etcd/peer.crt \
  --key /etc/etcd/peer.key \
  --cacert /etc/etcd/ca.crt \
  --endpoints $ETCD_EP \
  snapshot save /var/lib/etcd/snapshot.db"
```

4.7. BACKING UP A PROJECT

Creating a backup of all relevant data involves exporting all important information, then restoring into a new project.



NOTE

Currently, a OpenShift Container Platform project back up and restore tool is being developed by Red Hat. See the following bug for more information:

- [bugzilla 1303205](#).

Procedure

1. List all the relevant data to back up:

```
$ oc get all
```

```
NAME      TYPE    FROM    LATEST
bc/ruby-ex Source  Git     1
```

```
NAME          TYPE    FROM          STATUS   STARTED      DURATION
builds/ruby-ex-1 Source  Git@c457001  Complete 2 minutes ago 35s
```

```
NAME          DOCKER REPO          TAGS    UPDATED
is/guestbook  10.111.255.221:5000/myproject/guestbook  latest 2 minutes ago
is/hello-openshift 10.111.255.221:5000/myproject/hello-openshift latest 2 minutes ago
is/ruby-22-centos7 10.111.255.221:5000/myproject/ruby-22-centos7 latest 2 minutes ago
is/ruby-ex     10.111.255.221:5000/myproject/ruby-ex     latest 2 minutes ago
```

```
NAME          REVISION  DESIRED  CURRENT  TRIGGERED BY
dc/guestbook  1         1        1        config,image(guestbook:latest)
dc/hello-openshift 1         1        1        config,image(hello-openshift:latest)
dc/ruby-ex    1         1        1        config,image(ruby-ex:latest)
```

```
NAME          DESIRED  CURRENT  READY  AGE
rc/guestbook-1  1        1        1      2m
rc/hello-openshift-1 1        1        1      2m
rc/ruby-ex-1    1        1        1      2m
```

```
NAME          CLUSTER-IP  EXTERNAL-IP  PORT(S)    AGE
svc/guestbook  10.111.105.84 <none>      3000/TCP   2m
svc/hello-openshift 10.111.230.24 <none>      8080/TCP,8888/TCP 2m
svc/ruby-ex    10.111.232.117 <none>      8080/TCP   2m
```

```
NAME          READY  STATUS   RESTARTS  AGE
po/guestbook-1-c010g 1/1    Running  0          2m
po/hello-openshift-1-4zw2q 1/1    Running  0          2m
po/ruby-ex-1-build  0/1    Completed 0          2m
po/ruby-ex-1-rxc74  1/1    Running  0          2m
```

- Export the project objects to a **.yaml** or **.json** file.

- To export the project objects into a **project.yaml** file:

```
$ oc get -o yaml --export all > project.yaml
```

- To export the project objects into a **project.json** file:

```
$ oc get -o json --export all > project.json
```

- Export the project's **role bindings**, **secrets**, **service accounts**, and **persistent volume claims**:

```
$ for object in rolebindings serviceaccounts secrets imagestreamtags cm
egressnetworkpolicies rolebindingrestrictions limitranges resourcequotas pvc templates
cronjobs statefulsets hpa deployments replicasets poddisruptionbudget endpoints
do
  oc get -o yaml --export $object > $object.yaml
done
```

- To list all the namespaced objects:

■

```
$ oc api-resources --namespaced=true -o name
```

- Some exported objects can rely on specific metadata or references to unique IDs in the project. This is a limitation on the usability of the recreated objects.

When using **imagestreams**, the **image** parameter of a **deploymentconfig** can point to a specific **sha** checksum of an image in the internal registry that would not exist in a restored environment. For instance, running the sample "ruby-ex" as **oc new-app centos/ruby-22-centos7~https://github.com/sclorg/ruby-ex.git** creates an **imagestream ruby-ex** using the internal registry to host the image:

```
$ oc get dc ruby-ex -o jsonpath="{.spec.template.spec.containers[].image}"
10.111.255.221:5000/myproject/ruby-
ex@sha256:880c720b23c8d15a53b01db52f7abdcbb2280e03f686a5c8edfef1a2a7b21cee
```

If importing the **deploymentconfig** as it is exported with **oc get --export** it fails if the image does not exist.

4.8. BACKING UP PERSISTENT VOLUME CLAIMS

You can synchronize persistent data from inside of a container to a server.



IMPORTANT

Depending on the provider that is hosting the OpenShift Container Platform environment, the ability to launch third party snapshot services for backup and restore purposes also exists. As OpenShift Container Platform does not have the ability to launch these services, this guide does not describe these steps.

Consult any product documentation for the correct backup procedures of specific applications. For example, copying the mysql data directory itself does not create a usable backup. Instead, run the specific backup procedures of the associated application and then synchronize any data. This includes using snapshot solutions provided by the OpenShift Container Platform hosting platform.

Procedure

- View the project and pods:

```
$ oc get pods
NAME          READY   STATUS    RESTARTS   AGE
demo-1-build  0/1     Completed 0           2h
demo-2-fxx6d  1/1     Running   0           1h
```

- Describe the desired pod to find the volumes that are currently used by a persistent volume:

```
$ oc describe pod demo-2-fxx6d
Name:         demo-2-fxx6d
Namespace:    test
Security Policy: restricted
Node:         ip-10-20-6-20.ec2.internal/10.20.6.20
Start Time:   Tue, 05 Dec 2017 12:54:34 -0500
Labels:       app=demo
              deployment=demo-2
              deploymentconfig=demo
Status:       Running
```



```

IP: 172.16.12.5
Controllers: ReplicationController/demo-2
Containers:
  demo:
    Container ID:
    docker://201f3e55b373641eb36945d723e1e212ecab847311109b5cee1fd0109424217a
    Image: docker-
registry.default.svc:5000/test/demo@sha256:0a9f2487a0d95d51511e49d20dc9ff6f350436f935
968b0c83fcb98a7a8c381a
    Image ID: docker-pullable://docker-
registry.default.svc:5000/test/demo@sha256:0a9f2487a0d95d51511e49d20dc9ff6f350436f935
968b0c83fcb98a7a8c381a
    Port: 8080/TCP
    State: Running
      Started: Tue, 05 Dec 2017 12:54:52 -0500
    Ready: True
    Restart Count: 0
    Volume Mounts:
      */opt/app-root/src/uploaded from persistent-volume (rw)*
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-8mmrk (ro)
    Environment Variables: <none>
    ...omitted...

```

This output shows that the persistent data is in the **/opt/app-root/src/uploaded** directory.

3. Copy the data locally:

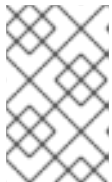
```

$ oc rsync demo-2-fxx6d:/opt/app-root/src/uploaded ./demo-app
receiving incremental file list
uploaded/
uploaded/ocp_sop.txt
uploaded/lost+found/

sent 38 bytes  received 190 bytes  152.00 bytes/sec
total size is 32  speedup is 0.14

```

The **ocp_sop.txt** file is downloaded to the local system to be backed up by backup software or another backup mechanism.



NOTE

You can also use the previous steps if a pod starts without needing to use a **pvc**, but you later decide that a **pvc** is necessary. You can preserve the data and then use the `restore` process to populate the new storage.

CHAPTER 5. HOST-LEVEL TASKS

5.1. ADDING A HOST TO THE CLUSTER

For information on adding master or node hosts to a cluster, see the [Adding hosts to an existing cluster](#) section in the Install and configuration guide.

5.2. MASTER HOST TASKS

5.2.1. Deprecating a master host

Deprecating a master host removes it from the OpenShift Container Platform environment.

The reasons to deprecate or scale down master hosts include hardware re-sizing or replacing the underlying infrastructure.

Highly available OpenShift Container Platform environments require at least three master hosts and three etcd nodes. Usually, the master hosts are colocated with the etcd services. If you deprecate a master host, you also remove the etcd static pods from that host.



IMPORTANT

Ensure that the master and etcd services are always deployed in odd numbers due to the voting mechanisms that take place among those services.

5.2.1.1. Creating a master host backup

Perform this backup process before any change to the OpenShift Container Platform infrastructure, such as a system update, upgrade, or any other significant modification. Back up data regularly to ensure that recent data is available if a failure occurs.

OpenShift Container Platform files

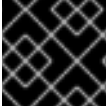
The master instances run important services, such as the API, controllers. The **/etc/origin/master** directory stores many important files:

- The configuration, the API, controllers, services, and more
- Certificates generated by the installation
- All cloud provider-related configuration
- Keys and other authentication files, such as **htpasswd** if you use **htpasswd**
- And more

You can customize OpenShift Container Platform services, such as increasing the log level or using proxies. The configuration files are stored in the **/etc/sysconfig** directory.

Because the masters are also nodes, back up the entire **/etc/origin** directory.

Procedure



IMPORTANT

You must perform the following steps on each master node.

1. Create a backup of the pod definitions, located [here](#).
2. Create a backup of the master host configuration files:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo cp -aR /etc/origin ${MYBACKUPDIR}/etc
$ sudo cp -aR /etc/sysconfig/ ${MYBACKUPDIR}/etc/sysconfig/
```



NOTE

The master configuration file is `/etc/origin/master/master-config.yaml`.



WARNING

The `/etc/origin/master/ca.serial.txt` file is generated on only the first master listed in the Ansible host inventory. If you deprecate the first master host, copy the `/etc/origin/master/ca.serial.txt` file to the rest of master hosts before the process.

3. Other important files that need to be considered when planning a backup include:

File	Description
<code>/etc/cni/*</code>	Container Network Interface configuration (if used)
<code>/etc/sysconfig/iptables</code>	Where the iptables rules are stored
<code>/etc/sysconfig/docker-storage-setup</code>	The input file for container-storage-setup command
<code>/etc/sysconfig/docker</code>	The docker configuration file
<code>/etc/sysconfig/docker-network</code>	docker networking configuration (i.e. MTU)
<code>/etc/sysconfig/docker-storage</code>	docker storage configuration (generated by container-storage-setup)
<code>/etc/dnsmasq.conf</code>	Main configuration file for dnsmasq
<code>/etc/dnsmasq.d/*</code>	Different dnsmasq configuration files

<code>/etc/sysconfig/flanneld</code>	flannel configuration file (if used)
<code>/etc/pki/ca-trust/source/anchors/</code>	Certificates added to the system (i.e. for external registries)

Create a backup of those files:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo mkdir -p ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors
$ sudo cp -aR /etc/sysconfig/{iptables,docker-*,flanneld} \
  ${MYBACKUPDIR}/etc/sysconfig/
$ sudo cp -aR /etc/dnsmasq* /etc/cni ${MYBACKUPDIR}/etc/
$ sudo cp -aR /etc/pki/ca-trust/source/anchors/* \
  ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors/
```

- If a package is accidentally removed or you need to restore a file that is included in an **rpm** package, having a list of **rhel** packages installed on the system can be useful.



NOTE

If you use Red Hat Satellite features, such as content views or the facts store, provide a proper mechanism to reinstall the missing packages and a historical data of packages installed in the systems.

To create a list of the current **rhel** packages installed in the system:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}
$ rpm -qa | sort | sudo tee ${MYBACKUPDIR}/packages.txt
```

- If you used the previous steps, the following files are present in the backup directory:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo find ${MYBACKUPDIR} -mindepth 1 -type f -printf '%P\n'
etc/sysconfig/flanneld
etc/sysconfig/iptables
etc/sysconfig/docker-network
etc/sysconfig/docker-storage
etc/sysconfig/docker-storage-setup
etc/sysconfig/docker-storage-setup.rpmnew
etc/origin/master/ca.crt
etc/origin/master/ca.key
etc/origin/master/ca.serial.txt
etc/origin/master/ca-bundle.crt
etc/origin/master/master.proxy-client.crt
etc/origin/master/master.proxy-client.key
etc/origin/master/service-signer.crt
etc/origin/master/service-signer.key
etc/origin/master/serviceaccounts.private.key
etc/origin/master/serviceaccounts.public.key
etc/origin/master/openshift-master.crt
```

```

etc/origin/master/openshift-master.key
etc/origin/master/openshift-master.kubeconfig
etc/origin/master/master.server.crt
etc/origin/master/master.server.key
etc/origin/master/master.kubelet-client.crt
etc/origin/master/master.kubelet-client.key
etc/origin/master/admin.crt
etc/origin/master/admin.key
etc/origin/master/admin.kubeconfig
etc/origin/master/etcd.server.crt
etc/origin/master/etcd.server.key
etc/origin/master/master.etcd-client.key
etc/origin/master/master.etcd-client.csr
etc/origin/master/master.etcd-client.crt
etc/origin/master/master.etcd-ca.crt
etc/origin/master/policy.json
etc/origin/master/scheduler.json
etc/origin/master/htpasswd
etc/origin/master/session-secrets.yaml
etc/origin/master/openshift-router.crt
etc/origin/master/openshift-router.key
etc/origin/master/registry.crt
etc/origin/master/registry.key
etc/origin/master/master-config.yaml
etc/origin/generated-configs/master-master-1.example.com/master.server.crt
...[OUTPUT OMITTED]...
etc/origin/cloudprovider/openstack.conf
etc/origin/node/system:node:master-0.example.com.crt
etc/origin/node/system:node:master-0.example.com.key
etc/origin/node/ca.crt
etc/origin/node/system:node:master-0.example.com.kubeconfig
etc/origin/node/server.crt
etc/origin/node/server.key
etc/origin/node/node-dnsmasq.conf
etc/origin/node/resolv.conf
etc/origin/node/node-config.yaml
etc/origin/node/flannel.etcd-client.key
etc/origin/node/flannel.etcd-client.csr
etc/origin/node/flannel.etcd-client.crt
etc/origin/node/flannel.etcd-ca.crt
etc/pki/ca-trust/source/anchors/openshift-ca.crt
etc/pki/ca-trust/source/anchors/registry-ca.crt
etc/dnsmasq.conf
etc/dnsmasq.d/origin-dns.conf
etc/dnsmasq.d/origin-upstream-dns.conf
etc/dnsmasq.d/node-dnsmasq.conf
packages.txt

```

If needed, you can compress the files to save space:

```

$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo tar -zcvf /backup/$(hostname)-$(date +%Y%m%d).tar.gz $MYBACKUPDIR
$ sudo rm -Rf ${MYBACKUPDIR}

```

To create any of these files from scratch, the **openshift-ansible-contrib** repository contains the **backup_master_node.sh** script, which performs the previous steps. The script creates a directory on the host where you run the script and copies all the files previously mentioned.



NOTE

The **openshift-ansible-contrib** script is not supported by Red Hat, but the reference architecture team performs testing to ensure the code operates as defined and is secure.

You can run the script on every master host with:

```
$ mkdir ~/git
$ cd ~/git
$ git clone https://github.com/openshift/openshift-ansible-contrib.git
$ cd openshift-ansible-contrib/reference-architecture/day2ops/scripts
$ ./backup_master_node.sh -h
```

5.2.1.2. Backing up etcd

When you back up etcd, you must back up both the etcd configuration files and the etcd data.

You can use either etcd v2 or v3 API versions to back up etcd because both versions contain commands to back up the v2 and v3 data.

5.2.1.2.1. Backing up etcd configuration files

The etcd configuration files to be preserved are all stored in the **/etc/etcd** directory of the instances where etcd is running. This includes the etcd configuration file (**/etc/etcd/etcd.conf**) and the required certificates for cluster communication. All those files are generated at installation time by the Ansible installer.

Procedure

For each etcd member of the cluster, back up the etcd configuration.

