



OpenShift Container Platform 4.12

Registry

Configuring registries for OpenShift Container Platform

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Abstract

This document provides instructions for configuring and managing the internal registry for OpenShift Container Platform. It also provides a general overview of registries associated with OpenShift Container Platform.

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CHAPTER 1. OPENSIFT IMAGE REGISTRY OVERVIEW

OpenShift Container Platform can build images from your source code, deploy them, and manage their lifecycle. It provides an internal, integrated container image registry that can be deployed in your OpenShift Container Platform environment to locally manage images. This overview contains reference information and links for registries commonly used with OpenShift Container Platform, with a focus on the OpenShift image registry.

1.1. GLOSSARY OF COMMON TERMS FOR OPENSIFT IMAGE REGISTRY

This glossary defines the common terms that are used in the registry content.

container

Lightweight and executable images that consist software and all its dependencies. Because containers virtualize the operating system, you can run containers in data center, a public or private cloud, or your local host.

Image Registry Operator

The Image Registry Operator runs in the **openshift-image-registry** namespace, and manages the registry instance in that location.

image repository

An image repository is a collection of related container images and tags identifying images.

mirror registry

The mirror registry is a registry that holds the mirror of OpenShift Container Platform images.

namespace

A namespace isolates groups of resources within a single cluster.

pod

The pod is the smallest logical unit in Kubernetes. A pod is comprised of one or more containers to run in a worker node.

private registry

A registry is a server that implements the container image registry API. A private registry is a registry that requires authentication to allow users access its contents.

public registry

A registry is a server that implements the container image registry API. A public registry is a registry that serves its content publicly.

Quay.io

A public Red Hat Quay Container Registry instance provided and maintained by Red Hat, that serves most of the container images and Operators to OpenShift Container Platform clusters.

OpenShift image registry

OpenShift image registry is the registry provided by OpenShift Container Platform to manage images.

registry authentication

To push and pull images to and from private image repositories, the registry needs to authenticate its users with credentials.

route

Exposes a service to allow for network access to pods from users and applications outside the OpenShift Container Platform instance.

scale down

To decrease the number of replicas.

scale up

To increase the number of replicas.

service

A service exposes a running application on a set of pods.

1.2. INTEGRATED OPENSIFT IMAGE REGISTRY

OpenShift Container Platform provides a built-in container image registry that runs as a standard workload on the cluster. The registry is configured and managed by an infrastructure Operator. It provides an out-of-the-box solution for users to manage the images that run their workloads, and runs on top of the existing cluster infrastructure. This registry can be scaled up or down like any other cluster workload and does not require specific infrastructure provisioning. In addition, it is integrated into the cluster user authentication and authorization system, which means that access to create and retrieve images is controlled by defining user permissions on the image resources.

The registry is typically used as a publication target for images built on the cluster, as well as being a source of images for workloads running on the cluster. When a new image is pushed to the registry, the cluster is notified of the new image and other components can react to and consume the updated image.

Image data is stored in two locations. The actual image data is stored in a configurable storage location, such as cloud storage or a filesystem volume. The image metadata, which is exposed by the standard cluster APIs and is used to perform access control, is stored as standard API resources, specifically images and imagestreams.

Additional resources

- [Image Registry Operator in OpenShift Container Platform](#)

1.3. THIRD-PARTY REGISTRIES

OpenShift Container Platform can create containers using images from third-party registries, but it is unlikely that these registries offer the same image notification support as the integrated OpenShift image registry. In this situation, OpenShift Container Platform will fetch tags from the remote registry upon imagestream creation. To refresh the fetched tags, run **oc import-image <stream>**. When new images are detected, the previously described build and deployment reactions occur.

1.3.1. Authentication

OpenShift Container Platform can communicate with registries to access private image repositories using credentials supplied by the user. This allows OpenShift Container Platform to push and pull images to and from private repositories.

1.3.1.1. Registry authentication with Podman

Some container image registries require access authorization. Podman is an open source tool for managing containers and container images and interacting with image registries. You can use Podman to authenticate your credentials, pull the registry image, and store local images in a local file system. The following is a generic example of authenticating the registry with Podman.

Procedure

1. Use the [Red Hat Ecosystem Catalog](#) to search for specific container images from the Red Hat Repository and select the required image.
2. Click **Get this image** to find the command for your container image.
3. Log in by running the following command and entering your username and password to authenticate:

```
$ podman login registry.redhat.io
Username:<your_registry_account_username>
Password:<your_registry_account_password>
```

4. Download the image and save it locally by running the following command:

```
$ podman pull registry.redhat.io/<repository_name>
```

1.4. RED HAT QUAY REGISTRIES

If you need an enterprise-quality container image registry, Red Hat Quay is available both as a hosted service and as software you can install in your own data center or cloud environment. Advanced features in Red Hat Quay include geo-replication, image scanning, and the ability to roll back images.

Visit the [Quay.io](#) site to set up your own hosted Quay registry account. After that, follow the Quay Tutorial to log in to the Quay registry and start managing your images.

You can access your Red Hat Quay registry from OpenShift Container Platform like any remote container image registry.

Additional resources

- [Red Hat Quay product documentation](#)

1.5. AUTHENTICATION ENABLED RED HAT REGISTRY

All container images available through the Container images section of the Red Hat Ecosystem Catalog are hosted on an image registry, **registry.redhat.io**.

The registry, **registry.redhat.io**, requires authentication for access to images and hosted content on OpenShift Container Platform. Following the move to the new registry, the existing registry will be available for a period of time.



NOTE

OpenShift Container Platform pulls images from **registry.redhat.io**, so you must configure your cluster to use it.

The new registry uses standard OAuth mechanisms for authentication, with the following methods:

- **Authentication token.** Tokens, which are generated by administrators, are service accounts that give systems the ability to authenticate against the container image registry. Service accounts are not affected by changes in user accounts, so the token authentication method is reliable and resilient. This is the only supported authentication option for production clusters.

- **Web username and password.** This is the standard set of credentials you use to log in to resources such as **access.redhat.com**. While it is possible to use this authentication method with OpenShift Container Platform, it is not supported for production deployments. Restrict this authentication method to stand-alone projects outside OpenShift Container Platform.