```
$ ssh master-0
# mkdir -p /backup/etcd-config-$(date +%Y%m%d)/
# cp -R /etc/etcd/ /backup/etcd-config-$(date +%Y%m%d)/
```



NOTE

The certificates and configuration files on each etcd cluster member are unique.

5.2.1.2.2. Backing up etcd data

Prerequisites



NOTE

The OpenShift Container Platform installer creates aliases to avoid typing all the flags named **etcdctl2** for etcd v2 tasks and **etcdctl3** for etcd v3 tasks.

However, the **etcdctl3** alias does not provide the full endpoint list to the **etcdctl** command, so you must specify the **--endpoints** option and list all the endpoints.

Before backing up etcd:

- **etcdctl** binaries must be available or, in containerized installations, the **rhel7/etcd** container must be available.
- Ensure that the OpenShift Container Platform API service is running.
- Ensure connectivity with the etcd cluster (port 2379/tcp).
- Ensure the proper certificates to connect to the etcd cluster.
- Ensure **go** is installed.

Procedure



NOTE

While the **etcdctl backup** command is used to perform the backup, etcd v3 has no concept of a *backup*. Instead, you either take a *snapshot* from a live member with the **etcdctl snapshot save** command or copy the **member/snap/db** file from an etcd data directory.

The **etcdctl backup** command rewrites some of the metadata contained in the backup, specifically, the node ID and cluster ID, which means that in the backup, the node loses its former identity. To recreate a cluster from the backup, you create a new, single-node cluster, then add the rest of the nodes to the cluster. The metadata is rewritten to prevent the new node from joining an existing cluster.

Back up the etcd data:

- If you run etcd on standalone hosts and use the v2 API, take the following actions:
 - a. Stop all etcd services by removing the etcd pod definition:

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

- b. Create the etcd data backup and copy the etcd **db** file:

```
# mkdir -p /backup/etcd-$(date +%Y%m%d)
# etcdctl2 backup \
  --data-dir /var/lib/etcd \
  --backup-dir /backup/etcd-$(date +%Y%m%d)
# cp /var/lib/etcd/member/snap/db /backup/etcd-$(date +%Y%m%d)
```

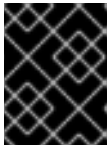
A **/backup/etcd-<date>/** directory is created, where **<date>** represents the current date, which must be an external NFS share, S3 bucket, or any external storage location.

In the case of an all-in-one cluster, the etcd data directory is located in the **/var/lib/origin/openshift.local.etcd** directory.

- c. Reboot the node to restart the etcd service.

```
# reboot
```

- If you run etcd on standalone hosts and use the v3 API, run the following commands:



IMPORTANT

Clusters upgraded from previous versions of OpenShift Container Platform might contain v2 data stores. Back up all etcd data stores.

- Back up etcd v3 data:
- Make a snapshot of the etcd node:

```
# systemctl show etcd --property=ActiveState,SubState
# mkdir -p /backup/etcd-$(date +%Y%m%d)
# etcdctl3 snapshot save /backup/etcd-$(date +%Y%m%d)/db
```



NOTE

The **etcdctl snapshot save** command requires the etcd service to be running.

- 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/
```

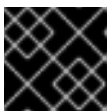
- Create the etcd data backup and copy the etcd **db** file:

```
# etcdctl2 backup \
  --data-dir /var/lib/etcd \
  --backup-dir /backup/etcd-$(date +%Y%m%d)
```

A **/backup/etcd-<date>/** directory is created, where **<date>** represents the current date, which must be an external NFS share, S3 bucket, or any external storage location.

In the case of an all-in-one cluster, the etcd data directory is located in the **/var/lib/origin/openshift.local.etcd** directory.

- If etcd runs as a static pod, run the following commands:



IMPORTANT

If you use static pods, use the v3 API.

- Obtain the etcd endpoint IP address from the static pod manifest:

```
$ export ETCD_POD_MANIFEST="/etc/origin/node/pods/etcd.yaml"
$ export ETCD_EP=$(grep https ${ETCD_POD_MANIFEST} | cut -d '/' -f3)
```

- Obtain the etcd pod name:

```
$ oc login -u system:admin
$ export ETCD_POD=$(oc get pods -n kube-system | grep -o -m 1 'S*etcd\S*')
```


- c. Take a snapshot of the etcd data in the pod and store it locally:

```
$ oc project kube-system
$ oc exec ${ETCD_POD} -c etcd -- /bin/bash -c "ETCDCTL_API=3 etcdctl \
--cert /etc/etcd/peer.crt \
--key /etc/etcd/peer.key \
--cacert /etc/etcd/ca.crt \
--endpoints $ETCD_EP \
snapshot save /var/lib/etcd/snapshot.db"
```

5.2.1.3. Deprecating a master host

Master hosts run important services, such as the OpenShift Container Platform API and controllers services. In order to deprecate a master host, these services must be stopped.

The OpenShift Container Platform API service is an active/active service, so stopping the service does not affect the environment as long as the requests are sent to a separate master server. However, the OpenShift Container Platform controllers service is an active/passive service, where the services use etcd to decide the active master.

Deprecating a master host in a multi-master architecture includes removing the master from the load balancer pool to avoid new connections attempting to use that master. This process depends heavily on the load balancer used. The steps below show the details of removing the master from **haproxy**. In the event that OpenShift Container Platform is running on a cloud provider, or using a **F5** appliance, see the specific product documents to remove the master from rotation.

Procedure

1. Remove the **backend** section in the `/etc/haproxy/haproxy.cfg` configuration file. For example, if deprecating a master named **master-0.example.com** using **haproxy**, ensure the host name is removed from the following:

```
backend mgmt8443
  balance source
  mode tcp
  # MASTERS 8443
  server master-1.example.com 192.168.55.12:8443 check
  server master-2.example.com 192.168.55.13:8443 check
```

2. Then, restart the **haproxy** service.

```
$ sudo systemctl restart haproxy
```

3. Once the master is removed from the load balancer, disable the API and controller services by moving definition files out of the static pods dir `/etc/origin/node/pods`:

```
# mkdir -p /etc/origin/node/pods/disabled
# mv /etc/origin/node/pods/controller.yaml /etc/origin/node/pods/disabled/
+
```

4. Because the master host is a schedulable OpenShift Container Platform node, follow the steps in the [Deprecating a node host](#) section.
5. Remove the master host from the **[masters]** and **[nodes]** groups in the `/etc/ansible/hosts` Ansible inventory file to avoid issues if running any Ansible tasks using that inventory file.

**WARNING**

Deprecating the first master host listed in the Ansible inventory file requires extra precautions.

The `/etc/origin/master/ca.serial.txt` file is generated on only the first master listed in the Ansible host inventory. If you deprecate the first master host, copy the `/etc/origin/master/ca.serial.txt` file to the rest of master hosts before the process.

- The **kubernetes** service includes the master host IPs as endpoints. To verify that the master has been properly deprecated, review the **kubernetes** service output and see if the deprecated master has been removed:

```
$ oc describe svc kubernetes -n default
Name: kubernetes
Namespace: default
Labels: component=apiserver
       provider=kubernetes
Annotations: <none>
Selector: <none>
Type: ClusterIP
IP: 10.111.0.1
Port: https 443/TCP
Endpoints: 192.168.55.12:8443,192.168.55.13:8443
Port: dns 53/UDP
Endpoints: 192.168.55.12:8053,192.168.55.13:8053
Port: dns-tcp 53/TCP
Endpoints: 192.168.55.12:8053,192.168.55.13:8053
Session Affinity: ClientIP
Events: <none>
```

After the master has been successfully deprecated, the host where the master was previously running can be safely deleted.

5.2.1.4. Removing an etcd host

If an etcd host fails beyond restoration, remove it from the cluster.

Steps to be performed on all masters hosts

Procedure

- Remove each other etcd host from the etcd cluster. Run the following command for each etcd node:

```
# etcdctl -C https://<surviving host IP address>:2379 \
--ca-file=/etc/etcd/ca.crt \
--cert-file=/etc/etcd/peer.crt \
--key-file=/etc/etcd/peer.key member remove <failed member ID>
```

- Restart the master API service on every master:

```
# master-restart api restart-master controller
```

Steps to be performed in the current etcd cluster

Procedure

- Remove the failed host from the cluster:

```
# etcdctl2 cluster-health
member 5ee217d19001 is healthy: got healthy result from https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from https://192.168.55.8:2379
failed to check the health of member 8372784203e11288 on https://192.168.55.21:2379: Get
https://192.168.55.21:2379/health: dial tcp 192.168.55.21:2379: getsockopt: connection
refused
member 8372784203e11288 is unreachable: [https://192.168.55.21:2379] are all
unreachable
member ed4f0efd277d7599 is healthy: got healthy result from https://192.168.55.13:2379
cluster is healthy

# etcdctl2 member remove 8372784203e11288 ❶
Removed member 8372784203e11288 from cluster

# etcdctl2 cluster-health
member 5ee217d19001 is healthy: got healthy result from https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from https://192.168.55.8:2379
member ed4f0efd277d7599 is healthy: got healthy result from https://192.168.55.13:2379
cluster is healthy
```

❶ The **remove** command requires the etcd ID, not the hostname.

- To ensure the etcd configuration does not use the failed host when the etcd service is restarted, modify the `/etc/etcd/etcd.conf` file on all remaining etcd hosts and remove the failed host in the value for the **ETCD_INITIAL_CLUSTER** variable:

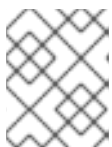
```
# vi /etc/etcd/etcd.conf
```

For example:

```
ETCD_INITIAL_CLUSTER=master-0.example.com=https://192.168.55.8:2380,master-
1.example.com=https://192.168.55.12:2380,master-
2.example.com=https://192.168.55.13:2380
```

becomes:

```
ETCD_INITIAL_CLUSTER=master-0.example.com=https://192.168.55.8:2380,master-
1.example.com=https://192.168.55.12:2380
```



NOTE

Restarting the etcd services is not required, because the failed host is removed using **etcdctl**.

3. Modify the Ansible inventory file to reflect the current status of the cluster and to avoid issues when re-running a playbook:

```
[OSEv3:children]
masters
nodes
etcd

... [OUTPUT ABBREVIATED] ...

[etcd]
master-0.example.com
master-1.example.com
```

4. If you are using Flannel, modify the **flanneld** service configuration located at **/etc/sysconfig/flanneld** on every host and remove the etcd host:

```
FLANNEL_ETCD_ENDPOINTS=https://master-0.example.com:2379,https://master-
1.example.com:2379,https://master-2.example.com:2379
```

5. Restart the **flanneld** service:

```
# systemctl restart flanneld.service
```

5.2.2. Creating a master host backup

Perform this backup process before any change to the OpenShift Container Platform infrastructure, such as a system update, upgrade, or any other significant modification. Back up data regularly to ensure that recent data is available if a failure occurs.

OpenShift Container Platform files

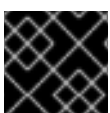
The master instances run important services, such as the API, controllers. The **/etc/origin/master** directory stores many important files:

- The configuration, the API, controllers, services, and more
- Certificates generated by the installation
- All cloud provider-related configuration
- Keys and other authentication files, such as **htpasswd** if you use **htpasswd**
- And more

You can customize OpenShift Container Platform services, such as increasing the log level or using proxies. The configuration files are stored in the **/etc/sysconfig** directory.

Because the masters are also nodes, back up the entire **/etc/origin** directory.

Procedure



IMPORTANT

You must perform the following steps on each master node.

1. Create a backup of the pod definitions, located [here](#).
2. Create a backup of the master host configuration files:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo cp -aR /etc/origin ${MYBACKUPDIR}/etc
$ sudo cp -aR /etc/sysconfig/ ${MYBACKUPDIR}/etc/sysconfig/
```



NOTE

The master configuration file is `/etc/origin/master/master-config.yaml`.



WARNING

The `/etc/origin/master/ca.serial.txt` file is generated on only the first master listed in the Ansible host inventory. If you deprecate the first master host, copy the `/etc/origin/master/ca.serial.txt` file to the rest of master hosts before the process.

3. Other important files that need to be considered when planning a backup include:

File	Description
<code>/etc/cni/*</code>	Container Network Interface configuration (if used)
<code>/etc/sysconfig/iptables</code>	Where the iptables rules are stored
<code>/etc/sysconfig/docker-storage-setup</code>	The input file for container-storage-setup command
<code>/etc/sysconfig/docker</code>	The docker configuration file
<code>/etc/sysconfig/docker-network</code>	docker networking configuration (i.e. MTU)
<code>/etc/sysconfig/docker-storage</code>	docker storage configuration (generated by container-storage-setup)
<code>/etc/dnsmasq.conf</code>	Main configuration file for dnsmasq
<code>/etc/dnsmasq.d/*</code>	Different dnsmasq configuration files
<code>/etc/sysconfig/flanneld</code>	flannel configuration file (if used)

<code>/etc/pki/ca-trust/source/anchors/</code>	Certificates added to the system (i.e. for external registries)
--	---

Create a backup of those files:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo mkdir -p ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors
$ sudo cp -aR /etc/sysconfig/{iptables,docker-*,flanneld} \
  ${MYBACKUPDIR}/etc/sysconfig/
$ sudo cp -aR /etc/dnsmasq* /etc/cni ${MYBACKUPDIR}/etc/
$ sudo cp -aR /etc/pki/ca-trust/source/anchors/* \
  ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors/
```

- If a package is accidentally removed or you need to restore a file that is included in an **rpm** package, having a list of **rhel** packages installed on the system can be useful.



NOTE

If you use Red Hat Satellite features, such as content views or the facts store, provide a proper mechanism to reinstall the missing packages and a historical data of packages installed in the systems.

To create a list of the current **rhel** packages installed in the system:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo mkdir -p ${MYBACKUPDIR}
$ rpm -qa | sort | sudo tee ${MYBACKUPDIR}/packages.txt
```

- If you used the previous steps, the following files are present in the backup directory:

```
$ MYBACKUPDIR=/backup/${hostname}/${date +%Y%m%d}
$ sudo find ${MYBACKUPDIR} -mindepth 1 -type f -printf '%P\n'
etc/sysconfig/flanneld
etc/sysconfig/iptables
etc/sysconfig/docker-network
etc/sysconfig/docker-storage
etc/sysconfig/docker-storage-setup
etc/sysconfig/docker-storage-setup.rpmnew
etc/origin/master/ca.crt
etc/origin/master/ca.key
etc/origin/master/ca.serial.txt
etc/origin/master/ca-bundle.crt
etc/origin/master/master.proxy-client.crt
etc/origin/master/master.proxy-client.key
etc/origin/master/service-signer.crt
etc/origin/master/service-signer.key
etc/origin/master/serviceaccounts.private.key
etc/origin/master/serviceaccounts.public.key
etc/origin/master/openshift-master.crt
etc/origin/master/openshift-master.key
etc/origin/master/openshift-master.kubeconfig
```

```

etc/origin/master/master.server.crt
etc/origin/master/master.server.key
etc/origin/master/master.kubelet-client.crt
etc/origin/master/master.kubelet-client.key
etc/origin/master/admin.crt
etc/origin/master/admin.key
etc/origin/master/admin.kubeconfig
etc/origin/master/etcd.server.crt
etc/origin/master/etcd.server.key
etc/origin/master/master.etcd-client.key
etc/origin/master/master.etcd-client.csr
etc/origin/master/master.etcd-client.crt
etc/origin/master/master.etcd-ca.crt
etc/origin/master/policy.json
etc/origin/master/scheduler.json
etc/origin/master/htpasswd
etc/origin/master/session-secrets.yaml
etc/origin/master/openshift-router.crt
etc/origin/master/openshift-router.key
etc/origin/master/registry.crt
etc/origin/master/registry.key
etc/origin/master/master-config.yaml
etc/origin/generated-configs/master-master-1.example.com/master.server.crt
...[OUTPUT OMITTED]...
etc/origin/cloudprovider/openstack.conf
etc/origin/node/system:node:master-0.example.com.crt
etc/origin/node/system:node:master-0.example.com.key
etc/origin/node/ca.crt
etc/origin/node/system:node:master-0.example.com.kubeconfig
etc/origin/node/server.crt
etc/origin/node/server.key
etc/origin/node/node-dnsmasq.conf
etc/origin/node/resolv.conf
etc/origin/node/node-config.yaml
etc/origin/node/flannel.etcd-client.key
etc/origin/node/flannel.etcd-client.csr
etc/origin/node/flannel.etcd-client.crt
etc/origin/node/flannel.etcd-ca.crt
etc/pki/ca-trust/source/anchors/openshift-ca.crt
etc/pki/ca-trust/source/anchors/registry-ca.crt
etc/dnsmasq.conf
etc/dnsmasq.d/origin-dns.conf
etc/dnsmasq.d/origin-upstream-dns.conf
etc/dnsmasq.d/node-dnsmasq.conf
packages.txt

```

If needed, you can compress the files to save space:

```

$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo tar -zcvf /backup/$(hostname)-$(date +%Y%m%d).tar.gz $MYBACKUPDIR
$ sudo rm -Rf ${MYBACKUPDIR}

```

To create any of these files from scratch, the **openshift-ansible-contrib** repository contains the **backup_master_node.sh** script, which performs the previous steps. The script creates a directory on the host where you run the script and copies all the files previously mentioned.

**NOTE**

The **openshift-ansible-contrib** script is not supported by Red Hat, but the reference architecture team performs testing to ensure the code operates as defined and is secure.

You can run the script on every master host with:

```
$ mkdir ~/git
$ cd ~/git
$ git clone https://github.com/openshift/openshift-ansible-contrib.git
$ cd openshift-ansible-contrib/reference-architecture/day2ops/scripts
$ ./backup_master_node.sh -h
```

5.2.3. Restoring a master host backup

After creating a backup of important master host files, if they become corrupted or accidentally removed, you can restore the files by copying the files back to master, ensuring they contain the proper content, and restarting the affected services.

Procedure

1. Restore the **/etc/origin/master/master-config.yaml** file:

```
# MYBACKUPDIR=~/backup/$(hostname)/$(date +%Y%m%d)*
# cp /etc/origin/master/master-config.yaml /etc/origin/master/master-config.yaml.old
# cp /backup/$(hostname)/$(date +%Y%m%d)/origin/master/master-config.yaml
/etc/origin/master/master-config.yaml
# master-restart api
# master-restart controllers
```

**WARNING**

Restarting the master services can lead to downtime. However, you can remove the master host from the highly available load balancer pool, then perform the restore operation. Once the service has been properly restored, you can add the master host back to the load balancer pool.

**NOTE**

Perform a full reboot of the affected instance to restore the **iptables** configuration.

2. If you cannot restart OpenShift Container Platform because packages are missing, reinstall the packages.
 - a. Get the list of the current installed packages:

```
$ rpm -qa | sort > /tmp/current_packages.txt
```


- b. View the differences between the package lists:

```
$ diff /tmp/current_packages.txt ${MYBACKUPDIR}/packages.txt
> ansible-2.4.0.0-5.el7.noarch
```

- c. Reinstall the missing packages:

```
# yum reinstall -y <packages> ❶
```

- ❶ Replace **<packages>** with the packages that are different between the package lists.

3. Restore a system certificate by copying the certificate to the **/etc/pki/ca-trust/source/anchors/** directory and execute the **update-ca-trust**:

```
$ MYBACKUPDIR=~/backup/${hostname}/${date +%Y%m%d}*
$ sudo cp ${MYBACKUPDIR}/external_certificates/my_company.crt /etc/pki/ca-
trust/source/anchors/
$ sudo update-ca-trust
```



NOTE

Always ensure the user ID and group ID are restored when the files are copied back, as well as the **SELinux** context.

5.3. NODE HOST TASKS

5.3.1. Deprecating a node host

The procedure is the same whether deprecating an infrastructure node or an application node.

Prerequisites

Ensure enough capacity is available to migrate the existing pods from the node set to be removed. Removing an infrastructure node is advised only when at least two more nodes will stay online after the infrastructure node is removed.

Procedure

1. List all available nodes to find the node to deprecate:

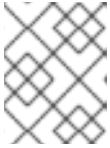
```
$ oc get nodes
NAME                STATUS              AGE    VERSION
ocp-infra-node-b7pl Ready              23h    v1.6.1+5115d708d7
ocp-infra-node-p5zj Ready              23h    v1.6.1+5115d708d7
ocp-infra-node-rghb Ready              23h    v1.6.1+5115d708d7
ocp-master-dgf8     Ready,SchedulingDisabled 23h    v1.6.1+5115d708d7
ocp-master-q1v2     Ready,SchedulingDisabled 23h    v1.6.1+5115d708d7
ocp-master-vq70     Ready,SchedulingDisabled 23h    v1.6.1+5115d708d7
ocp-node-020m       Ready              23h    v1.6.1+5115d708d7
ocp-node-7t5p       Ready              23h    v1.6.1+5115d708d7
ocp-node-n0dd       Ready              23h    v1.6.1+5115d708d7
```

As an example, this topic deprecates the **ocp-infra-node-b7pl** infrastructure node.

2. Describe the node and its running services:

```
$ oc describe node ocp-infra-node-b7pl
Name: ocp-infra-node-b7pl
Role:
Labels: beta.kubernetes.io/arch=amd64
        beta.kubernetes.io/instance-type=n1-standard-2
        beta.kubernetes.io/os=linux
        failure-domain.beta.kubernetes.io/region=europe-west3
        failure-domain.beta.kubernetes.io/zone=europe-west3-c
        kubernetes.io/hostname=ocp-infra-node-b7pl
        role=infra
Annotations: volumes.kubernetes.io/controller-managed-attach-detach=true
Taints: <none>
CreationTimestamp: Wed, 22 Nov 2017 09:36:36 -0500
Phase:
Conditions:
...
Addresses: 10.156.0.11,ocp-infra-node-b7pl
Capacity:
cpu: 2
memory: 7494480Ki
pods: 20
Allocatable:
cpu: 2
memory: 7392080Ki
pods: 20
System Info:
Machine ID: bc95ccf67d047f2ae42c67862c202e44
System UUID: 9762CC3D-E23C-AB13-B8C5-FA16F0BCCE4C
Boot ID: ca8bf088-905d-4ec0-beec-8f89f4527ce4
Kernel Version: 3.10.0-693.5.2.el7.x86_64
OS Image: Employee SKU
Operating System: linux
Architecture: amd64
Container Runtime Version: docker://1.12.6
Kubelet Version: v1.6.1+5115d708d7
Kube-Proxy Version: v1.6.1+5115d708d7
ExternalID: 437740049672994824
Non-terminated Pods: (2 in total)
  Namespace   Name          CPU Requests  CPU Limits  Memory Requests  Memory Limits
  -----
  default     docker-registry-1-5szjs  100m (5%) 0 (0%)  256Mi (3%)0 (0%)
  default     router-1-vzllzq  100m (5%) 0 (0%)  256Mi (3%)0 (0%)
Allocated resources:
(Total limits may be over 100 percent, i.e., overcommitted.)
CPU Requests CPU Limits Memory Requests Memory Limits
-----
200m (10%) 0 (0%) 512Mi (7%) 0 (0%)
Events: <none>
```

The output above shows that the node is running two pods: **router-1-vzllzq** and **docker-registry-1-5szjs**. Two more infrastructure nodes are available to migrate these two pods.

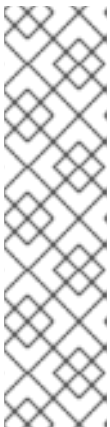
**NOTE**

The cluster described above is a highly available cluster, this means both the **router** and **docker-registry** services are running on all infrastructure nodes.

3. Mark a node as unschedulable and evacuate all of its pods:

```
$ oc adm drain ocp-infra-node-b7pl --delete-local-data
node "ocp-infra-node-b7pl" cordoned
WARNING: Deleting pods with local storage: docker-registry-1-5szjs
pod "docker-registry-1-5szjs" evicted
pod "router-1-vzlzq" evicted
node "ocp-infra-node-b7pl" drained
```

If the pod has attached local storage (for example, **EmptyDir**), the **--delete-local-data** option must be provided. Generally, pods running in production should use the local storage only for temporary or cache files, but not for anything important or persistent. For regular storage, applications should use object storage or persistent volumes. In this case, the **docker-registry** pod's local storage is empty, because the object storage is used instead to store the container images.

**NOTE**

The above operation deletes existing pods running on the node. Then, new pods are created according to the replication controller.

In general, every application should be deployed with a deployment configuration, which creates pods using the replication controller.

oc adm drain will not delete any bare pods (pods that are neither mirror pods nor managed by **ReplicationController**, **ReplicaSet**, **DaemonSet**, **StatefulSet**, or a job). To do so, the **--force** option is required. Be aware that the bare pods will not be recreated on other nodes and data may be lost during this operation.

The example below shows the output of the replication controller of the registry:

```
$ oc describe rc/docker-registry-1
Name: docker-registry-1
Namespace: default
Selector: deployment=docker-registry-1,deploymentconfig=docker-registry,docker-registry=default
Labels: docker-registry=default
       openshift.io/deployment-config.name=docker-registry
Annotations: ...
Replicas: 3 current / 3 desired
Pods Status: 3 Running / 0 Waiting / 0 Succeeded / 0 Failed
Pod Template:
  Labels: deployment=docker-registry-1
         deploymentconfig=docker-registry
         docker-registry=default
  Annotations: openshift.io/deployment-config.latest-version=1
              openshift.io/deployment-config.name=docker-registry
              openshift.io/deployment.name=docker-registry-1
  Service Account: registry
  Containers:
```

```

registry:
  Image: openshift3/ose-docker-registry:v3.6.173.0.49
  Port: 5000/TCP
  Requests:
    cpu: 100m
    memory: 256Mi
  Liveness: http-get https://:5000/healthz delay=10s timeout=5s period=10s #success=1
#failure=3
  Readiness: http-get https://:5000/healthz delay=0s timeout=5s period=10s #success=1
#failure=3
  Environment:
    REGISTRY_HTTP_ADDR:      :5000
    REGISTRY_HTTP_NET:      tcp
    REGISTRY_HTTP_SECRET:    tyGEnDZmc8dQfioP3WkNd5z+Xbdfy/JVXf/NLo3s/zE=
    REGISTRY_MIDDLEWARE_REPOSITORY_OPENSHIFT_ENFORCEQUOTA: false
    REGISTRY_HTTP_TLS_KEY:   /etc/secrets/registry.key
    OPENSHIFT_DEFAULT_REGISTRY: docker-registry.default.svc:5000
    REGISTRY_CONFIGURATION_PATH: /etc/registry/config.yml
    REGISTRY_HTTP_TLS_CERTIFICATE: /etc/secrets/registry.crt
  Mounts:
    /etc/registry from docker-config (rw)
    /etc/secrets from registry-certificates (rw)
    /registry from registry-storage (rw)
  Volumes:
    registry-storage:
      Type: EmptyDir (a temporary directory that shares a pod's lifetime)
      Medium:
    registry-certificates:
      Type: Secret (a volume populated by a Secret)
      SecretName: registry-certificates
      Optional: false
    docker-config:
      Type: Secret (a volume populated by a Secret)
      SecretName: registry-config
      Optional: false
  Events:
    FirstSeen LastSeen Count From SubObjectPath Type Reason Message
    -----
    49m 49m 1 replication-controller Normal SuccessfulCreate Created pod: docker-registry-1-dprp5

```

The event at the bottom of the output displays information about new pod creation. So, when listing all pods:

```

$ oc get pods
NAME                READY   STATUS    RESTARTS   AGE
docker-registry-1-dprp5  1/1    Running   0          52m
docker-registry-1-kr8jq  1/1    Running   0          1d
docker-registry-1-ncpl2  1/1    Running   0          1d
registry-console-1-g4nqg  1/1    Running   0          1d
router-1-2gshr        0/1    Pending   0          52m
router-1-85qm4        1/1    Running   0          1d
router-1-q5sr8        1/1    Running   0          1d

```

- The **docker-registry-1-5szjs** and **router-1-vz1zq** pods that were running on the now

deprecated node are no longer available. Instead, two new pods have been created: **docker-registry-1-dprp5** and **router-1-2gshr**. As shown above, the new router pod is **router-1-2gshr**, but is in the **Pending** state. This is because every node can be running only on one single router and is bound to the ports 80 and 443 of the host.

- When observing the newly created registry pod, the example below shows that the pod has been created on the **ocp-infra-node-rghb** node, which is different from the deprecating node:

```
$ oc describe pod docker-registry-1-dprp5
Name: docker-registry-1-dprp5
Namespace: default
Security Policy: hostnetwork
Node: ocp-infra-node-rghb/10.156.0.10
...
```

The only difference between deprecating the infrastructure and the application node is that once the infrastructure node is evacuated, and if there is no plan to replace that node, the services running on infrastructure nodes can be scaled down:

```
$ oc scale dc/router --replicas 2
deploymentconfig "router" scaled

$ oc scale dc/docker-registry --replicas 2
deploymentconfig "docker-registry" scaled
```

- Now, every infrastructure node is running only one kind of each pod:

```
$ oc get pods
NAME                READY   STATUS    RESTARTS   AGE
docker-registry-1-kr8jq  1/1     Running   0           1d
docker-registry-1-ncpl2  1/1     Running   0           1d
registry-console-1-g4nqg  1/1     Running   0           1d
router-1-85qm4         1/1     Running   0           1d
router-1-q5sr8         1/1     Running   0           1d
```

```
$ oc describe po/docker-registry-1-kr8jq | grep Node:
Node: ocp-infra-node-p5zj/10.156.0.9
```

```
$ oc describe po/docker-registry-1-ncpl2 | grep Node:
Node: ocp-infra-node-rghb/10.156.0.10
```



NOTE

To provide a full highly available cluster, at least three infrastructure nodes should always be available.

- To verify that the scheduling on the node is disabled:

```
$ oc get nodes
NAME                STATUS                    AGE     VERSION
ocp-infra-node-b7pl Ready,SchedulingDisabled 1d      v1.6.1+5115d708d7
ocp-infra-node-p5zj Ready                    1d      v1.6.1+5115d708d7
ocp-infra-node-rghb Ready                    1d      v1.6.1+5115d708d7
ocp-master-dgf8    Ready,SchedulingDisabled 1d      v1.6.1+5115d708d7
```

```

ocp-master-q1v2    Ready,SchedulingDisabled 1d    v1.6.1+5115d708d7
ocp-master-vq70    Ready,SchedulingDisabled 1d    v1.6.1+5115d708d7
ocp-node-020m      Ready                    1d    v1.6.1+5115d708d7
ocp-node-7t5p      Ready                    1d    v1.6.1+5115d708d7
ocp-node-n0dd      Ready                    1d    v1.6.1+5115d708d7

```

And that the node does not contain any pods:

```

$ oc describe node ocp-infra-node-b7pl
Name: ocp-infra-node-b7pl
Role:
Labels: beta.kubernetes.io/arch=amd64
       beta.kubernetes.io/instance-type=n1-standard-2
       beta.kubernetes.io/os=linux
       failure-domain.beta.kubernetes.io/region=europe-west3
       failure-domain.beta.kubernetes.io/zone=europe-west3-c
       kubernetes.io/hostname=ocp-infra-node-b7pl
       role=infra
Annotations: volumes.kubernetes.io/controller-managed-attach-detach=true
Taints: <none>
CreationTimestamp: Wed, 22 Nov 2017 09:36:36 -0500
Phase:
Conditions:
...
Addresses: 10.156.0.11,ocp-infra-node-b7pl
Capacity:
  cpu: 2
  memory: 7494480Ki
  pods: 20
Allocatable:
  cpu: 2
  memory: 7392080Ki
  pods: 20
System Info:
  Machine ID: bc95ccf67d047f2ae42c67862c202e44
  System UUID: 9762CC3D-E23C-AB13-B8C5-FA16F0BCCE4C
  Boot ID: ca8bf088-905d-4ec0-beec-8f89f4527ce4
  Kernel Version: 3.10.0-693.5.2.el7.x86_64
  OS Image: Employee SKU
  Operating System: linux
  Architecture: amd64
  Container Runtime Version: docker://1.12.6
  Kubelet Version: v1.6.1+5115d708d7
  Kube-Proxy Version: v1.6.1+5115d708d7
  ExternalID: 437740049672994824
  Non-terminated Pods: (0 in total)
    Namespace   Name   CPU Requests  CPU Limits  Memory Requests  Memory Limits
    -----
Allocated resources:
  (Total limits may be over 100 percent, i.e., overcommitted.)
  CPU Requests  CPU Limits  Memory Requests  Memory Limits
  -----
  0 (0%) 0 (0%)  0 (0%)  0 (0%)
Events: <none>

```

8. Remove the infrastructure instance from the **backend** section in the `/etc/haproxy/haproxy.cfg` configuration file:

```
backend router80
  balance source
  mode tcp
  server infra-1.example.com 192.168.55.12:80 check
  server infra-2.example.com 192.168.55.13:80 check

backend router443
  balance source
  mode tcp
  server infra-1.example.com 192.168.55.12:443 check
  server infra-2.example.com 192.168.55.13:443 check
```

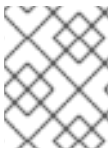
9. Then, restart the **haproxy** service.