You can use **podman login** with your credentials, either username and password or authentication token, to access content on the new registry.

All imagestreams point to the new registry, which uses the installation pull secret to authenticate.

You must place your credentials in either of the following places:

- **openshift namespace.** Your credentials must exist in the **openshift** namespace so that the imagestreams in the **openshift** namespace can import.
- **Your host.** Your credentials must exist on your host because Kubernetes uses the credentials from your host when it goes to pull images.

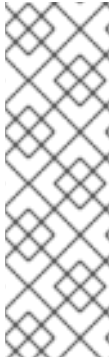
Additional resources

- [Registry service accounts](#)

CHAPTER 2. IMAGE REGISTRY OPERATOR IN OPENSIFT CONTAINER PLATFORM

2.1. IMAGE REGISTRY ON CLOUD PLATFORMS AND OPENSTACK

The Image Registry Operator installs a single instance of the OpenShift image registry, and manages all registry configuration, including setting up registry storage.



NOTE

Storage is only automatically configured when you install an installer-provisioned infrastructure cluster on AWS, Azure, GCP, IBM, or OpenStack.

When you install or upgrade an installer-provisioned infrastructure cluster on AWS, Azure, GCP, IBM, or OpenStack, the Image Registry Operator sets the **spec.storage.managementState** parameter to **Managed**. If the **spec.storage.managementState** parameter is set to **Unmanaged**, the Image Registry Operator takes no action related to storage.

After the control plane deploys, the Operator creates a default **configs.imageregistry.operator.openshift.io** resource instance based on configuration detected in the cluster.

If insufficient information is available to define a complete **configs.imageregistry.operator.openshift.io** resource, the incomplete resource is defined and the Operator updates the resource status with information about what is missing.

The Image Registry Operator runs in the **openshift-image-registry** namespace, and manages the registry instance in that location as well. All configuration and workload resources for the registry reside in that namespace.



IMPORTANT

The Image Registry Operator's behavior for managing the pruner is orthogonal to the **managementState** specified on the **ClusterOperator** object for the Image Registry Operator. If the Image Registry Operator is not in the **Managed** state, the image pruner can still be configured and managed by the **Pruning** custom resource.

However, the **managementState** of the Image Registry Operator alters the behavior of the deployed image pruner job:

- **Managed:** the **--prune-registry** flag for the image pruner is set to **true**.
- **Removed:** the **--prune-registry** flag for the image pruner is set to **false**, meaning it only prunes image metadata in etcd.

2.2. IMAGE REGISTRY ON BARE METAL, NUTANIX, AND VSPHERE

2.2.1. Image registry removed during installation

On platforms that do not provide shareable object storage, the OpenShift Image Registry Operator bootstraps itself as **Removed**. This allows **openshift-installer** to complete installations on these platform types.

After installation, you must edit the Image Registry Operator configuration to switch the **managementState** from **Removed** to **Managed**.

2.3. IMAGE REGISTRY OPERATOR DISTRIBUTION ACROSS AVAILABILITY ZONES

The default configuration of the Image Registry Operator spreads image registry pods across topology zones to prevent delayed recovery times in case of a complete zone failure where all pods are impacted.

The Image Registry Operator defaults to the following when deployed with a zone-related topology constraint:

Image Registry Operator deployed with a zone related topology constraint

```
topologySpreadConstraints:
- labelSelector:
  matchLabels:
    docker-registry: default
  maxSkew: 1
  topologyKey: kubernetes.io/hostname
  whenUnsatisfiable: DoNotSchedule
- labelSelector:
  matchLabels:
    docker-registry: default
  maxSkew: 1
  topologyKey: node-role.kubernetes.io/worker
  whenUnsatisfiable: DoNotSchedule
- labelSelector:
  matchLabels:
    docker-registry: default
  maxSkew: 1
  topologyKey: topology.kubernetes.io/zone
  whenUnsatisfiable: DoNotSchedule
```

The Image Registry Operator defaults to the following when deployed without a zone-related topology constraint, which applies to bare metal and vSphere instances:

Image Registry Operator deployed without a zone related topology constraint

```
topologySpreadConstraints:
- labelSelector:
  matchLabels:
    docker-registry: default
  maxSkew: 1
  topologyKey: kubernetes.io/hostname
  whenUnsatisfiable: DoNotSchedule
- labelSelector:
  matchLabels:
    docker-registry: default
  maxSkew: 1
  topologyKey: node-role.kubernetes.io/worker
  whenUnsatisfiable: DoNotSchedule
```

A cluster administrator can override the default **topologySpreadConstraints** by configuring the **configs.imageregistry.operator.openshift.io/cluster** spec file. In that case, only the constraints you provide apply.

2.4. ADDITIONAL RESOURCES

- [Configuring pod topology spread constraints](#)

2.5. IMAGE REGISTRY OPERATOR CONFIGURATION PARAMETERS

The **configs.imageregistry.operator.openshift.io** resource offers the following configuration parameters.

Parameter	Description
managementState	<p>Managed: The Operator updates the registry as configuration resources are updated.</p> <p>Unmanaged: The Operator ignores changes to the configuration resources.</p> <p>Removed: The Operator removes the registry instance and tear down any storage that the Operator provisioned.</p>
logLevel	<p>Sets logLevel of the registry instance. Defaults to Normal.</p> <p>The following values for logLevel are supported:</p> <ul style="list-style-type: none"> • Normal • Debug • Trace • TraceAll
httpSecret	Value needed by the registry to secure uploads, generated by default.
operatorLogLevel	<p>The operatorLogLevel configuration parameter provides intent-based logging for the Operator itself and a simple way to manage coarse-grained logging choices that Operators must interpret for themselves. This configuration parameter defaults to Normal. It does not provide fine-grained control.</p> <p>The following values for operatorLogLevel are supported:</p> <ul style="list-style-type: none"> • Normal • Debug • Trace • TraceAll