```
$ sudo systemctl restart haproxy
```

10. Remove the node from the cluster after all pods are evicted with command:

```
$ oc delete node ocp-infra-node-b7pl
node "ocp-infra-node-b7pl" deleted
```

```
$ oc get nodes
NAME                STATUS              AGE    VERSION
ocp-infra-node-p5zj Ready              1d    v1.6.1+5115d708d7
ocp-infra-node-rghb Ready              1d    v1.6.1+5115d708d7
ocp-master-dgf8     Ready,SchedulingDisabled 1d    v1.6.1+5115d708d7
ocp-master-q1v2     Ready,SchedulingDisabled 1d    v1.6.1+5115d708d7
ocp-master-vq70     Ready,SchedulingDisabled 1d    v1.6.1+5115d708d7
ocp-node-020m       Ready              1d    v1.6.1+5115d708d7
ocp-node-7t5p       Ready              1d    v1.6.1+5115d708d7
ocp-node-n0dd       Ready              1d    v1.6.1+5115d708d7
```



NOTE

For more information on evacuating and draining pods or nodes, see [Node maintenance](#) section.

5.3.1.1. Replacing a node host

In the event that a node would need to be added in place of the deprecated node, follow the [Adding hosts to an existing cluster](#) section.

5.3.2. Creating a node host backup

Creating a backup of a node host is a different use case from backing up a master host. Because master hosts contain many important files, creating a backup is highly recommended. However, the nature of nodes is that anything special is replicated over the nodes in case of failover, and they typically do not contain data that is necessary to run an environment. If a backup of a node contains something necessary to run an environment, then a creating a backup is recommended.

The backup process is to be performed before any change to the infrastructure, such as a system update, upgrade, or any other significant modification. Backups should be performed on a regular basis to ensure the most recent data is available if a failure occurs.

OpenShift Container Platform files

Node instances run applications in the form of pods, which are based on containers. The `/etc/origin/` and `/etc/origin/node` directories house important files, such as:

- The configuration of the node services
- Certificates generated by the installation
- Cloud provider-related configuration
- Keys and other authentication files, such as the `dnsmasq` configuration

The OpenShift Container Platform services can be customized to increase the log level, use proxies, and more, and the configuration files are stored in the `/etc/sysconfig` directory.

Procedure

1. Create a backup of the node configuration files:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo cp -aR /etc/origin ${MYBACKUPDIR}/etc
$ sudo cp -aR /etc/sysconfig/atomic-openshift-node ${MYBACKUPDIR}/etc/sysconfig/
```

2. OpenShift Container Platform uses specific files that must be taken into account when planning the backup policy, including:

File	Description
<code>/etc/cni/*</code>	Container Network Interface configuration (if used)
<code>/etc/sysconfig/iptables</code>	Where the <code>iptables</code> rules are stored
<code>/etc/sysconfig/docker-storage-setup</code>	The input file for <code>container-storage-setup</code> command
<code>/etc/sysconfig/docker</code>	The <code>docker</code> configuration file
<code>/etc/sysconfig/docker-network</code>	<code>docker</code> networking configuration (i.e. MTU)
<code>/etc/sysconfig/docker-storage</code>	<code>docker</code> storage configuration (generated by <code>container-storage-setup</code>)
<code>/etc/dnsmasq.conf</code>	Main configuration file for <code>dnsmasq</code>
<code>/etc/dnsmasq.d/*</code>	Different <code>dnsmasq</code> configuration files

<code>/etc/sysconfig/flanneld</code>	flannel configuration file (if used)
<code>/etc/pki/ca-trust/source/anchors/</code>	Certificates added to the system (i.e. for external registries)

To create those files:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}/etc/sysconfig
$ sudo mkdir -p ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors
$ sudo cp -aR /etc/sysconfig/{iptables,docker-*,flanneld} \
  ${MYBACKUPDIR}/etc/sysconfig/
$ sudo cp -aR /etc/dnsmasq* /etc/cni ${MYBACKUPDIR}/etc/
$ sudo cp -aR /etc/pki/ca-trust/source/anchors/* \
  ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors/
```

- If a package is accidentally removed, or a file included in an **rpm** package should be restored, having a list of **rhel** packages installed on the system can be useful.



NOTE

If using Red Hat Satellite features, such as content views or the facts store, provide a proper mechanism to reinstall the missing packages and a historical data of packages installed in the systems.

To create a list of the current **rhel** packages installed in the system:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo mkdir -p ${MYBACKUPDIR}
$ rpm -qa | sort | sudo tee $MYBACKUPDIR/packages.txt
```

- The following files should now be present in the backup directory:

```
$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo find ${MYBACKUPDIR} -mindepth 1 -type f -printf '%P\n'
etc/sysconfig/atomic-openshift-node
etc/sysconfig/flanneld
etc/sysconfig/iptables
etc/sysconfig/docker-network
etc/sysconfig/docker-storage
etc/sysconfig/docker-storage-setup
etc/sysconfig/docker-storage-setup.rpmnew
etc/origin/node/system:node:app-node-0.example.com.crt
etc/origin/node/system:node:app-node-0.example.com.key
etc/origin/node/ca.crt
etc/origin/node/system:node:app-node-0.example.com.kubeconfig
etc/origin/node/server.crt
etc/origin/node/server.key
etc/origin/node/node-dnsmasq.conf
etc/origin/node/resolv.conf
etc/origin/node/node-config.yaml
etc/origin/node/flannel.etcd-client.key
```

```

etc/origin/node/flannel.etcd-client.csr
etc/origin/node/flannel.etcd-client.crt
etc/origin/node/flannel.etcd-ca.crt
etc/origin/cloudprovider/openstack.conf
etc/pki/ca-trust/source/anchors/openshift-ca.crt
etc/pki/ca-trust/source/anchors/registry-ca.crt
etc/dnsmasq.conf
etc/dnsmasq.d/origin-dns.conf
etc/dnsmasq.d/origin-upstream-dns.conf
etc/dnsmasq.d/node-dnsmasq.conf
packages.txt

```

If needed, the files can be compressed to save space:

```

$ MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
$ sudo tar -zcvf /backup/$(hostname)-$(date +%Y%m%d).tar.gz $MYBACKUPDIR
$ sudo rm -Rf ${MYBACKUPDIR}

```

To create any of these files from scratch, the **openshift-ansible-contrib** repository contains the **backup_master_node.sh** script, which performs the previous steps. The script creates a directory on the host running the script and copies all the files previously mentioned.



NOTE

The **openshift-ansible-contrib** script is not supported by Red Hat, but the reference architecture team performs testing to ensure the code operates as defined and is secure.

The script can be executed on every master host with:

```

$ mkdir ~/git
$ cd ~/git
$ git clone https://github.com/openshift/openshift-ansible-contrib.git
$ cd openshift-ansible-contrib/reference-architecture/day2ops/scripts
$ ./backup_master_node.sh -h

```

5.3.3. Restoring a node host backup

After creating a backup of important node host files, if they become corrupted or accidentally removed, you can restore the file by copying back the file, ensuring it contains the proper content and restart the affected services.

Procedure

1. Restore the **/etc/origin/node/node-config.yaml** file:

```

# MYBACKUPDIR=/backup/$(hostname)/$(date +%Y%m%d)
# cp /etc/origin/node/node-config.yaml /etc/origin/node/node-config.yaml.old
# cp /backup/$(hostname)/$(date +%Y%m%d)/etc/origin/node/node-config.yaml
/etc/origin/node/node-config.yaml
# reboot

```

**WARNING**

Restarting the services can lead to downtime. See [Node maintenance](#), for tips on how to ease the process.

**NOTE**

Perform a full reboot of the affected instance to restore the **iptables** configuration.

1. If you cannot restart OpenShift Container Platform because packages are missing, reinstall the packages.

- a. Get the list of the current installed packages:

```
$ rpm -qa | sort > /tmp/current_packages.txt
```

- b. View the differences between the package lists:

```
$ diff /tmp/current_packages.txt ${MYBACKUPDIR}/packages.txt
> ansible-2.4.0.0-5.el7.noarch
```

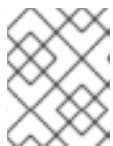
- c. Reinstall the missing packages:

```
# yum reinstall -y <packages> 1
```

- 1** Replace **<packages>** with the packages that are different between the package lists.

2. Restore a system certificate by copying the certificate to the **/etc/pki/ca-trust/source/anchors/** directory and execute the **update-ca-trust**:

```
$ MYBACKUPDIR=*/backup/${hostname}/${date +%Y%m%d}*
$ sudo cp ${MYBACKUPDIR}/etc/pki/ca-trust/source/anchors/my_company.crt /etc/pki/ca-trust/source/anchors/
$ sudo update-ca-trust
```

**NOTE**

Always ensure proper user ID and group ID are restored when the files are copied back, as well as the **SELinux** context.

5.3.4. Node maintenance and next steps

See [Managing nodes](#) or [Managing pods](#) topics for various node management options. These include:

- [Marking Nodes as Unschedulable or Schedulable](#)
- [Evacuating Pods on Nodes](#)

- [Setting Pod Disruption Budgets](#)

A node can reserve a portion of its resources to be used by specific components. These include the kubelet, kube-proxy, Docker, or other remaining system components such as `sshd` and `NetworkManager`. See the [Allocating node resources section in the Cluster Administrator guide](#) for more information.

5.4. ETCD TASKS

5.4.1. etcd backup

etcd is the key value store for all object definitions, as well as the persistent master state. Other components watch for changes, then bring themselves into the desired state.

OpenShift Container Platform versions prior to 3.5 use etcd version 2 (v2), while 3.5 and later use version 3 (v3). The data model between the two versions of etcd is different. etcd v3 can use both the v2 and v3 data models, whereas etcd v2 can only use the v2 data model. In an etcd v3 server, the v2 and v3 data stores exist in parallel and are independent.

For both v2 and v3 operations, you can use the `ETCDCTL_API` environment variable to use the correct API:

```
$ etcdctl -v
etcdctl version: 3.2.5
API version: 2
$ ETCDCTL_API=3 etcdctl version
etcdctl version: 3.2.5
API version: 3.2
```

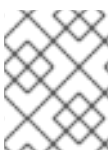
See [Migrating etcd Data \(v2 to v3\) section](#) in the OpenShift Container Platform 3.7 documentation for information about how to migrate to v3.

In OpenShift Container Platform version 3.10 and later, you can either install etcd on separate hosts or run it as a static pod on your master hosts. If you do not specify separate etcd hosts, etcd runs as a static pod on master hosts. Because of this difference, the backup process is different if you use static pods.

The etcd backup process is composed of two different procedures:

- Configuration backup: Including the required etcd configuration and certificates
- Data backup: Including both v2 and v3 data model.

You can perform the data backup process on any host that has connectivity to the etcd cluster, where the proper certificates are provided, and where the `etcdctl` tool is installed.



NOTE

The backup files must be copied to an external system, ideally outside the OpenShift Container Platform environment, and then encrypted.

Note that the etcd backup still has all the references to current storage volumes. When you restore etcd, OpenShift Container Platform starts launching the previous pods on nodes and reattaching the same storage. This process is no different than the process of when you remove a node from the cluster and

add a new one back in its place. Anything attached to that node is reattached to the pods on whatever nodes they are rescheduled to.

5.4.1.1. Backing up etcd

When you back up etcd, you must back up both the etcd configuration files and the etcd data.

You can use either etcd v2 or v3 API versions to back up etcd because both versions contain commands to back up the v2 and v3 data.

5.4.1.1.1. Backing up etcd configuration files

The etcd configuration files to be preserved are all stored in the `/etc/etcd` directory of the instances where etcd is running. This includes the etcd configuration file (`/etc/etcd/etcd.conf`) and the required certificates for cluster communication. All those files are generated at installation time by the Ansible installer.

Procedure

For each etcd member of the cluster, back up the etcd configuration.

```
$ ssh master-0
# mkdir -p /backup/etcd-config-$(date +%Y%m%d)/
# cp -R /etc/etcd/ /backup/etcd-config-$(date +%Y%m%d)/
```



NOTE

The certificates and configuration files on each etcd cluster member are unique.

5.4.1.1.2. Backing up etcd data

Prerequisites



NOTE

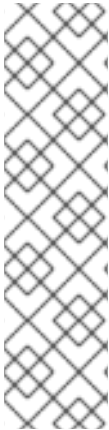
The OpenShift Container Platform installer creates aliases to avoid typing all the flags named `etcdctl2` for etcd v2 tasks and `etcdctl3` for etcd v3 tasks.

However, the `etcdctl3` alias does not provide the full endpoint list to the `etcdctl` command, so you must specify the `--endpoints` option and list all the endpoints.

Before backing up etcd:

- `etcdctl` binaries must be available or, in containerized installations, the `rhel7/etcd` container must be available.
- Ensure that the OpenShift Container Platform API service is running.
- Ensure connectivity with the etcd cluster (port 2379/tcp).
- Ensure the proper certificates to connect to the etcd cluster.
- Ensure `go` is installed.

Procedure



NOTE

While the **etcdctl backup** command is used to perform the backup, etcd v3 has no concept of a *backup*. Instead, you either take a *snapshot* from a live member with the **etcdctl snapshot save** command or copy the **member/snap/db** file from an etcd data directory.

The **etcdctl backup** command rewrites some of the metadata contained in the backup, specifically, the node ID and cluster ID, which means that in the backup, the node loses its former identity. To recreate a cluster from the backup, you create a new, single-node cluster, then add the rest of the nodes to the cluster. The metadata is rewritten to prevent the new node from joining an existing cluster.

Back up the etcd data:

- If you run etcd on standalone hosts and use the v2 API, take the following actions:
 - a. Stop all etcd services by removing the etcd pod definition:

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

- b. Create the etcd data backup and copy the etcd **db** file:

```
# mkdir -p /backup/etcd-$(date +%Y%m%d)
# etcdctl2 backup \
  --data-dir /var/lib/etcd \
  --backup-dir /backup/etcd-$(date +%Y%m%d)
# cp /var/lib/etcd/member/snap/db /backup/etcd-$(date +%Y%m%d)
```

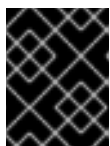
A **/backup/etcd-<date>/** directory is created, where **<date>** represents the current date, which must be an external NFS share, S3 bucket, or any external storage location.

In the case of an all-in-one cluster, the etcd data directory is located in the **/var/lib/origin/openshift.local.etcd** directory.

- c. Reboot the node to restart the etcd service.

```
# reboot
```

- If you run etcd on standalone hosts and use the v3 API, run the following commands:



IMPORTANT

Clusters upgraded from previous versions of OpenShift Container Platform might contain v2 data stores. Back up all etcd data stores.

- a. Back up etcd v3 data:
- b. Make a snapshot of the etcd node:

```
# systemctl show etcd --property=ActiveState,SubState
# mkdir -p /backup/etcd-$(date +%Y%m%d)
# etcdctl3 snapshot save /backup/etcd-$(date +%Y%m%d)/db
```

**NOTE**

The **etcdctl snapshot save** command requires the etcd service to be running.

- c. 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/
```

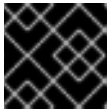
- d. Create the etcd data backup and copy the etcd **db** file:

```
# etcdctl2 backup \
  --data-dir /var/lib/etcd \
  --backup-dir /backup/etcd-$(date +%Y%m%d)
```

A **/backup/etcd-<date>/** directory is created, where **<date>** represents the current date, which must be an external NFS share, S3 bucket, or any external storage location.

In the case of an all-in-one cluster, the etcd data directory is located in the **/var/lib/origin/openshift.local.etcd** directory.

- If etcd runs as a static pod, run the following commands:

**IMPORTANT**

If you use static pods, use the v3 API.

- a. Obtain the etcd endpoint IP address from the static pod manifest:

```
$ export ETCD_POD_MANIFEST="/etc/origin/node/pods/etcd.yaml"
$ export ETCD_EP=$(grep https ${ETCD_POD_MANIFEST} | cut -d '/' -f3)
```

- b. Obtain the etcd pod name:

```
$ oc login -u system:admin
$ export ETCD_POD=$(oc get pods -n kube-system | grep -o -m 1 '\S*etcd\S*')
```

- c. Take a snapshot of the etcd data in the pod and store it locally:

```
$ oc project kube-system
$ oc exec ${ETCD_POD} -c etcd -- /bin/bash -c "ETCDCTL_API=3 etcdctl \
  --cert /etc/etcd/peer.crt \
  --key /etc/etcd/peer.key \
  --cacert /etc/etcd/ca.crt \
  --endpoints $ETCD_EP \
  snapshot save /var/lib/etcd/snapshot.db"
```

5.4.2. 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.

5.4.2.1. Restoring etcd v2 & v3 data

The following process restores healthy data files and starts the etcd cluster as a single node, then adds the rest of the nodes if an etcd cluster is required.

Procedure

1. 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
```

2. To ensure the proper backup is restored, delete the etcd directories:

- To back up the current etcd data before you delete the directory, run the following command:

```
# mv /var/lib/etcd /var/lib/etcd.old
# mkdir /var/lib/etcd
# restorecon -Rv /var/lib/etcd/
```

- Or, to delete the directory and the etcd, data, run the following command:

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



NOTE

In an all-in-one cluster, the etcd data directory is located in the `/var/lib/origin/openshift.local.etcd` directory.