Parameter	Description
proxy	Defines the Proxy to be used when calling master API and upstream registries.
storage	Storagetype : Details for configuring registry storage, for example S3 bucket coordinates. Normally configured by default.
readOnly	Indicates whether the registry instance should reject attempts to push new images or delete existing ones.
requests	API Request Limit details. Controls how many parallel requests a given registry instance will handle before queuing additional requests.
defaultRoute	Determines whether or not an external route is defined using the default hostname. If enabled, the route uses re-encrypt encryption. Defaults to false .
routes	Array of additional routes to create. You provide the hostname and certificate for the route.
rolloutStrategy	Defines rollout strategy for the image registry deployment. Defaults to RollingUpdate .
replicas	Replica count for the registry.
disableRedirect	Controls whether to route all data through the registry, rather than redirecting to the back end. Defaults to false .
spec.storage.managementState	<p>The Image Registry Operator sets the spec.storage.managementState parameter to Managed on new installations or upgrades of clusters using installer-provisioned infrastructure on AWS or Azure.</p> <ul style="list-style-type: none"> ● Managed: Determines that the Image Registry Operator manages underlying storage. If the Image Registry Operator's managementState is set to Removed, then the storage is deleted. <ul style="list-style-type: none"> ○ If the managementState is set to Managed, the Image Registry Operator attempts to apply some default configuration on the underlying storage unit. For example, if set to Managed, the Operator tries to enable encryption on the S3 bucket before making it available to the registry. If you do not want the default settings to be applied on the storage you are providing, make sure the managementState is set to Unmanaged. ● Unmanaged: Determines that the Image Registry Operator ignores the storage settings. If the Image Registry Operator's managementState is set to Removed, then the storage is not deleted. If you provided an underlying storage unit configuration, such as a bucket or container name, and the spec.storage.managementState is not yet set to any value, then the Image Registry Operator configures it to Unmanaged.

2.6. ENABLE THE IMAGE REGISTRY DEFAULT ROUTE WITH THE CUSTOM RESOURCE DEFINITION

In OpenShift Container Platform, the **Registry** Operator controls the OpenShift image registry feature. The Operator is defined by the **configs.imageregistry.operator.openshift.io** Custom Resource Definition (CRD).

If you need to automatically enable the Image Registry default route, patch the Image Registry Operator CRD.

Procedure

- Patch the Image Registry Operator CRD:

```
$ oc patch configs.imageregistry.operator.openshift.io/cluster --type merge -p '{"spec": {"defaultRoute":true}}'
```

2.7. CONFIGURING ADDITIONAL TRUST STORES FOR IMAGE REGISTRY ACCESS

The **image.config.openshift.io/cluster** custom resource can contain a reference to a config map that contains additional certificate authorities to be trusted during image registry access.

Prerequisites

- The certificate authorities (CA) must be PEM-encoded.

Procedure

You can create a config map in the **openshift-config** namespace and use its name in **AdditionalTrustedCA** in the **image.config.openshift.io** custom resource to provide additional CAs that should be trusted when contacting external registries.

The config map key is the hostname of a registry with the port for which this CA is to be trusted, and the PEM certificate content is the value, for each additional registry CA to trust.

Image registry CA config map example

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: my-registry-ca
data:
  registry.example.com: |
    -----BEGIN CERTIFICATE-----
    ...
    -----END CERTIFICATE-----
  registry-with-port.example.com:5000: | 1
    -----BEGIN CERTIFICATE-----
    ...
    -----END CERTIFICATE-----
```

- 1** If the registry has the port, such as **registry-with-port.example.com:5000**, **:** should be replaced with **...**

You can configure additional CAs with the following procedure.

1. To configure an additional CA:

```
$ oc create configmap registry-config --from-file=<external_registry_address>=ca.crt -n openshift-config
```

```
$ oc edit image.config.openshift.io cluster
```

```
spec:  
  additionalTrustedCA:  
    name: registry-config
```

2.8. CONFIGURING STORAGE CREDENTIALS FOR THE IMAGE REGISTRY OPERATOR

In addition to the **configs.imageregistry.operator.openshift.io** and ConfigMap resources, storage credential configuration is provided to the Operator by a separate secret resource located within the **openshift-image-registry** namespace.

The **image-registry-private-configuration-user** secret provides credentials needed for storage access and management. It overrides the default credentials used by the Operator, if default credentials were found.

Procedure

- Create an OpenShift Container Platform secret that contains the required keys.

```
$ oc create secret generic image-registry-private-configuration-user --from-literal=KEY1=value1 --from-literal=KEY2=value2 --namespace openshift-image-registry
```

2.9. ADDITIONAL RESOURCES

- [Configuring the registry for AWS user-provisioned infrastructure](#)
- [Configuring the registry for GCP user-provisioned infrastructure](#)
- [Configuring the registry for Azure user-provisioned infrastructure](#)
- [Configuring the registry for bare metal](#)
- [Configuring the registry for vSphere](#)

CHAPTER 3. SETTING UP AND CONFIGURING THE REGISTRY

3.1. CONFIGURING THE REGISTRY FOR AWS USER-PROVISIONED INFRASTRUCTURE

3.1.1. Configuring a secret for the Image Registry Operator

In addition to the `configs.imageregistry.operator.openshift.io` and ConfigMap resources, configuration is provided to the Operator by a separate secret resource located within the `openshift-image-registry` namespace.

The `image-registry-private-configuration-user` secret provides credentials needed for storage access and management. It overrides the default credentials used by the Operator, if default credentials were found.

For S3 on AWS storage, the secret is expected to contain two keys:

- `REGISTRY_STORAGE_S3_ACCESSKEY`
- `REGISTRY_STORAGE_S3_SECRETKEY`

Procedure

- Create an OpenShift Container Platform secret that contains the required keys.

```
$ oc create secret generic image-registry-private-configuration-user --from-literal=REGISTRY_STORAGE_S3_ACCESSKEY=myaccesskey --from-literal=REGISTRY_STORAGE_S3_SECRETKEY=mysecretkey --namespace openshift-image-registry
```

3.1.2. Configuring registry storage for AWS with user-provisioned infrastructure

During installation, your cloud credentials are sufficient to create an Amazon S3 bucket and the Registry Operator will automatically configure storage.

If the Registry Operator cannot create an S3 bucket and automatically configure storage, you can create an S3 bucket and configure storage with the following procedure.

Prerequisites

- You have a cluster on AWS with user-provisioned infrastructure.
- For Amazon S3 storage, the secret is expected to contain two keys:
 - `REGISTRY_STORAGE_S3_ACCESSKEY`
 - `REGISTRY_STORAGE_S3_SECRETKEY`

Procedure

Use the following procedure if the Registry Operator cannot create an S3 bucket and automatically configure storage.

1. Set up a [Bucket Lifecycle Policy](#) to abort incomplete multipart uploads that are one day old.

- Fill in the storage configuration in **configs.imageregistry.operator.openshift.io/cluster**:

```
$ oc edit configs.imageregistry.operator.openshift.io/cluster
```

Example configuration

```
storage:
  s3:
    bucket: <bucket-name>
    region: <region-name>
```



WARNING

To secure your registry images in AWS, [block public access](#) to the S3 bucket.

3.1.3. Image Registry Operator configuration parameters for AWS S3

The following configuration parameters are available for AWS S3 registry storage.

The image registry **spec.storage.s3** configuration parameter holds the information to configure the registry to use the AWS S3 service for back-end storage. See the [S3 storage driver documentation](#) for more information.

Parameter	Description
bucket	Bucket is the bucket name in which you want to store the registry's data. It is optional and is generated if not provided.
region	Region is the AWS region in which your bucket exists. It is optional and is set based on the installed AWS Region.
regionEndpoint	RegionEndpoint is the endpoint for S3 compatible storage services. It is optional and defaults based on the Region that is provided.
virtualHostedStyle	VirtualHostedStyle enables using S3 virtual hosted style bucket paths with a custom RegionEndpoint. It is optional and defaults to false. Set this parameter to deploy OpenShift Container Platform to hidden regions.
encrypt	Encrypt specifies whether or not the registry stores the image in encrypted format. It is optional and defaults to false.
keyID	KeyID is the KMS key ID to use for encryption. It is optional. Encrypt must be true, or this parameter is ignored.

Parameter	Description
cloudFront	CloudFront configures Amazon Cloudfront as the storage middleware in a registry. It is optional.
trustedCA	The namespace for the config map referenced by trustedCA is openshift-config . The key for the bundle in the config map is ca-bundle.crt . It is optional.

**NOTE**

When the value of the **regionEndpoint** parameter is configured to a URL of a Rados Gateway, an explicit port must not be specified. For example:

```
regionEndpoint: http://rook-ceph-rgw-ocs-storagecluster-cephobjectstore.openshift-storage.svc.cluster.local
```

3.2. CONFIGURING THE REGISTRY FOR GCP USER-PROVISIONED INFRASTRUCTURE

3.2.1. Configuring a secret for the Image Registry Operator

In addition to the **configs.imageregistry.operator.openshift.io** and ConfigMap resources, configuration is provided to the Operator by a separate secret resource located within the **openshift-image-registry** namespace.

The **image-registry-private-configuration-user** secret provides credentials needed for storage access and management. It overrides the default credentials used by the Operator, if default credentials were found.

For GCS on GCP storage, the secret is expected to contain one key whose value is the contents of a credentials file provided by GCP:

- **REGISTRY_STORAGE_GCS_KEYFILE**

Procedure

- Create an OpenShift Container Platform secret that contains the required keys.

```
$ oc create secret generic image-registry-private-configuration-user --from-file=REGISTRY_STORAGE_GCS_KEYFILE=<path_to_keyfile> --namespace openshift-image-registry
```

3.2.2. Configuring the registry storage for GCP with user-provisioned infrastructure

If the Registry Operator cannot create a Google Cloud Platform (GCP) bucket, you must set up the storage medium manually and configure the settings in the registry custom resource (CR).

Prerequisites

- A cluster on GCP with user-provisioned infrastructure.
- To configure registry storage for GCP, you need to provide Registry Operator cloud credentials.
- For GCS on GCP storage, the secret is expected to contain one key whose value is the contents of a credentials file provided by GCP:
 - **REGISTRY_STORAGE_GCS_KEYFILE**

Procedure

1. Set up an [Object Lifecycle Management policy](#) to abort incomplete multipart uploads that are one day old.
2. Fill in the storage configuration in **configs.imageregistry.operator.openshift.io/cluster**:

```
$ oc edit configs.imageregistry.operator.openshift.io/cluster
```

Example configuration

```
# ...
storage:
  gcs:
    bucket: <bucket-name>
    projectID: <project-id>
    region: <region-name>
# ...
```



WARNING

You can secure your registry images that use a Google Cloud Storage bucket by setting [public access prevention](#).

3.2.3. Image Registry Operator configuration parameters for GCP GCS

The following configuration parameters are available for GCP GCS registry storage.

Parameter	Description
bucket	Bucket is the bucket name in which you want to store the registry's data. It is optional and is generated if not provided.
region	Region is the GCS location in which your bucket exists. It is optional and is set based on the installed GCS Region.
projectID	ProjectID is the Project ID of the GCP project that this bucket should be associated with. It is optional.

Parameter	Description
keyID	KeyID is the KMS key ID to use for encryption. It is optional because buckets are encrypted by default on GCP. This allows for the use of a custom encryption key.

3.3. CONFIGURING THE REGISTRY FOR OPENSTACK USER-PROVISIONED INFRASTRUCTURE

You can configure the registry of a cluster that runs on your own Red Hat OpenStack Platform (RHOSP) infrastructure.

3.3.1. Configuring the Image Registry Operator to trust Swift storage

You must configure the Image Registry Operator to trust Red Hat OpenStack Platform (RHOSP) Swift storage.

Procedure

- From a command line, enter the following command to change the value of the **spec.disableRedirect** field in the **config.imageregistry** object to **true**:

```
$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec": {"disableRedirect":true}}'
```

3.3.2. Configuring a secret for the Image Registry Operator

In addition to the **configs.imageregistry.operator.openshift.io** and ConfigMap resources, configuration is provided to the Operator by a separate secret resource located within the **openshift-image-registry** namespace.

The **image-registry-private-configuration-user** secret provides credentials needed for storage access and management. It overrides the default credentials used by the Operator, if default credentials were found.

For Swift on Red Hat OpenStack Platform (RHOSP) storage, the secret is expected to contain the following two keys:

- REGISTRY_STORAGE_SWIFT_USERNAME**
- REGISTRY_STORAGE_SWIFT_PASSWORD**

Procedure

- Create an OpenShift Container Platform secret that contains the required keys.