3. Restore a healthy backup data file to each of the etcd nodes. Perform this step on all etcd hosts, including master hosts collocated with etcd.

```
# cp -R /backup/etcd-xxx/* /var/lib/etcd/
# mv /var/lib/etcd/db /var/lib/etcd/member/snap/db
# chcon -R --reference /backup/etcd-xxx/* /var/lib/etcd/
```


4. Run the etcd service on each host, forcing a new cluster.
This creates a custom file for the etcd service, which overwrites the execution command adding the **--force-new-cluster** option:

```
# mkdir -p /etc/systemd/system/etcd.service.d/
# echo "[Service]" > /etc/systemd/system/etcd.service.d/temp.conf
# echo "ExecStart=" >> /etc/systemd/system/etcd.service.d/temp.conf
# sed -n '/ExecStart/s/"$/ --force-new-cluster"/p' \
    /usr/lib/systemd/system/etcd.service \
    >> /etc/systemd/system/etcd.service.d/temp.conf

# systemctl daemon-reload
# master-restart etcd
```

5. Check for error messages:

```
$ master-logs etcd etcd
```

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

7. Check for health status:

```
# etcdctl2 cluster-health
member 5ee217d17301 is healthy: got healthy result from https://192.168.55.8:2379
cluster is healthy
```

8. Restart the etcd service in cluster mode:

```
# rm -f /etc/systemd/system/etcd.service.d/temp.conf
# systemctl daemon-reload
# master-restart etcd
```

9. Check for health status and member list:

```
# etcdctl2 cluster-health
member 5ee217d17301 is healthy: got healthy result from https://192.168.55.8:2379
cluster is healthy

# etcdctl2 member list
5ee217d17301: name=master-0.example.com peerURLs=http://localhost:2380
clientURLs=https://192.168.55.8:2379 isLeader=true
```

10. After the first instance is running, you can restore the rest of your etcd servers.

5.4.2.1.1. Fix the **peerURLS** parameter

After restoring the data and creating a new cluster, the **peerURLS** parameter shows **localhost** instead of the IP where etcd is listening for peer communication:

```
# etcdctl2 member list
5ee217d17301: name=master-0.example.com peerURLs=http://*localhost*:2380
clientURLs=https://192.168.55.8:2379 isLeader=true
```

5.4.2.1.1. Procedure

1. Get the member ID using **etcdctl member list**:

```
`etcdctl member list`
```

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

```
$ ss -ltn | grep 2380
```

3. Update the member information with that IP:

```
# etcdctl2 member update 5ee217d17301 https://192.168.55.8:2380
Updated member with ID 5ee217d17301 in cluster
```

4. To verify, check that the IP is in the member list:

```
$ etcdctl2 member list
5ee217d17301: name=master-0.example.com peerURLs=https://*192.168.55.8*:2380
clientURLs=https://192.168.55.8:2379 isLeader=true
```

5.4.2.2. Restoring etcd v3 snapshot

The restore procedure for v3 data is similar to the restore procedure for the v2 data.

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. 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
```

2. 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
```

3. 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
```

- Restore permissions and **selinux** context to the restored files:

```
# restorecon -Rv /var/lib/etcd
```

- Start the etcd service:

```
# systemctl start etcd
```

- Check for any error messages:

```
# master-logs etcd etcd
```

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

5.4.2.3. 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:

- 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 .
```

- 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.

- 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:

```
$ 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/.
```

5.4.3. Replacing an etcd host

To replace an etcd host, scale up the etcd cluster and then remove the host. This process ensures that you keep quorum if you lose an etcd host during the replacement procedure.



WARNING

The etcd cluster must maintain a quorum during the replacement operation. This means that at least one host must be in operation at all times.

If the host replacement operation occurs while the etcd cluster maintains a quorum, cluster operations are usually not affected. If a large amount of etcd data must replicate, some operations might slow down.



NOTE

Before you start any procedure involving the etcd cluster, you must have a backup of the etcd data and configuration files so that you can restore the cluster if the procedure fails.

5.4.4. Scaling etcd

You can scale the etcd cluster vertically by adding more resources to the etcd hosts or horizontally by adding more etcd hosts.



NOTE

Due to the voting system etcd uses, the cluster must always contain an odd number of members.

Having a cluster with an odd number of etcd hosts can account for fault tolerance. Having an odd number of etcd hosts does not change the number needed for a quorum but increases the tolerance for failure. For example, with a cluster of three members, quorum is two, which leaves a failure tolerance of one. This ensures the cluster continues to operate if two of the members are healthy.

Having an in-production cluster of three etcd hosts is recommended.

The new host requires a fresh Red Hat Enterprise Linux version 7 dedicated host. The etcd storage should be located on an SSD disk to achieve maximum performance and on a dedicated disk mounted in **/var/lib/etcd**.

Prerequisites

1. Before you add a new etcd host, [perform a backup of both etcd configuration and data](#) to prevent data loss.
2. Check the current etcd cluster status to avoid adding new hosts to an unhealthy cluster.
 - If you use the v2 etcd api, run this command:

```
# etcdctl --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key \
  --ca-file=/etc/etcd/ca.crt \
  --peers="https://*master-0.example.com*:2379,\
  https://*master-1.example.com*:2379,\
  https://*master-2.example.com*:2379" \
  cluster-health
member 5ee217d19001 is healthy: got healthy result from https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from https://192.168.55.8:2379
member ed4f0efd277d7599 is healthy: got healthy result from https://192.168.55.13:2379
cluster is healthy
```

- If you use the v3 etcd api, run this command:

```
# ETCDCTL_API=3 etcdctl --cert="/etc/etcd/peer.crt" \
  --key=/etc/etcd/peer.key \
  --cacert="/etc/etcd/ca.crt" \
  --endpoints="https://*master-0.example.com*:2379,\
  https://*master-1.example.com*:2379,\
  https://*master-2.example.com*:2379" \
  endpoint health
https://master-0.example.com:2379 is healthy: successfully committed proposal: took =
5.011358ms
https://master-1.example.com:2379 is healthy: successfully committed proposal: took =
1.305173ms
https://master-2.example.com:2379 is healthy: successfully committed proposal: took =
1.388772ms
```

3. Before running the **scaleup** playbook, ensure the new host is registered to the proper Red Hat software channels:

```
# subscription-manager register \
  --username=*<username>* --password=*<password>*
# subscription-manager attach --pool=*<poolid>*
# subscription-manager repos --disable=""
# subscription-manager repos \
  --enable=rhel-7-server-rpms \
  --enable=rhel-7-server-extras-rpms
```

etcd is hosted in the **rhel-7-server-extras-rpms** software channel.

- Upgrade etcd and iptables on the current etcd nodes:

```
# yum update etcd iptables-services
```

- Back up the `/etc/etcd` configuration for the etcd hosts.
- If the new etcd members will also be OpenShift Container Platform nodes, [add the desired number of hosts to the cluster](#).
- The rest of this procedure assumes you added one host, but if you add multiple hosts, perform all steps on each host.

5.4.4.1. Adding a new etcd host using Ansible

Procedure

- In the Ansible inventory file, create a new group named **[new_etcd]** and add the new host. Then, add the **new_etcd** group as a child of the **[OSEv3]** group:

```
[OSEv3:children]
masters
nodes
etcd
new_etcd 1

... [OUTPUT ABBREVIATED] ...

[etcd]
master-0.example.com
master-1.example.com
master-2.example.com

[new_etcd] 2
etcd0.example.com 3
```

1 2 3 Add these lines.

- From the host that installed OpenShift Container Platform and hosts the Ansible inventory file, change to the playbook directory and run the etcd **scaleup** playbook:

```
$ cd /usr/share/ansible/openshift-ansible
$ ansible-playbook playbooks/openshift-etcd/scaleup.yml
```

- After the playbook runs, modify the inventory file to reflect the current status by moving the new etcd host from the **[new_etcd]** group to the **[etcd]** group:

```
[OSEv3:children]
masters
nodes
etcd
new_etcd

... [OUTPUT ABBREVIATED] ...

[etcd]
master-0.example.com
master-1.example.com
master-2.example.com
etcd0.example.com
```

- If you use Flannel, modify the **flanneld** service configuration on every OpenShift Container Platform host, located at **/etc/sysconfig/flanneld**, to include the new etcd host:

```
FLANNEL_ETCD_ENDPOINTS=https://master-0.example.com:2379,https://master-
1.example.com:2379,https://master-2.example.com:2379,https://etcd0.example.com:2379
```

- Restart the **flanneld** service:

```
# systemctl restart flanneld.service
```

5.4.4.2. Manually adding a new etcd host

If you do not run etcd as static pods on master nodes, you might need to add another etcd host.

Procedure

Modify the current etcd cluster

To create the etcd certificates, run the **openssl** command, replacing the values with those from your environment.

- Create some environment variables:

```
export NEW_ETCD_HOSTNAME="*etcd0.example.com*"
export NEW_ETCD_IP="192.168.55.21"

export CN=$NEW_ETCD_HOSTNAME
export SAN="IP:${NEW_ETCD_IP}, DNS:${NEW_ETCD_HOSTNAME}"
export PREFIX="/etc/etcd/generated_certs/etcd-$CN/"
export OPENSLLCFG="/etc/etcd/ca/openssl.cnf"
```



NOTE

The custom **openssl** extensions used as **etcd_v3_ca_*** include the \$SAN environment variable as **subjectAltName**. See **/etc/etcd/ca/openssl.cnf** for more information.

- Create the directory to store the configuration and certificates:

-

```
# mkdir -p ${PREFIX}
```

3. Create the server certificate request and sign it: (**server.csr** and **server.crt**)

```
# openssl req -new -config ${OPENSSLCFG} \
  -keyout ${PREFIX}server.key \
  -out ${PREFIX}server.csr \
  -reqexts etcd_v3_req -batch -nodes \
  -subj /CN=$CN

# openssl ca -name etcd_ca -config ${OPENSSLCFG} \
  -out ${PREFIX}server.crt \
  -in ${PREFIX}server.csr \
  -extensions etcd_v3_ca_server -batch
```

4. Create the peer certificate request and sign it: (**peer.csr** and **peer.crt**)

```
# openssl req -new -config ${OPENSSLCFG} \
  -keyout ${PREFIX}peer.key \
  -out ${PREFIX}peer.csr \
  -reqexts etcd_v3_req -batch -nodes \
  -subj /CN=$CN

# openssl ca -name etcd_ca -config ${OPENSSLCFG} \
  -out ${PREFIX}peer.crt \
  -in ${PREFIX}peer.csr \
  -extensions etcd_v3_ca_peer -batch
```

5. Copy the current etcd configuration and **ca.crt** files from the current node as examples to modify later:

```
# cp /etc/etcd/etcd.conf ${PREFIX}
# cp /etc/etcd/ca.crt ${PREFIX}
```

6. While still on the surviving etcd host, add the new host to the cluster. To add additional etcd members to the cluster, you must first adjust the default **localhost** peer in the **peerURLs** value for the first member:

- a. Get the member ID for the first member using the **member list** command:

```
# etcdctl --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key \
  --ca-file=/etc/etcd/ca.crt \
  --peers="https://172.18.1.18:2379,https://172.18.9.202:2379,https://172.18.0.75:2379"
\ 1
  member list
```

- 1** Ensure that you specify the URLs of only active etcd members in the **--peers** parameter value.

- b. Obtain the IP address where etcd listens for cluster peers:

```
$ ss -ltn | grep 2380
```


- c. Update the value of **peerURLs** using the **etcdctl member update** command by passing the member ID and IP address obtained from the previous steps:

```
# etcdctl --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key \
  --ca-file=/etc/etcd/ca.crt \
  --peers="https://172.18.1.18:2379,https://172.18.9.202:2379,https://172.18.0.75:2379" \
  member update 511b7fb6cc0001 https://172.18.1.18:2380
```

- d. Re-run the **member list** command and ensure the peer URLs no longer include **localhost**.
7. Add the new host to the etcd cluster. Note that the new host is not yet configured, so the status stays as **unstarted** until the you configure the new host.



WARNING

You must add each member and bring it online one at a time. When you add each additional member to the cluster, you must adjust the **peerURLs** list for the current peers. The **peerURLs** list grows by one for each member added. The **etcdctl member add** command outputs the values that you must set in the **etcd.conf** file as you add each member, as described in the following instructions.

```
# etcdctl -C https://${CURRENT_ETCD_HOST}:2379 \
  --ca-file=/etc/etcd/ca.crt \
  --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key member add ${NEW_ETCD_HOSTNAME}
https://${NEW_ETCD_IP}:2380 1
```

Added member named 10.3.9.222 with ID 4e1db163a21d7651 to cluster

```
ETCD_NAME="<NEW_ETCD_HOSTNAME>"
ETCD_INITIAL_CLUSTER="<NEW_ETCD_HOSTNAME>=https://<NEW_HOST_IP>:2380,
<CLUSTERMEMBER1_NAME>=https://<CLUSTERMEMBER2_IP>:2380,
<CLUSTERMEMBER2_NAME>=https://<CLUSTERMEMBER2_IP>:2380,
<CLUSTERMEMBER3_NAME>=https://<CLUSTERMEMBER3_IP>:2380"
ETCD_INITIAL_CLUSTER_STATE="existing"
```

- 1 In this line, **10.3.9.222** is a label for the etcd member. You can specify the host name, IP address, or a simple name.

8. Update the sample **/\${PREFIX}/etcd.conf** file.
- a. Replace the following values with the values generated in the previous step:
- ETCD_NAME
 - ETCD_INITIAL_CLUSTER

- `ETCD_INITIAL_CLUSTER_STATE`
- Modify the following variables with the new host IP from the output of the previous step. You can use `${NEW_ETCD_IP}` as the value.

```
ETCD_LISTEN_PEER_URLS
ETCD_LISTEN_CLIENT_URLS
ETCD_INITIAL_ADVERTISE_PEER_URLS
ETCD_ADVERTISE_CLIENT_URLS
```

- If you previously used the member system as an etcd node, you must overwrite the current values in the `/etc/etcd/etcd.conf` file.
- Check the file for syntax errors or missing IP addresses, otherwise the etcd service might fail:

```
# vi ${PREFIX}/etcd.conf
```

- On the node that hosts the installation files, update the `[etcd]` hosts group in the `/etc/ansible/hosts` inventory file. Remove the old etcd hosts and add the new ones.
- Create a `tgz` file that contains the certificates, the sample configuration file, and the `ca` and copy it to the new host:

```
# tar -czvf /etc/etcd/generated_certs/${CN}.tgz -C ${PREFIX} .
# scp /etc/etcd/generated_certs/${CN}.tgz ${CN}:/tmp/
```

Modify the new etcd host

- Install `iptables-services` to provide iptables utilities to open the required ports for etcd:

```
# yum install -y iptables-services
```

- Create the `OS_FIREWALL_ALLOW` firewall rules to allow etcd to communicate:

- Port 2379/tcp for clients
- Port 2380/tcp for peer communication

```
# systemctl enable iptables.service --now
# iptables -N OS_FIREWALL_ALLOW
# iptables -t filter -I INPUT -j OS_FIREWALL_ALLOW
# iptables -A OS_FIREWALL_ALLOW -p tcp -m state --state NEW -m tcp --dport 2379 -j ACCEPT
# iptables -A OS_FIREWALL_ALLOW -p tcp -m state --state NEW -m tcp --dport 2380 -j ACCEPT
# iptables-save | tee /etc/sysconfig/iptables
```



NOTE

In this example, a new chain `OS_FIREWALL_ALLOW` is created, which is the standard naming the OpenShift Container Platform installer uses for firewall rules.

**WARNING**

If the environment is hosted in an IaaS environment, modify the security groups for the instance to allow incoming traffic to those ports as well.

3. Install etcd:

```
# yum install -y etcd
```

Ensure version **etcd-2.3.7-4.el7.x86_64** or greater is installed,

4. Ensure the etcd service is not running by removing the etcd pod definition:

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

5. Remove any etcd configuration and data:

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

6. Extract the certificates and configuration files:

```
# tar xzvf /tmp/etcd0.example.com.tgz -C /etc/etcd/
```

7. Start etcd on the new host:

```
# systemctl enable etcd --now
```

8. Verify that the host is part of the cluster and the current cluster health:

- If you use the v2 etcd api, run the following command:

```
# etcdctl --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key \
  --ca-file=/etc/etcd/ca.crt \
  --peers="https://*master-0.example.com*:2379,\
  https://*master-1.example.com*:2379,\
  https://*master-2.example.com*:2379,\
  https://*etcd0.example.com*:2379" \
  cluster-health
member 5ee217d19001 is healthy: got healthy result from https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from https://192.168.55.8:2379
member 8b8904727bf526a5 is healthy: got healthy result from
https://192.168.55.21:2379
member ed4f0efd277d7599 is healthy: got healthy result from https://192.168.55.13:2379
cluster is healthy
```

- If you use the v3 etcd api, run the following command:

```
# ETCDCTL_API=3 etcdctl --cert="/etc/etcd/peer.crt" \
  --key="/etc/etcd/peer.key" \
  --cacert="/etc/etcd/ca.crt" \
  --endpoints="https://*master-0.example.com*:2379,\
  https://*master-1.example.com*:2379,\
  https://*master-2.example.com*:2379,\
  https://*etcd0.example.com*:2379" \
  endpoint health
https://master-0.example.com:2379 is healthy: successfully committed proposal: took =
5.011358ms
https://master-1.example.com:2379 is healthy: successfully committed proposal: took =
1.305173ms
https://master-2.example.com:2379 is healthy: successfully committed proposal: took =
1.388772ms
https://etcd0.example.com:2379 is healthy: successfully committed proposal: took =
1.498829ms
```

Modify each OpenShift Container Platform master

1. Modify the master configuration in the **etcdClientInfo** section of the **/etc/origin/master/master-config.yaml** file on every master. Add the new etcd host to the list of the etcd servers OpenShift Container Platform uses to store the data, and remove any failed etcd hosts:

```
etcdClientInfo:
  ca: master.etcd-ca.crt
  certFile: master.etcd-client.crt
  keyFile: master.etcd-client.key
  urls:
  - https://master-0.example.com:2379
  - https://master-1.example.com:2379
  - https://master-2.example.com:2379
  - https://etcd0.example.com:2379
```

2. Restart the master API service:

- On every master:

```
# master-restart api
# master-restart controllers
```



WARNING

The number of etcd nodes must be odd, so you must add at least two hosts.