```
$ oc create secret generic image-registry-private-configuration-user --from-literal=REGISTRY_STORAGE_SWIFT_USERNAME=<username> --from-literal=REGISTRY_STORAGE_SWIFT_PASSWORD=<password> -n openshift-image-registry
```

3.3.3. Registry storage for RHOSP with user-provisioned infrastructure

If the Registry Operator cannot create a Swift bucket, you must set up the storage medium manually and configure the settings in the registry custom resource (CR).

Prerequisites

- A cluster on Red Hat OpenStack Platform (RHOSP) with user-provisioned infrastructure.
- To configure registry storage for RHOSP, you need to provide Registry Operator cloud credentials.
- For Swift on RHOSP storage, the secret is expected to contain the following two keys:
 - **REGISTRY_STORAGE_SWIFT_USERNAME**
 - **REGISTRY_STORAGE_SWIFT_PASSWORD**

Procedure

- Fill in the storage configuration in **configs.imageregistry.operator.openshift.io/cluster**:

```
$ oc edit configs.imageregistry.operator.openshift.io/cluster
```

Example configuration

```
# ...
storage:
  swift:
    container: <container-id>
# ...
```

3.3.4. Image Registry Operator configuration parameters for RHOSP Swift

The following configuration parameters are available for Red Hat OpenStack Platform (RHOSP) Swift registry storage.

Parameter	Description
authURL	Defines the URL for obtaining the authentication token. This value is optional.
authVersion	Specifies the Auth version of RHOSP, for example, authVersion: "3" . This value is optional.
container	Defines the name of a Swift container for storing registry data. This value is optional.
domain	Specifies the RHOSP domain name for the Identity v3 API. This value is optional.
domainID	Specifies the RHOSP domain ID for the Identity v3 API. This value is optional.

Parameter	Description
tenant	Defines the RHOSP tenant name to be used by the registry. This value is optional.
tenantID	Defines the RHOSP tenant ID to be used by the registry. This value is optional.
regionName	Defines the RHOSP region in which the container exists. This value is optional.

3.4. CONFIGURING THE REGISTRY FOR AZURE USER-PROVISIONED INFRASTRUCTURE

3.4.1. Configuring a secret for the Image Registry Operator

In addition to the **configs.imageregistry.operator.openshift.io** and ConfigMap resources, configuration is provided to the Operator by a separate secret resource located within the **openshift-image-registry** namespace.

The **image-registry-private-configuration-user** secret provides credentials needed for storage access and management. It overrides the default credentials used by the Operator, if default credentials were found.

For Azure registry storage, the secret is expected to contain one key whose value is the contents of a credentials file provided by Azure:

- **REGISTRY_STORAGE_AZURE_ACCOUNTKEY**

Procedure

- Create an OpenShift Container Platform secret that contains the required key.

```
$ oc create secret generic image-registry-private-configuration-user --from-literal=REGISTRY_STORAGE_AZURE_ACCOUNTKEY=<accountkey> --namespace openshift-image-registry
```

3.4.2. Configuring registry storage for Azure

During installation, your cloud credentials are sufficient to create Azure Blob Storage, and the Registry Operator automatically configures storage.

Prerequisites

- A cluster on Azure with user-provisioned infrastructure.
- To configure registry storage for Azure, provide Registry Operator cloud credentials.
- For Azure storage the secret is expected to contain one key:
 - **REGISTRY_STORAGE_AZURE_ACCOUNTKEY**

Procedure

1. Create an [Azure storage container](#).
2. Fill in the storage configuration in **configs.imageregistry.operator.openshift.io/cluster**:

```
$ oc edit configs.imageregistry.operator.openshift.io/cluster
```

Example configuration

```
storage:
  azure:
    accountName: <storage-account-name>
    container: <container-name>
```

3.4.3. Configuring registry storage for Azure Government

During installation, your cloud credentials are sufficient to create Azure Blob Storage, and the Registry Operator automatically configures storage.

Prerequisites

- A cluster on Azure with user-provisioned infrastructure in a government region.
- To configure registry storage for Azure, provide Registry Operator cloud credentials.
- For Azure storage, the secret is expected to contain one key:
 - **REGISTRY_STORAGE_AZURE_ACCOUNTKEY**

Procedure

1. Create an [Azure storage container](#).
2. Fill in the storage configuration in **configs.imageregistry.operator.openshift.io/cluster**:

```
$ oc edit configs.imageregistry.operator.openshift.io/cluster
```

Example configuration

```
storage:
  azure:
    accountName: <storage-account-name>
    container: <container-name>
    cloudName: AzureUSGovernmentCloud 1
```

- 1** **cloudName** is the name of the Azure cloud environment, which can be used to configure the Azure SDK with the appropriate Azure API endpoints. Defaults to **AzurePublicCloud**. You can also set **cloudName** to **AzureUSGovernmentCloud**, **AzureChinaCloud**, or **AzureGermanCloud** with sufficient credentials.

3.5. CONFIGURING THE REGISTRY FOR RHOSP

3.5.1. Configuring an image registry with custom storage on clusters that run on RHOSP

After you install a cluster on Red Hat OpenStack Platform (RHOSP), you can use a Cinder volume that is in a specific availability zone for registry storage.

Procedure

1. Create a YAML file that specifies the storage class and availability zone to use. For example:

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: custom-csi-storageclass
provisioner: cinder.csi.openstack.org
volumeBindingMode: WaitForFirstConsumer
allowVolumeExpansion: true
parameters:
  availability: <availability_zone_name>
```



NOTE

OpenShift Container Platform does not verify the existence of the availability zone you choose. Verify the name of the availability zone before you apply the configuration.