3. If you use Flannel, modify the **flanneld** service configuration located at **/etc/sysconfig/flanneld** on every OpenShift Container Platform host to include the new etcd host:

```
FLANNEL_ETCD_ENDPOINTS=https://master-0.example.com:2379,https://master-1.example.com:2379,https://master-2.example.com:2379,https://etcd0.example.com:2379
```

- Restart the **flanneld** service:

```
# systemctl restart flanneld.service
```

5.4.5. Removing an etcd host

If an etcd host fails beyond restoration, remove it from the cluster.

Steps to be performed on all masters hosts

Procedure

- Remove each other etcd host from the etcd cluster. Run the following command for each etcd node:

```
# etcdctl -C https://<surviving host IP address>:2379 \
  --ca-file=/etc/etcd/ca.crt \
  --cert-file=/etc/etcd/peer.crt \
  --key-file=/etc/etcd/peer.key member remove <failed member ID>
```

- Restart the master API service on every master:

```
# master-restart api restart-master controller
```

Steps to be performed in the current etcd cluster

Procedure

- Remove the failed host from the cluster:

```
# etcdctl2 cluster-health
member 5ee217d19001 is healthy: got healthy result from https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from https://192.168.55.8:2379
failed to check the health of member 8372784203e11288 on https://192.168.55.21:2379: Get
https://192.168.55.21:2379/health: dial tcp 192.168.55.21:2379: getsockopt: connection
refused
member 8372784203e11288 is unreachable: [https://192.168.55.21:2379] are all
unreachable
member ed4f0efd277d7599 is healthy: got healthy result from https://192.168.55.13:2379
cluster is healthy

# etcdctl2 member remove 8372784203e11288 1
Removed member 8372784203e11288 from cluster

# etcdctl2 cluster-health
member 5ee217d19001 is healthy: got healthy result from https://192.168.55.12:2379
member 2a529ba1840722c0 is healthy: got healthy result from https://192.168.55.8:2379
member ed4f0efd277d7599 is healthy: got healthy result from https://192.168.55.13:2379
cluster is healthy
```

1 The **remove** command requires the etcd ID, not the hostname.

- To ensure the etcd configuration does not use the failed host when the etcd service is restarted, modify the `/etc/etcd/etcd.conf` file on all remaining etcd hosts and remove the failed host in the value for the `ETCD_INITIAL_CLUSTER` variable:

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

For example:

```
ETCD_INITIAL_CLUSTER=master-0.example.com=https://192.168.55.8:2380,master-1.example.com=https://192.168.55.12:2380,master-2.example.com=https://192.168.55.13:2380
```

becomes:

```
ETCD_INITIAL_CLUSTER=master-0.example.com=https://192.168.55.8:2380,master-1.example.com=https://192.168.55.12:2380
```



NOTE

Restarting the etcd services is not required, because the failed host is removed using `etcdctl`.

- Modify the Ansible inventory file to reflect the current status of the cluster and to avoid issues when re-running a playbook:

```
[OSEv3:children]
masters
nodes
etcd

... [OUTPUT ABBREVIATED] ...

[etcd]
master-0.example.com
master-1.example.com
```

- If you are using Flannel, modify the `flanneld` service configuration located at `/etc/sysconfig/flanneld` on every host and remove the etcd host:

```
FLANNEL_ETCD_ENDPOINTS=https://master-0.example.com:2379,https://master-1.example.com:2379,https://master-2.example.com:2379
```

- Restart the `flanneld` service:

```
# systemctl restart flanneld.service
```

CHAPTER 6. PROJECT-LEVEL TASKS

6.1. BACKING UP A PROJECT

Creating a backup of all relevant data involves exporting all important information, then restoring into a new project.



NOTE

Currently, a OpenShift Container Platform project back up and restore tool is being developed by Red Hat. See the following bug for more information:

- [bugzilla 1303205](#).

Procedure

1. List all the relevant data to back up:

```
$ oc get all
NAME          TYPE          FROM          LATEST
bc/ruby-ex    Source        Git           1

NAME          TYPE          FROM          STATUS   STARTED      DURATION
builds/ruby-ex-1 Source        Git@c457001   Complete 2 minutes ago 35s

NAME          DOCKER REPO          TAGS          UPDATED
is/guestbook  10.111.255.221:5000/myproject/guestbook latest        2 minutes ago
is/hello-openshift 10.111.255.221:5000/myproject/hello-openshift latest        2 minutes ago
is/ruby-22-centos7 10.111.255.221:5000/myproject/ruby-22-centos7 latest        2 minutes ago
is/ruby-ex    10.111.255.221:5000/myproject/ruby-ex latest        2 minutes ago

NAME          REVISION  DESIRED  CURRENT  TRIGGERED BY
dc/guestbook  1         1        1        config,image(guestbook:latest)
dc/hello-openshift 1         1        1        config,image(hello-openshift:latest)
dc/ruby-ex    1         1        1        config,image(ruby-ex:latest)

NAME          DESIRED  CURRENT  READY  AGE
rc/guestbook-1  1        1        1      2m
rc/hello-openshift-1 1        1        1      2m
rc/ruby-ex-1   1        1        1      2m

NAME          CLUSTER-IP    EXTERNAL-IP  PORT(S)    AGE
svc/guestbook 10.111.105.84 <none>       3000/TCP   2m
svc/hello-openshift 10.111.230.24 <none>       8080/TCP,8888/TCP 2m
svc/ruby-ex    10.111.232.117 <none>       8080/TCP   2m

NAME          READY  STATUS    RESTARTS  AGE
po/guestbook-1-c010g 1/1    Running   0          2m
po/hello-openshift-1-4zw2q 1/1    Running   0          2m
po/ruby-ex-1-build  0/1    Completed 0          2m
po/ruby-ex-1-rxc74  1/1    Running   0          2m
```

2. Export the project objects to a **.yaml** or **.json** file.

- To export the project objects into a **project.yaml** file:

```
$ oc get -o yaml --export all > project.yaml
```

- To export the project objects into a **project.json** file:

```
$ oc get -o json --export all > project.json
```

3. Export the project's **role bindings**, **secrets**, **service accounts**, and **persistent volume claims**:

```
$ for object in rolebindings serviceaccounts secrets imagestreamtags cm
egressnetworkpolicies rolebindingrestrictions limitranges resourcequotas pvc templates
cronjobs statefulsets hpa deployments replicaset poddisruptionbudget endpoints
do
  oc get -o yaml --export $object > $object.yaml
done
```

4. To list all the namespaced objects:

```
$ oc api-resources --namespaced=true -o name
```

5. Some exported objects can rely on specific metadata or references to unique IDs in the project. This is a limitation on the usability of the recreated objects.

When using **imagestreams**, the **image** parameter of a **deploymentconfig** can point to a specific **sha** checksum of an image in the internal registry that would not exist in a restored environment. For instance, running the sample "ruby-ex" as **oc new-app centos/ruby-22-centos7~https://github.com/sclorg/ruby-ex.git** creates an **imagestream ruby-ex** using the internal registry to host the image:

```
$ oc get dc ruby-ex -o jsonpath="{.spec.template.spec.containers[].image}"
10.111.255.221:5000/myproject/ruby-
ex@sha256:880c720b23c8d15a53b01db52f7abdcbb2280e03f686a5c8edfef1a2a7b21cee
```

If importing the **deploymentconfig** as it is exported with **oc get --export** it fails if the image does not exist.

6.2. RESTORING A PROJECT

To restore a project, create the new project, then restore any exported files by running **oc create -f pods.json**. However, restoring a project from scratch requires a specific order because some objects depend on others. For example, you must create the **configmaps** before you create any **pods**.

Procedure

1. If the project was exported as a single file, import it by running the following commands:

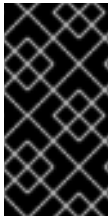
```
$ oc new-project <projectname>
$ oc create -f project.yaml
$ oc create -f secret.yaml
$ oc create -f serviceaccount.yaml
$ oc create -f pvc.yaml
$ oc create -f rolebindings.yaml
```


**WARNING**

Some resources, such as pods and default service accounts, can fail to be created.

6.2.1. Backing up persistent volume claims

You can synchronize persistent data from inside of a container to a server.

**IMPORTANT**

Depending on the provider that is hosting the OpenShift Container Platform environment, the ability to launch third party snapshot services for backup and restore purposes also exists. As OpenShift Container Platform does not have the ability to launch these services, this guide does not describe these steps.

Consult any product documentation for the correct backup procedures of specific applications. For example, copying the mysql data directory itself does not create a usable backup. Instead, run the specific backup procedures of the associated application and then synchronize any data. This includes using snapshot solutions provided by the OpenShift Container Platform hosting platform.

Procedure

1. View the project and pods:

```
$ oc get pods
NAME          READY   STATUS    RESTARTS  AGE
demo-1-build  0/1     Completed 0          2h
demo-2-fxx6d  1/1     Running   0          1h
```

2. Describe the desired pod to find the volumes that are currently used by a persistent volume:

```
$ oc describe pod demo-2-fxx6d
Name:         demo-2-fxx6d
Namespace:    test
Security Policy: restricted
Node:         ip-10-20-6-20.ec2.internal/10.20.6.20
Start Time:   Tue, 05 Dec 2017 12:54:34 -0500
Labels:       app=demo
              deployment=demo-2
              deploymentconfig=demo
Status:       Running
IP:           172.16.12.5
Controllers:  ReplicationController/demo-2
Containers:
  demo:
    Container ID:
    docker://201f3e55b373641eb36945d723e1e212ecab847311109b5cee1fd0109424217a
    Image:      docker-
registry.default.svc:5000/test/demo@sha256:0a9f2487a0d95d51511e49d20dc9ff6f350436f935
```

```

968b0c83fcb98a7a8c381a
  Image ID: docker-pullable://docker-
registry.default.svc:5000/test/demo@sha256:0a9f2487a0d95d51511e49d20dc9ff6f350436f935
968b0c83fcb98a7a8c381a
  Port: 8080/TCP
  State: Running
  Started: Tue, 05 Dec 2017 12:54:52 -0500
  Ready: True
  Restart Count: 0
  Volume Mounts:
    */opt/app-root/src/uploaded from persistent-volume (rw)*
    /var/run/secrets/kubernetes.io/serviceaccount from default-token-8mmrk (ro)
  Environment Variables: <none>
  ...omitted...

```

This output shows that the persistent data is in the **/opt/app-root/src/uploaded** directory.

3. Copy the data locally:

```

$ oc rsync demo-2-fxx6d:/opt/app-root/src/uploaded ./demo-app
receiving incremental file list
uploaded/
uploaded/ocp_sop.txt
uploaded/lost+found/

sent 38 bytes  received 190 bytes  152.00 bytes/sec
total size is 32  speedup is 0.14

```

The **ocp_sop.txt** file is downloaded to the local system to be backed up by backup software or another backup mechanism.



NOTE

You can also use the previous steps if a pod starts without needing to use a **pvc**, but you later decide that a **pvc** is necessary. You can preserve the data and then use the `restore` process to populate the new storage.

6.2.2. Restoring persistent volume claims

You can restore persistent volume claim (PVC) data that you backed up. You can delete the file and then place the file back in the expected location or migrate the persistent volume claims. You might migrate if you need to move the storage or in a disaster scenario when the backend storage no longer exists.

Consult any product documentation for the correct restoration procedures for specific applications.

6.2.2.1. Restoring files to an existing PVC

Procedure

1. Delete the file:

```

$ oc rsh demo-2-fxx6d
sh-4.2$ ls */opt/app-root/src/uploaded/*
lost+found  ocp_sop.txt

```

```
sh-4.2$ *rm -rf /opt/app-root/src/uploaded/ocp_sop.txt*
sh-4.2$ *ls /opt/app-root/src/uploaded/*
lost+found
```

2. Replace the file from the server that contains the rsync backup of the files that were in the pvc:

```
$ oc rsync uploaded demo-2-fxx6d:/opt/app-root/src/
```

3. Validate that the file is back on the pod by using **oc rsh** to connect to the pod and view the contents of the directory:

```
$ oc rsh demo-2-fxx6d
sh-4.2$ *ls /opt/app-root/src/uploaded/*
lost+found ocp_sop.txt
```

6.2.2.2. Restoring data to a new PVC

The following steps assume that a new **pvc** has been created.

Procedure

1. Overwrite the currently defined **claim-name**:

```
$ oc set volume dc/demo --add --name=persistent-volume \
  --type=persistentVolumeClaim --claim-name=filestore \ --mount-path=/opt/app-
  root/src/uploaded --overwrite
```

2. Validate that the pod is using the new PVC:

```
$ oc describe dc/demo
Name: demo
Namespace: test
Created: 3 hours ago
Labels: app=demo
Annotations: openshift.io/generated-by=OpenShiftNewApp
Latest Version: 3
Selector: app=demo,deploymentconfig=demo
Replicas: 1
Triggers: Config, Image(demo@latest, auto=true)
Strategy: Rolling
Template:
  Labels: app=demo
  deploymentconfig=demo
  Annotations: openshift.io/container.demo.image.entrypoint=["container-
  entrypoint", "/bin/sh", "-c", "$STI_SCRIPTS_PATH/usage"]
  openshift.io/generated-by=OpenShiftNewApp
  Containers:
    demo:
      Image: docker-
  registry.default.svc:5000/test/demo@sha256:0a9f2487a0d95d51511e49d20dc9ff6f350436f935
  968b0c83fcb98a7a8c381a
      Port: 8080/TCP
      Volume Mounts:
        /opt/app-root/src/uploaded from persistent-volume (rw)
```

```
Environment Variables: <none>
Volumes:
persistent-volume:
  Type: PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same
namespace)
  *ClaimName: filestore*
  ReadOnly: false
...omitted...
```

3. Now that the deployment configuration uses the new **pvc**, run **oc rsync** to place the files onto the new **pvc**:

```
$ oc rsync uploaded demo-3-2b8gs:/opt/app-root/src/
sending incremental file list
uploaded/
uploaded/ocp_sop.txt
uploaded/lost+found/

sent 181 bytes received 39 bytes 146.67 bytes/sec
total size is 32 speedup is 0.15
```

4. Validate that the file is back on the pod by using **oc rsh** to connect to the pod and view the contents of the directory:

```
$ oc rsh demo-3-2b8gs
sh-4.2$ ls /opt/app-root/src/uploaded/
lost+found ocp_sop.txt
```

6.2.3. Pruning images and containers

See the [Pruning Resources](#) topic for information about pruning collected data and older versions of objects.

CHAPTER 7. DOCKER TASKS

OpenShift Container Platform uses container engines (CRI-O or Docker) to run applications in pods that are composed by any number of containers.

As a cluster administrator, sometimes container engines requires some extra configuration in order to efficiently run elements of the OpenShift Container Platform installation.

7.1. INCREASING CONTAINER STORAGE

Increasing the amount of storage available ensures continued deployment without any outages. To do so, a free partition must be made available that contains an appropriate amount of free capacity.