2. From a command line, apply the configuration:

```
$ oc apply -f <storage_class_file_name>
```

Example output

```
storageclass.storage.k8s.io/custom-csi-storageclass created
```

3. Create a YAML file that specifies a persistent volume claim (PVC) that uses your storage class and the **openshift-image-registry** namespace. For example:

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: csi-pvc-imageregistry
  namespace: openshift-image-registry 1
  annotations:
    imageregistry.openshift.io: "true"
spec:
  accessModes:
  - ReadWriteOnce
  volumeMode: Filesystem
  resources:
    requests:
      storage: 100Gi 2
  storageClassName: <your_custom_storage_class> 3
```

- 1 Enter the namespace **openshift-image-registry**. This namespace allows the Cluster Image Registry Operator to consume the PVC.
- 2 Optional: Adjust the volume size.
- 3 Enter the name of the storage class that you created.

4. From a command line, apply the configuration:

```
$ oc apply -f <pvc_file_name>
```

Example output

```
persistentvolumeclaim/csi-pvc-imageregistry created
```

5. Replace the original persistent volume claim in the image registry configuration with the new claim:

```
$ oc patch configs.imageregistry.operator.openshift.io/cluster --type 'json' -p='[{"op": "replace", "path": "/spec/storage/pvc/claim", "value": "csi-pvc-imageregistry"}]'
```

Example output

```
config.imageregistry.operator.openshift.io/cluster patched
```

Over the next several minutes, the configuration is updated.

Verification

To confirm that the registry is using the resources that you defined:

1. Verify that the PVC claim value is identical to the name that you provided in your PVC definition:

```
$ oc get configs.imageregistry.operator.openshift.io/cluster -o yaml
```

Example output

```
...
status:
  ...
  managementState: Managed
  pvc:
    claim: csi-pvc-imageregistry
  ...
```

2. Verify that the status of the PVC is **Bound**:

```
$ oc get pvc -n openshift-image-registry csi-pvc-imageregistry
```

Example output

```
NAME                STATUS  VOLUME                CAPACITY  ACCESS MODES
```

STORAGECLASS	AGE
csi-pvc-imageregistry	Bound pvc-72a8f9c9-f462-11e8-b6b6-fa163e18b7b5 100Gi
RWO	custom-csi-storageclass 11m

3.6. CONFIGURING THE REGISTRY FOR BARE METAL

3.6.1. Image registry removed during installation

On platforms that do not provide shareable object storage, the OpenShift Image Registry Operator bootstraps itself as **Removed**. This allows **openshift-installer** to complete installations on these platform types.

After installation, you must edit the Image Registry Operator configuration to switch the **managementState** from **Removed** to **Managed**.

3.6.2. Changing the image registry's management state

To start the image registry, you must change the Image Registry Operator configuration's **managementState** from **Removed** to **Managed**.

Procedure

- Change **managementState** Image Registry Operator configuration from **Removed** to **Managed**. For example:

```
$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec": {"managementState": "Managed"}}'
```

3.6.3. Image registry storage configuration

The Image Registry Operator is not initially available for platforms that do not provide default storage. After installation, you must configure your registry to use storage so that the Registry Operator is made available.

Instructions are shown for configuring a persistent volume, which is required for production clusters. Where applicable, instructions are shown for configuring an empty directory as the storage location, which is available for only non-production clusters.

Additional instructions are provided for allowing the image registry to use block storage types by using the **Recreate** rollout strategy during upgrades.

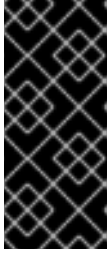
3.6.3.1. Configuring registry storage for bare metal and other manual installations

As a cluster administrator, following installation you must configure your registry to use storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have a cluster that uses manually-provisioned Red Hat Enterprise Linux CoreOS (RHCOS) nodes, such as bare metal.

- You have provisioned persistent storage for your cluster, such as Red Hat OpenShift Data Foundation.



IMPORTANT

OpenShift Container Platform supports **ReadWriteOnce** access for image registry storage when you have only one replica. **ReadWriteOnce** access also requires that the registry uses the **Recreate** rollout strategy. To deploy an image registry that supports high availability with two or more replicas, **ReadWriteMany** access is required.

- Must have 100Gi capacity.

Procedure

- To configure your registry to use storage, change the **spec.storage.pvc** in the **configs.imageregistry/cluster** resource.



NOTE

When you use shared storage, review your security settings to prevent outside access.

- Verify that you do not have a registry pod:

```
$ oc get pod -n openshift-image-registry -l docker-registry=default
```

Example output

```
No resources found in openshift-image-registry namespace
```



NOTE

If you do have a registry pod in your output, you do not need to continue with this procedure.

- Check the registry configuration:

```
$ oc edit configs.imageregistry.operator.openshift.io
```

Example output

```
storage:
  pvc:
    claim:
```

Leave the **claim** field blank to allow the automatic creation of an **image-registry-storage** PVC.

- Check the **clusteroperator** status:

```
$ oc get clusteroperator image-registry
```

Example output

NAME	VERSION	AVAILABLE	PROGRESSING	DEGRADED	SINCE
image-registry	4.12	True	False	False	6h50m

5. Ensure that your registry is set to managed to enable building and pushing of images.

- Run:

```
$ oc edit configs.imageregistry/cluster
```

Then, change the line

```
managementState: Removed
```

to

```
managementState: Managed
```

3.6.3.2. Configuring storage for the image registry in non-production clusters

You must configure storage for the Image Registry Operator. For non-production clusters, you can set the image registry to an empty directory. If you do so, all images are lost if you restart the registry.

Procedure

- To set the image registry storage to an empty directory:

```
$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec": {"storage":{"emptyDir":{}}}'
```



WARNING

Configure this option for only non-production clusters.

If you run this command before the Image Registry Operator initializes its components, the **oc patch** command fails with the following error:

```
Error from server (NotFound): configs.imageregistry.operator.openshift.io "cluster" not found
```

Wait a few minutes and run the command again.

3.6.3.3. Configuring block registry storage for bare metal

To allow the image registry to use block storage types during upgrades as a cluster administrator, you can use the **Recreate** rollout strategy.



IMPORTANT

Block storage volumes, or block persistent volumes, are supported but not recommended for use with the image registry on production clusters. An installation where the registry is configured on block storage is not highly available because the registry cannot have more than one replica.

If you choose to use a block storage volume with the image registry, you must use a filesystem persistent volume claim (PVC).

Procedure

1. Enter the following command to set the image registry storage as a block storage type, patch the registry so that it uses the **Recreate** rollout strategy, and runs with only one (**1**) replica:

```
$ oc patch config.imageregistry.operator.openshift.io/cluster --type=merge -p '{"spec": {"rolloutStrategy": "Recreate", "replicas": 1}}'
```

2. Provision the PV for the block storage device, and create a PVC for that volume. The requested block volume uses the ReadWriteOnce (RWO) access mode.
 - a. Create a **pvc.yaml** file with the following contents to define a VMware vSphere **PersistentVolumeClaim** object:

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: image-registry-storage ①
  namespace: openshift-image-registry ②
spec:
  accessModes:
  - ReadWriteOnce ③
  resources:
    requests:
      storage: 100Gi ④
```

- ① A unique name that represents the **PersistentVolumeClaim** object.
- ② The namespace for the **PersistentVolumeClaim** object, which is **openshift-image-registry**.
- ③ The access mode of the persistent volume claim. With **ReadWriteOnce**, the volume can be mounted with read and write permissions by a single node.
- ④ The size of the persistent volume claim.

- b. Enter the following command to create the **PersistentVolumeClaim** object from the file:

```
$ oc create -f pvc.yaml -n openshift-image-registry
```

3. Enter the following command to edit the registry configuration so that it references the correct PVC:

```
$ oc edit config.imageregistry.operator.openshift.io -o yaml
```

Example output

```
storage:
  pvc:
    claim: 1
```

- 1 By creating a custom PVC, you can leave the **claim** field blank for the default automatic creation of an **image-registry-storage** PVC.

3.6.3.4. Configuring the Image Registry Operator to use Ceph RGW storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Ceph RGW storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Ceph RGW object storage.

Procedure

1. Create the object bucket claim using the **ocs-storagecluster-ceph-rgw** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: rgwbucket
  namespace: openshift-storage 1
spec:
  storageClassName: ocs-storagecluster-ceph-rgw
  generateBucketName: rgwbucket
EOF
```

- 1 Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:


```
$ bucket_name=$(oc get obc -n openshift-storage rgwbucket -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_ACCESS_KEY_ID}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_SECRET_ACCESS_KEY}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-
literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-
literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --
namespace openshift-image-registry
```

5. Get the **route** host by entering the following command:

```
$ route_host=$(oc get route ocs-storagecluster-cephobjectstore -n openshift-storage --
template='{{ .spec.host }}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/router-certs-default -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n
openshift-config
```

7. Configure the image registry to use the Ceph RGW object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","s3":{"bucket":"${bucket_name}","region":"us-east-
1","regionEndpoint":"https://${route_host}","virtualHostedStyle":false,"encrypt":false,"trustedC
A":{"name":"image-registry-s3-bundle"}}}}' --type=merge
```

3.6.3.5. Configuring the Image Registry Operator to use Noobaa storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Noobaa storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Noobaa object storage.

Procedure

1. Create the object bucket claim using the **openshift-storage.noobaa.io** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: noobaatest
  namespace: openshift-storage ❶
spec:
  storageClassName: openshift-storage.noobaa.io
  generateBucketName: noobaatest
EOF
```

- ❶ Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage noobaatest -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage noobaatest -o yaml | grep -w
"AWS_ACCESS_KEY_ID:" | head -n1 | awk '{print $2}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage noobaatest -o yaml |
grep -w "AWS_SECRET_ACCESS_KEY:" | head -n1 | awk '{print $2}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-
literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-
literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --
namespace openshift-image-registry
```

5. Get the route host by entering the following command:

```
$ route_host=$(oc get route s3 -n openshift-storage -o=jsonpath='{.spec.host}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/$(oc get ingresscontroller -n openshift-ingress-operator default -o json | jq
'.spec.defaultCertificate.name // "router-certs-default" -r) -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n
openshift-config
```

7. Configure the image registry to use the Nooba object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","s3":{"bucket":"${bucket_name}","region":"us-east-
1","regionEndpoint":"https://${route_host}"},"virtualHostedStyle":false,"encrypt":false,"trustedC
A":{"name":"image-registry-s3-bundle"}}}}' --type=merge
```

3.6.4. Configuring the Image Registry Operator to use CephFS storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use CephFS storage.



NOTE

CephFS uses persistent volume claim (PVC) storage. It is not recommended to use PVCs for image registry storage if there are other options available, such as Ceph RGW or Noobaa.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and CephFS file storage.

Procedure

1. Create a PVC to use the **cephfs** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
```

```

name: registry-storage-pvc
namespace: openshift-image-registry
spec:
  accessModes:
  - ReadWriteMany
  resources:
    requests:
      storage: 100Gi
  storageClassName: ocs-storagecluster-cephfs
EOF

```

2. Configure the image registry to use the CephFS file system storage by entering the following command:

```

$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","pvc":{"claim":"registry-storage-pvc"}}}' --type=merge

```

3.6.5. Additional resources

- [Recommended configurable storage technology](#)
- [Configuring Image Registry to use OpenShift Data Foundation](#)

3.7. CONFIGURING THE REGISTRY FOR VSPHERE

3.7.1. Image registry removed during installation

On platforms that do not provide shareable object storage, the OpenShift Image Registry Operator bootstraps itself as **Removed**. This allows **openshift-installer** to complete installations on these platform types.

After installation, you must edit the Image Registry Operator configuration to switch the **managementState** from **Removed** to **Managed**.

3.7.2. Changing the image registry's management state

To start the image registry, you must change the Image Registry Operator configuration's **managementState** from **Removed** to **Managed**.

Procedure

- Change **managementState** Image Registry Operator configuration from **Removed** to **Managed**. For example:

```

$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec":
{"managementState":"Managed"}}'

```

3.7.3. Image registry storage configuration

The Image Registry Operator is not initially available for platforms that do not provide default storage. After installation, you must configure your registry to use storage so that the Registry Operator is made available.

Instructions are shown for configuring a persistent volume, which is required for production clusters. Where applicable, instructions are shown for configuring an empty directory as the storage location, which is available for only non-production clusters.

Additional instructions are provided for allowing the image registry to use block storage types by using the **Recreate** rollout strategy during upgrades.

3.7.3.1. Configuring registry storage for VMware vSphere

As a cluster administrator, following installation you must configure your registry to use storage.