7.1.1. Evacuating the node

Procedure

1. From a master instance, or as a cluster administrator, allow the evacuation of any pod from the node and disable scheduling of other pods on that node:

```
$ NODE=ose-app-node01.example.com
$ oc adm manage-node ${NODE} --schedulable=false
NAME                STATUS              AGE    VERSION
ose-app-node01.example.com Ready,SchedulingDisabled 20m    v1.6.1+5115d708d7

$ oc adm drain ${NODE} --ignore-daemonsets
node "ose-app-node01.example.com" already cordoned
pod "perl-1-build" evicted
pod "perl-1-3lnsh" evicted
pod "perl-1-9jzd8" evicted
node "ose-app-node01.example.com" drained
```



NOTE

If there are containers running with local volumes that will not migrate, run the following command: **oc adm drain \${NODE} --ignore-daemonsets --delete-local-data**.

2. List the pods on the node to verify that they have been removed:

```
$ oc adm manage-node ${NODE} --list-pods

Listing matched pods on node: ose-app-node01.example.com

NAME    READY    STATUS    RESTARTS    AGE
```

3. Repeat the previous two steps for each node.

For more information on evacuating and draining pods or nodes, see [Node maintenance](#).

7.1.2. Increasing storage

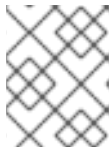
You can increase Docker storage in two ways: attaching a new disk, or extending the existing disk.

Increasing storage with a new disk

Prerequisites

- A new disk must be available to the existing instance that requires more storage. In the following steps, the original disk is labeled **/dev/xvdb**, and the new disk is labeled **/dev/xvdd**, as shown in the `/etc/sysconfig/docker-storage-setup` file:

```
# vi /etc/sysconfig/docker-storage-setup
DEVS="/dev/xvdb /dev/xvdd"
```



NOTE

The process may differ depending on the underlying OpenShift Container Platform infrastructure.

Procedure

1. Stop the **docker**:

```
# systemctl stop docker
```

2. Stop the node service 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/
```

3. Run the **docker-storage-setup** command to extend the volume groups and logical volumes associated with container storage:

```
# docker-storage-setup
INFO: Volume group backing root filesystem could not be determined
INFO: Device /dev/xvdb is already partitioned and is part of volume group docker_vol
INFO: Device node /dev/xvdd1 exists.
Physical volume "/dev/xvdd1" successfully created.
Volume group "docker_vol" successfully extended
```

4. Start the Docker services:

```
# systemctl start docker
# vgs
VG      #PV #LV #SN Attr  VSize  VFree
docker_vol  2  1  0 wz--n- 64.99g <55.00g
```

5. Restart the node service by rebooting the host:

```
# systemctl restart atomic-openshift-node.service
```

6. A benefit in adding a disk compared to creating a new volume group and re-running **docker-storage-setup** is that the images that were used on the system still exist after the new storage has been added:

```
# container images
```

REPOSITORY SIZE	TAG	IMAGE ID	CREATED
docker-registry.default.svc:5000/tet/perl minutes ago 627.4 MB	latest	8b0b0106fb5e	13
registry.redhat.io/rhsccl/perl-524-rhel7 559.5 MB	<none>	912b01ac7570	6 days ago
registry.redhat.io/openshift3/ose-deployer ago 970.2 MB	v3.6.173.0.21	89fd398a337d	5 weeks
registry.redhat.io/openshift3/ose-pod ago 208.6 MB	v3.6.173.0.21	63accd48a0d7	5 weeks

- With the increase in storage capacity, enable the node to be schedulable in order to accept new incoming pods.

As a cluster administrator, run the following from a master instance:

```
$ oc adm manage-node ${NODE} --schedulable=true

ose-master01.example.com Ready,SchedulingDisabled 24m v1.6.1+5115d708d7
ose-master02.example.com Ready,SchedulingDisabled 24m v1.6.1+5115d708d7
ose-master03.example.com Ready,SchedulingDisabled 24m v1.6.1+5115d708d7
ose-infra-node01.example.com Ready 24m v1.6.1+5115d708d7
ose-infra-node02.example.com Ready 24m v1.6.1+5115d708d7
ose-infra-node03.example.com Ready 24m v1.6.1+5115d708d7
ose-app-node01.example.com Ready 24m v1.6.1+5115d708d7
ose-app-node02.example.com Ready 24m v1.6.1+5115d708d7
```

Increasing storage with a new disk

- Evacuate the node [following the previous steps](#).
- Stop the **docker**:

```
# systemctl stop docker
```

- Stop the node service by removing the pod definition:

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

- Resize the existing disk as desired. This can depend on your environment:

- If you are using LVM (Logical Volume Manager):

- Remove the logical volume:

```
# lvremove /dev/docker_vg/docker/lv
```

- Remove the Docker volume group:

```
# vgremove docker_vg
```

- Remove the physical volume:

```
# pvremove /dev/<my_previous_disk_device>
```

- If you are using a cloud provider, you can detach the disk, destroy the disk, then create a new bigger disk, and attach it to the instance.
 - For a non-cloud environment, the disk and file system can be resized. See the following solution for more information:
 - <https://access.redhat.com/solutions/199573>
5. Verify that the `/etc/sysconfig/container-storage-setup` file is correctly configured for the new disk by checking the device name, size, etc.
 6. Run `docker-storage-setup` to reconfigure the new disk:

```
# docker-storage-setup
INFO: Volume group backing root filesystem could not be determined
INFO: Device /dev/xvdb is already partitioned and is part of volume group docker_vol
INFO: Device node /dev/xvdd1 exists.
Physical volume "/dev/xvdd1" successfully created.
Volume group "docker_vol" successfully extended
```

7. Start the Docker services:

```
# systemctl start docker
# vgs
VG      #PV #LV #SN Attr  VSize VFree
docker_vol 2  1  0 wz--n- 64.99g <55.00g
```

8. Restart the node service by rebooting the host:

```
# systemctl restart atomic-openshift-node.service
```

7.1.3. Changing the storage backend

With the advancements of services and file systems, changes in a storage backend may be necessary to take advantage of new features. The following steps provide an example of changing a device mapper backend to an **overlay2** storage backend. **overlay2** offers increased speed and density over traditional device mapper.

7.1.3.1. Evacuating the node

1. From a master instance, or as a cluster administrator, allow the evacuation of any pod from the node and disable scheduling of other pods on that node:

```
$ NODE=ose-app-node01.example.com
$ oc adm manage-node ${NODE} --schedulable=false
NAME                STATUS              AGE    VERSION
ose-app-node01.example.com Ready,SchedulingDisabled 20m    v1.6.1+5115d708d7

$ oc adm drain ${NODE} --ignore-daemonsets
node "ose-app-node01.example.com" already cordoned
pod "perl-1-build" evicted
pod "perl-1-3lnsh" evicted
pod "perl-1-9jzd8" evicted
node "ose-app-node01.example.com" drained
```


**NOTE**

If there are containers running with local volumes that will not migrate, run the following command: **oc adm drain \${NODE} --ignore-daemonsets --delete-local-data**

- List the pods on the node to verify that they have been removed:

```
$ oc adm manage-node ${NODE} --list-pods
```

Listing matched pods on node: ose-app-node01.example.com

```
NAME    READY   STATUS    RESTARTS  AGE
```

For more information on evacuating and draining pods or nodes, see [Node maintenance](#).

- With no containers currently running on the instance, stop the **docker** service:

```
# systemctl stop docker
```

- Stop the node service by removing the pod definition:

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

- Verify the name of the volume group, logical volume name, and physical volume name:

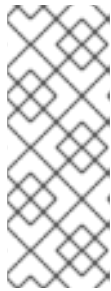
```
# vgs
VG      #PV #LV #SN Attr  VSize  VFree
docker_vol  1  1  0 wz--n- <25.00g 15.00g

# lvs
LV      VG      Attr      LSize  Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
dockerlv docker_vol -wi-ao---- <10.00g

# lvremove /dev/docker_vol/docker-pool -y
# vgremove docker_vol -y
# pvs
PV      VG      Fmt Attr PSize  PFree
/dev/xvdb1 docker_vol lvm2 a-- <25.00g 15.00g

# pvremove /dev/xvdb1 -y
# rm -Rf /var/lib/docker/*
# rm -f /etc/sysconfig/docker-storage
```

- Modify the **docker-storage-setup** file to specify the **STORAGE_DRIVER**.

**NOTE**

When a system is upgraded from Red Hat Enterprise Linux version 7.3 to 7.4, the **docker** service attempts to use `/var` with the **STORAGE_DRIVER** of `extfs`. The use of `extfs` as the **STORAGE_DRIVER** causes errors. See the following bug for more info regarding the error:

- [Bugzilla ID: 1490910](#)

```
DEVS=/dev/xvdb
VG=docker_vol
DATA_SIZE=95%VG
STORAGE_DRIVER=overlay2
CONTAINER_ROOT_LV_NAME=dockerlv
CONTAINER_ROOT_LV_MOUNT_PATH=/var/lib/docker
CONTAINER_ROOT_LV_SIZE=100%FREE
```

7. Set up the storage:

```
# docker-storage-setup
```

8. Start the **docker**:

```
# systemctl start docker
```

9. Restart the node service by rebooting the host:

```
# systemctl restart atomic-openshift-node.service
```

10. With the storage modified to use **overlay2**, enable the node to be schedulable in order to accept new incoming pods.

From a master instance, or as a cluster administrator:

```
$ oc adm manage-node ${NODE} --schedulable=true

ose-master01.example.com Ready,SchedulingDisabled 24m v1.6.1+5115d708d7
ose-master02.example.com Ready,SchedulingDisabled 24m v1.6.1+5115d708d7
ose-master03.example.com Ready,SchedulingDisabled 24m v1.6.1+5115d708d7
ose-infra-node01.example.com Ready 24m v1.6.1+5115d708d7
ose-infra-node02.example.com Ready 24m v1.6.1+5115d708d7
ose-infra-node03.example.com Ready 24m v1.6.1+5115d708d7
ose-app-node01.example.com Ready 24m v1.6.1+5115d708d7
ose-app-node02.example.com Ready 24m v1.6.1+5115d708d7
```

7.2. MANAGING CONTAINER REGISTRY CERTIFICATES

An OpenShift Container Platform internal registry is created as a pod. However, containers may be pulled from external registries if desired. By default, registries listen on TCP port 5000. Registries provide the option of securing exposed images via TLS or running a registry without encrypting traffic.

**WARNING**

Docker interprets **.crt** files as CA certificates and **.cert** files as client certificates. Any CA extensions **must** be **.crt**.

7.2.1. Installing a certificate authority certificate for external registries

In order to use OpenShift Container Platform with an external registry, the registry certificate authority (CA) certificate must be trusted for all the nodes that can pull images from the registry.

**NOTE**

Depending on the Docker version, the process to trust a container image registry varies. The latest versions of Docker's root certificate authorities are merged with system defaults. Prior to **docker** version 1.13, the system default certificate is used only when no other custom root certificates exist.

Procedure

1. Copy the CA certificate to **/etc/pki/ca-trust/source/anchors/**:

```
$ sudo cp myregistry.example.com.crt /etc/pki/ca-trust/source/anchors/
```

2. Extract and add the CA certificate to the list of trusted certificates authorities:

```
$ sudo update-ca-trust extract
```

3. Verify the SSL certificate using the **openssl** command:

```
$ openssl verify myregistry.example.com.crt
myregistry.example.com.crt: OK
```

4. Once the certificate is in place and the trust is updated, restart the **docker** service to ensure the new certificates are properly set:

```
$ sudo systemctl restart docker.service
```

For Docker versions prior to 1.13, perform the following additional steps for trusting certificates of authority:

1. On every node create a new directory in **/etc/docker/certs.d** where the name of the directory is the host name of the container image registry:

```
$ sudo mkdir -p /etc/docker/certs.d/myregistry.example.com
```

**NOTE**

The port number is not required unless the container image registry cannot be accessed without a port number. Addressing the port to the original Docker registry is as follows: **myregistry.example.com:port**

2. Accessing the container image registry via IP address requires the creation of a new directory within **/etc/docker/certs.d** on every node where the name of the directory is the IP of the container image registry:

```
$ sudo mkdir -p /etc/docker/certs.d/10.10.10.10
```

3. Copy the CA certificate to the newly created Docker directories from the previous steps:

```
$ sudo cp myregistry.example.com.crt \
  /etc/docker/certs.d/myregistry.example.com/ca.crt
```

```
$ sudo cp myregistry.example.com.crt /etc/docker/certs.d/10.10.10.10/ca.crt
```

4. Once the certificates have been copied, restart the **docker** service to ensure the new certificates are used:

```
$ sudo systemctl restart docker.service
```

7.2.2. Docker certificates backup

When performing a node host backup, ensure to include the certificates for external registries.

Procedure

1. If using **/etc/docker/certs.d**, copy all the certificates included in the directory and store the files:

```
$ sudo tar -czvf docker-registry-certs-$(hostname)-$(date +%Y%m%d).tar.gz
  /etc/docker/certs.d/
```

2. If using a system trust, store the certificates prior to adding them within the system trust. Once the store is complete, extract the certificate for restoration using the **trust** command. Identify the system trust CAs and note the **pkcs11** ID:

```
$ trust list
...[OUTPUT OMITTED]...
pkcs11:id=%a5%b3%e1%2b%2b%49%b6%d7%73%a1%aa%94%f5%01%e7%73%65%4c%
ac%50;type=cert
  type: certificate
  label: MyCA
  trust: anchor
  category: authority
...[OUTPUT OMITTED]...
```

3. Extract the certificate in **pem** format and provide it a name. For example, **myca.crt**.

```
$ trust extract --format=pem-bundle \
  --
```

```
filter="%a5%b3%e1%2b%2b%49%b6%d7%73%a1%aa%94%f5%01%e7%73%65%4c%ac%50;type=cert" myca.crt
```

4. Verify the certificate has been properly extracted via **openssl**:

```
$ openssl verify myca.crt
```

5. Repeat the procedure for all the required certificates and store the files in a remote location.

7.2.3. Docker certificates restore

In the event of the deletion or corruption of the Docker certificates for the external registries, the restore mechanism uses the same steps as the installation method using the files from the backups performed previously.

7.3. MANAGING CONTAINER REGISTRIES

You can configure OpenShift Container Platform to use external **docker** registries to pull images. However, you can use configuration files to allow or deny certain images or registries.

If the external registry is exposed using certificates for the network traffic, it can be named as a secure registry. Otherwise, traffic between the registry and host is plain text and not encrypted, meaning it is an insecure registry.

7.3.1. Docker search external registries

By default, the **docker** daemon has the ability to pull images from any registry, but the search operation is performed against **docker.io/** and **registry.redhat.io**. The daemon can be configured to search images from other registries using the **--add-registry** option with the **docker** daemon.



NOTE

The ability to search images from the Red Hat Registry **registry.redhat.io** exists by default in the Red Hat Enterprise Linux **docker** package.

Procedure

1. To allow users to search for images using **docker search** with other registries, add those registries to the **/etc/containers/registries.conf** file under the **registries** parameter:

```
registries:
- registry.redhat.io
- my.registry.example.com
```

2. Restart the **docker** daemon to allow for **my.registry.example.com** to be used:

```
$ sudo systemctl restart docker.service
```

Restarting the **docker** daemon causes the **docker** containers to restart.

3. Using the Ansible installer, this can be configured using the **openshift_docker_additional_registries** variable in the Ansible hosts file:

```
openshift_docker_additional_registries=registry.redhat.io,my.registry.example.com
```

7.3.2. Docker external registries whitelist and blacklist

Docker can be configured to block operations from external registries by configuring the **registries** and **block_registries** flags for the **docker** daemon.

Procedure

1. Add the allowed registries to the `/etc/containers/registries.conf` file with the **registries** flag:

```
registries:
- registry.redhat.io
- my.registry.example.com
```



NOTE

The **docker.io** registry can be added using the same method.

2. Block the rest of the registries:

```
block_registries:
- all
```

3. Block the rest of the registries in older versions:

```
BLOCK_REGISTRY='--block-registry=all'
```

4. Restart the **docker** daemon:

```
$ sudo systemctl restart docker.service
```

Restarting the **docker** daemon causes the **docker** containers to restart.

5. In this example, the **docker.io** registry has been blacklisted, so any operation regarding that registry fails:

```
$ sudo docker pull hello-world
Using default tag: latest
Trying to pull repository registry.redhat.io/hello-world ...
Trying to pull repository my.registry.example.com/hello-world ...
Trying to pull repository registry.redhat.io/hello-world ...
unknown: Not Found
$ sudo docker pull docker.io/hello-world
Using default tag: latest
Trying to pull repository docker.io/library/hello-world ...
All endpoints blocked.
```

Add **docker.io** back to the **registries** variable by modifying the file again and restarting the service.

```
registries:
```

```
- registry.redhat.io
- my.registry.example.com
- docker.io
block_registries:
- all
```

or

```
ADD_REGISTRY="--add-registry=registry.redhat.io --add-registry=my.registry.example.com -
-add-registry=docker.io"
BLOCK_REGISTRY='--block-registry=all'
```

- Restart the Docker service:

```
$ sudo systemctl restart docker
```

- To verify that the image is now available to be pulled:

```
$ sudo docker pull docker.io/hello-world
Using default tag: latest
Trying to pull repository docker.io/library/hello-world ...
latest: Pulling from docker.io/library/hello-world

9a0669468bf7: Pull complete
Digest:
sha256:0e06ef5e1945a718b02a8c319e15bae44f47039005530bc617a5d071190ed3fc
```

- If using an external registry is required, for example to modify the **docker** daemon configuration file in all the node hosts that require to use that registry, create a blacklist on those nodes to avoid malicious containers from being executed. Using the Ansible installer, this can be configured using the **openshift_docker_additional_registries** and **openshift_docker_blocked_registries** variables in the Ansible hosts file:

```
openshift_docker_additional_registries=registry.redhat.io,my.registry.example.com
openshift_docker_blocked_registries=all
```

7.3.3. Secure registries

In order to be able to pull images from an external registry, it is required to trust the registry certificates, otherwise the pull image operation fails.

In order to do so, see the [Installing a Certificate Authority Certificate for External Registries](#) section.

If using a whitelist, the external registries should be added to the **registries** variable, as explained above.

7.3.4. Insecure registries

External registries that use non-trusted certificates, or without certificates at all, should be avoided.

However, any insecure registries should be added using the **--insecure-registry** option to allow for the **docker** daemon to pull images from the repository. This is the same as the **--add-registry** option, but the **docker** operation is not verified.

The registry should be added using both options to enable search, and, if there is a blacklist, to perform other operations, such as pulling images.

For testing purposes, an example is shown on how to add a **localhost** insecure registry.

Procedure

1. Modify **/etc/containers/registries.conf** configuration file to add the localhost insecure registry:

```
registries:
- registry.redhat.io
- my.registry.example.com
- docker.io
insecure_registries:
- localhost:5000
block_registries:
- all
```

2. Restart the **docker** daemon to use the registry:

```
$ sudo systemctl restart docker.service
```

Restarting the **docker** daemon causes the **docker** containers to be restarted.

3. Run a container image registry pod at **localhost**:

```
$ sudo docker run -p 5000:5000 registry:2
```

4. Pull an image:

```
$ sudo docker pull openshift/hello-openshift
```

5. Tag the image:

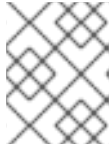
```
$ sudo docker tag docker.io/openshift/hello-openshift:latest localhost:5000/hello-openshift-local:latest
```

6. Push the image to the local registry:

```
$ sudo docker push localhost:5000/hello-openshift-local:latest
```

7. Using the Ansible installer, this can be configured using the **openshift_docker_additional_registries**, **openshift_docker_blocked_registries**, and **openshift_docker_insecure_registries** variables in the **Ansible** hosts file:

```
openshift_docker_additional_registries=registry.redhat.io,my.registry.example.com,localhost:5000
openshift_docker_insecure_registries=localhost:5000
openshift_docker_blocked_registries=all
```


**NOTE**

You can also set the **openshift_docker_insecure_registries** variable to the IP address of the host. **0.0.0.0/0** is not a valid setting.

7.3.5. Authenticated registries

Using authenticated registries with **docker** requires the **docker** daemon to log in to the registry. With OpenShift Container Platform, a different set of steps must be performed, because the users can not run **docker login** commands on the host. Authenticated registries can be used to limit the images users can pull or who can access the external registries.

If an external **docker** registry requires authentication, create a special secret in the project that uses that registry and then use that secret to perform the **docker** operations.

Procedure

1. Create a **dockercfg** secret in the project where the user is going to log in to the **docker** registry:

```
$ oc project <my_project>
$ oc create secret docker-registry <my_registry> --docker-server=
<my.registry.example.com> --docker-username=<username> --docker-password=
<my_password> --docker-email=<me@example.com>
```

2. If a **.dockercfg** file exists, create the secret using the **oc** command:

```
$ oc create secret generic <my_registry> --from-file=.dockercfg=<path/to/.dockercfg> --
type=kubernetes.io/dockercfg
```

3. Populate the **\$HOME/.docker/config.json** file:

```
$ oc create secret generic <my_registry> --from-file=.dockerconfigjson=<path/to/.dockercfg>
--type=kubernetes.io/dockerconfigjson
```

4. Use the **dockercfg** secret to pull images from the authenticated registry by linking the secret to the service account performing the pull operations. The default service account to pull images is named **default**:

```
$ oc secrets link default <my_registry> --for=pull
```

5. For pushing images using the S2I feature, the **dockercfg** secret is mounted in the S2I pod, so it needs to be linked to the proper service account that performs the build. The default service account used to build images is named **builder**.

```
$ oc secrets link builder <my_registry>
```

6. In the **buildconfig**, the secret should be specified for push or pull operations:

```
"type": "Source",
"sourceStrategy": {
  "from": {
    "kind": "DockerImage",
    "name": "*my.registry.example.com*/myproject/myimage:stable"
  },
}
```

```

    "pullSecret": {
      "name": "*mydockerregistry*"
    },
    ...[OUTPUT ABBREVIATED]...
  "output": {
    "to": {
      "kind": "DockerImage",
      "name": "*my.registry.example.com*/myproject/myimage:latest"
    },
    "pushSecret": {
      "name": "*mydockerregistry*"
    },
    ...[OUTPUT ABBREVIATED]...
  }
}

```

- If the external registry delegates authentication to external services, create both **dockercfg** secrets: the registry one using the registry URL and the external authentication system using its own URL. Both secrets should be added to the service accounts.

```

$ oc project <my_project>
$ oc create secret docker-registry <my_registry> --docker-server=*
<my_registry_example.com> --docker-username=<username> --docker-password=
<my_password> --docker-email=<me@example.com>
$ oc create secret docker-registry <my_docker_registry_ext_auth> --docker-server=
<my.authsystem.example.com> --docker-username=<username> --docker-password=
<my_password> --docker-email=<me@example.com>
$ oc secrets link default <my_registry> --for=pull
$ oc secrets link default <my_docker_registry_ext_auth> --for=pull
$ oc secrets link builder <my_registry>
$ oc secrets link builder <my_docker_registry_ext_auth>

```

7.3.6. ImagePolicy admission plug-in

An admission control plug-in intercepts requests to the API, and performs checks depending on the configured rules and allows or denies certain actions based on those rules. OpenShift Container Platform can limit the allowed images running in the environment [using the ImagePolicy admission plug-in](#) where it can control:

- The source of images: which registries can be used to pull images
- Image resolution: force pods to run with immutable digests to ensure the image does not change due to a re-tag
- Container image label restrictions: force an image to have or not have particular labels
- Image annotation restrictions: force an image in the integrated container registry to have or not have particular annotations



WARNING

ImagePolicy admission plug-in is currently considered beta.

Procedure

1. If the **ImagePolicy** plug-in is enabled, it needs to be modified to allow the external registries to be used by modifying the **/etc/origin/master/master-config.yaml** file on every master node:

```
admissionConfig:
  pluginConfig:
    openshift.io/ImagePolicy:
      configuration:
        kind: ImagePolicyConfig
        apiVersion: v1
        executionRules:
          - name: allow-images-from-other-registries
            onResources:
              - resource: pods
              - resource: builds
            matchRegistries:
              - docker.io
              - <my.registry.example.com>
              - registry.redhat.io
```



NOTE

Enabling **ImagePolicy** requires users to specify the registry when deploying an application like **oc new-app docker.io/kubernetes/guestbook** instead **oc new-app kubernetes/guestbook**, otherwise it fails.

2. To enable the admission plug-ins at installation time, the **openshift_master_admission_plugin_config** variable can be used with a **json** formatted string including all the **pluginConfig** configuration:

```
openshift_master_admission_plugin_config={"openshift.io/ImagePolicy":{"configuration":
{"kind":"ImagePolicyConfig","apiVersion":"v1","executionRules":[{"name":"allow-images-from-
other-registries","onResources":[{"resource":"pods"}, {"resource":"builds"}],"matchRegistries":
["docker.io","*my.registry.example.com","registry.redhat.io"]}}}}
```

7.3.7. Import images from external registries

Application developers can import images to create **imagestreams** using the **oc import-image** command, and OpenShift Container Platform can be configured to allow or deny image imports from external registries.

Procedure

1. To configure the allowed registries where users can import images, add the following to the **/etc/origin/master/master-config.yaml** file:

```
imagePolicyConfig:
  allowedRegistriesForImport:
    - domainName: docker.io
    - domainName: '*.docker.io'
    - domainName: '*.redhat.com'
    - domainName: 'my.registry.example.com'
```

- To import images from an external authenticated registry, create a secret within the desired project.
- Even if not recommended, if the external authenticated registry is insecure or the certificates can not be trusted, the **oc import-image** command can be used with the **--insecure=true** option.
If the external authenticated registry is secure, the registry certificate should be trusted in the master hosts as they run the registry import controller as:

Copy the certificate in the **/etc/pki/ca-trust/source/anchors/**:

```
$ sudo cp <my.registry.example.com.crt> /etc/pki/ca-trust/source/anchors/<my.registry.example.com.crt>
```

- Run **update-ca-trust** command:

```
$ sudo update-ca-trust
```

- Restart the master services on all the master hosts:

```
$ sudo master-restart api
$ sudo master-restart controllers
```

- The certificate for the external registry should be trusted in the OpenShift Container Platform registry:

```
$ for i in pem openssl java; do
  oc create configmap ca-trust-extracted-${i} --from-file /etc/pki/ca-trust/extracted/${i}
  oc set volume dc/docker-registry --add -m /etc/pki/ca-trust/extracted/${i} --configmap-name=ca-trust-extracted-${i} --name ca-trust-extracted-${i}
done
```



WARNING

There is no official procedure currently for adding the certificate to the registry pod, but the above workaround can be used.

This workaround creates **configmaps** with all the trusted certificates from the system running those commands, so the recommendation is to run it from a clean system where just the required certificates are trusted.

- Alternatively, modify the registry image in order to trust the proper certificates rebuilding the image using a **Dockerfile** as:

```
FROM registry.redhat.io/openshift3/ose-docker-registry:v3.6
ADD <my.registry.example.com.crt> /etc/pki/ca-trust/source/anchors/
USER 0
RUN update-ca-trust extract
USER 1001
```

8. Rebuild the image, push it to a **docker** registry, and use that image as **spec.template.spec.containers["name":"registry"].image** in the registry **deploymentconfig**:

```
$ oc patch dc docker-registry -p '{"spec":{"template":{"spec":{"containers":
[{"name":"registry","image":"*myregistry.example.com/openshift3/ose-docker-
registry:latest*"}]}}}'
```

NOTE

To add the **imagePolicyConfig** configuration at installation, the **openshift_master_image_policy_config** variable can be used with a **json** formatted string including all the **imagePolicyConfig** configuration, like:

```
openshift_master_image_policy_config={"imagePolicyConfig":
{"allowedRegistriesForImport":[{"domainName":"docker.io"},
{"domainName":"*.docker.io"}, {"domainName":"*.redhat.com"},
{"domainName":"*my.registry.example.com*"}]}}
```

For more information about the **ImagePolicy**, see the [ImagePolicy admission plug-in](#) section.

7.3.8. OpenShift Container Platform registry integration

You can install OpenShift Container Platform as a stand-alone container image registry to provide only the registry capabilities, but with the advantages of running in an OpenShift Container Platform platform.

For more information about the OpenShift Container Platform registry, see [Installing a Stand-alone Deployment of OpenShift Container Registry](#).

To integrate the OpenShift Container Platform registry, all previous sections apply. From the OpenShift Container Platform point of view, it is treated as an external registry, but there are some extra tasks that need to be performed, because it is a multi-tenant registry and the authorization model from OpenShift Container Platform applies so when a new project is created, the registry does not create a project within its environment as it is independent.

7.3.8.1. Connect the registry project with the cluster

As the registry is a full OpenShift Container Platform environment with a registry pod and a web interface, the process to create a new project in the registry is performed using the **oc new-project** or **oc create** command line or via the web interface.

Once the project has been created, the usual service accounts (**builder**, **default**, and **deployer**) are created automatically, as well as the project administrator user is granted permissions. Different users can be authorized to push/pull images as well as "anonymous" users.

There can be several use cases, such as allowing all the users to pull images from this new project within the registry, but if you want to have a 1:1 project relationship between OpenShift Container Platform and the registry, where the users can push and pull images from that specific project, some steps are required.



WARNING

The registry web console shows a token to be used for pull/push operations, but the token showed there is a session token, so it expires. Creating a service account with specific permissions allows the administrator to limit the permissions for the service account, so that, for example, different service accounts can be used for push or pull images. Then, a user does not have to configure for token expiration, secret recreation, and other tasks, as the service account tokens will not expire.

Procedure

1. Create a new project:

```
$ oc new-project <my_project>
```

2. Create a registry project:

```
$ oc new-project <registry_project>
```

3. Create a service account in the registry project:

```
$ oc create serviceaccount <my_serviceaccount> -n <registry_project>
```

4. Give permissions to push and pull images using the **registry-editor** role:

```
$ oc adm policy add-role-to-user registry-editor -z <my_serviceaccount> -n <registry_project>
```

If only pull permissions are required, the **registry-viewer** role can be used.

5. Get the service account token:

```
$ TOKEN=$(oc sa get-token <my_serviceaccount> -n <registry_project>)
```

6. Use the token as the password to create a **dockercfg** secret:

```
$ oc create secret docker-registry <my_registry> \
  --docker-server=<myregistry.example.com> --docker-username=<notused> --docker-
  password=${TOKEN} --docker-email=<me@example.com>
```

7. Use the **dockercfg** secret to pull images from the registry by linking the secret to the service account performing the pull operations. The default service account to pull images is named **default**:

```
$ oc secrets link default <my_registry> --for=pull
```

8. For pushing images using the S2I feature, the **dockercfg** secret is mounted in the S2I pod, so it needs to be linked to the proper service account that performs the build. The default service account used to build images is named **builder**:

```
$ oc secrets link builder <my_registry>
```

9. In the **buildconfig**, the secret should be specified for push or pull operations:

```
"type": "Source",
"sourceStrategy": {
  "from": {
    "kind": "DockerImage",
    "name": "<myregistry.example.com/registry_project/my_image:stable>"
  },
  "pullSecret": {
    "name": "<my_registry>"
  },
  ...[OUTPUT ABBREVIATED]...
"output": {
  "to": {
    "kind": "DockerImage",
    "name": "<myregistry.example.com/registry_project/my_image:latest>"
  },
  "pushSecret": {
    "name": "<my_registry>"
  },
  ...[OUTPUT ABBREVIATED]...
```

CHAPTER 8. MANAGING CERTIFICATES

Over the lifetime of a OpenShift Container Platform cluster, certificates will enter various phases of their lifecycle. The following procedures describe how to manage various parts of that lifecycle.

8.1. CHANGING AN APPLICATION'S SELF-SIGNED CERTIFICATE TO CA-SIGNED CERTIFICATE

Some application templates create a self-signed certificate that is then directly presented by the application to clients. As an example, by default and as part of the OpenShift Container Platform Ansible installer deployment process, the metrics deployer creates self-signed certificates.

These self-signed certificates are not recognized by browsers. To mitigate this issue, use a publicly signed certificate, then configure it to re-encrypt traffic with the self-signed certificate.

1. Delete the existing route:

```
$ oc delete route hawkular-metrics -n openshift-infra
```

With the route deleted, the certificates that will be used in the new route with the re-encrypt strategy must be assembled from the existing wildcard and self-signed certificates created by the metrics deployer. The following certificates must be available:

- Wildcard CA certificate
- Wildcard private key
- Wildcard certificate
- Hawkular CA certificate

Each certificate must be available as a file on the file system for the new route.

You can retrieve the Hawkular CA and store it in a file by executing the following command:

```
$ oc get secrets hawkular-metrics-certificate -n openshift-infra \
  -o jsonpath='{.data.hawkular-metrics-ca\.certificate}' | base64 -d > hawkular-internal-
  ca.crt
```

2. Locate the wildcard private key, certificate, and CA certificate. Place each into a separate file, such as *wildcard.key*, *wildcard.crt*, and *wildcard.ca*.
3. Create the new re-encrypt route:

```
$ oc create route reencrypt hawkular-metrics-reencrypt \
  -n openshift-infra \
  --hostname hawkular-metrics.ocp.example.com \
  --key wildcard.key \
  --cert wildcard.crt \
  --ca-cert wildcard.ca \
  --service hawkular-metrics \
  --dest-ca-cert hawkular-internal-ca.crt
```