Prerequisites

- Cluster administrator permissions.
- A cluster on VMware vSphere.
- Persistent storage provisioned for your cluster, such as Red Hat OpenShift Data Foundation.



IMPORTANT

OpenShift Container Platform supports **ReadWriteOnce** access for image registry storage when you have only one replica. **ReadWriteOnce** access also requires that the registry uses the **Recreate** rollout strategy. To deploy an image registry that supports high availability with two or more replicas, **ReadWriteMany** access is required.

- Must have "100Gi" capacity.



IMPORTANT

Testing shows issues with using the NFS server on RHEL as storage backend for core services. This includes the OpenShift Container Registry and Quay, Prometheus for monitoring storage, and Elasticsearch for logging storage. Therefore, using RHEL NFS to back PVs used by core services is not recommended.

Other NFS implementations on the marketplace might not have these issues. Contact the individual NFS implementation vendor for more information on any testing that was possibly completed against these OpenShift Container Platform core components.

Procedure

1. To configure your registry to use storage, change the **spec.storage.pvc** in the **configs.imageregistry/cluster** resource.



NOTE

When you use shared storage, review your security settings to prevent outside access.

2. Verify that you do not have a registry pod:

```
$ oc get pod -n openshift-image-registry -l docker-registry=default
```

Example output

```
No resources found in openshift-image-registry namespace
```



NOTE

If you do have a registry pod in your output, you do not need to continue with this procedure.

3. Check the registry configuration:

```
$ oc edit configs.imageregistry.operator.openshift.io
```

Example output

```
storage:
  pvc:
    claim: 1
```

- 1 Leave the **claim** field blank to allow the automatic creation of an **image-registry-storage** persistent volume claim (PVC). The PVC is generated based on the default storage class. However, be aware that the default storage class might provide ReadWriteOnce (RWO) volumes, such as a RADOS Block Device (RBD), which can cause issues when you replicate to more than one replica.

4. Check the **clusteroperator** status:

```
$ oc get clusteroperator image-registry
```

Example output

NAME	VERSION	AVAILABLE	PROGRESSING	DEGRADED
image-registry	4.7	True	False	False 6h50m

3.7.3.2. Configuring storage for the image registry in non-production clusters

You must configure storage for the Image Registry Operator. For non-production clusters, you can set the image registry to an empty directory. If you do so, all images are lost if you restart the registry.

Procedure

- To set the image registry storage to an empty directory:

```
$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec": {"storage":{"emptyDir":{}}}'
```

**WARNING**

Configure this option for only non-production clusters.

If you run this command before the Image Registry Operator initializes its components, the **oc patch** command fails with the following error:

```
Error from server (NotFound): configs.imageregistry.operator.openshift.io "cluster" not found
```

Wait a few minutes and run the command again.

3.7.3.3. Configuring block registry storage for VMware vSphere

To allow the image registry to use block storage types such as vSphere Virtual Machine Disk (VMDK) during upgrades as a cluster administrator, you can use the **Recreate** rollout strategy.

**IMPORTANT**

Block storage volumes are supported but not recommended for use with image registry on production clusters. An installation where the registry is configured on block storage is not highly available because the registry cannot have more than one replica.

Procedure

1. Enter the following command to set the image registry storage as a block storage type, patch the registry so that it uses the **Recreate** rollout strategy, and runs with only **1** replica:

```
$ oc patch config.imageregistry.operator.openshift.io/cluster --type=merge -p '{"spec": {"rolloutStrategy": "Recreate", "replicas": 1}}'
```

2. Provision the PV for the block storage device, and create a PVC for that volume. The requested block volume uses the ReadWriteOnce (RWO) access mode.

- a. Create a **pvc.yaml** file with the following contents to define a VMware vSphere **PersistentVolumeClaim** object:

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: image-registry-storage 1
  namespace: openshift-image-registry 2
spec:
  accessModes:
  - ReadWriteOnce 3
  resources:
    requests:
      storage: 100Gi 4
```

- 1 A unique name that represents the **PersistentVolumeClaim** object.

- 2 The namespace for the **PersistentVolumeClaim** object, which is **openshift-image-registry**.
- 3 The access mode of the persistent volume claim. With **ReadWriteOnce**, the volume can be mounted with read and write permissions by a single node.
- 4 The size of the persistent volume claim.

b. Enter the following command to create the **PersistentVolumeClaim** object from the file:

```
$ oc create -f pvc.yaml -n openshift-image-registry
```

3. Enter the following command to edit the registry configuration so that it references the correct PVC:

```
$ oc edit config.imageregistry.operator.openshift.io -o yaml
```

Example output

```
storage:
  pvc:
    claim: 1
```

- 1 By creating a custom PVC, you can leave the **claim** field blank for the default automatic creation of an **image-registry-storage** PVC.

For instructions about configuring registry storage so that it references the correct PVC, see [Configuring the registry for vSphere](#).

3.7.3.4. Configuring the Image Registry Operator to use Ceph RGW storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Ceph RGW storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Ceph RGW object storage.

Procedure

1. Create the object bucket claim using the **ocs-storagecluster-ceph-rgw** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: rgwbucket
  namespace: openshift-storage 1
spec:
  storageClassName: ocs-storagecluster-ceph-rgw
  generateBucketName: rgwbucket
EOF
```

- 1** Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage rgwbucket -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_ACCESS_KEY_ID}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_SECRET_ACCESS_KEY}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-
literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-
literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --
namespace openshift-image-registry
```

5. Get the **route** host by entering the following command:

```
$ route_host=$(oc get route ocs-storagecluster-cephobjectstore -n openshift-storage --
template='{{ .spec.host }}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/router-certs-default -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n
openshift-config
```

- Configure the image registry to use the Ceph RGW object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","s3":{"bucket":"${bucket_name}","region":"us-east-
1","regionEndpoint":"https://${route_host}","virtualHostedStyle":false,"encrypt":false,"trustedC
A":{"name":"image-registry-s3-bundle"}}}}' --type=merge
```

3.7.3.5. Configuring the Image Registry Operator to use Noobaa storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Noobaa storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Noobaa object storage.

Procedure

- Create the object bucket claim using the **openshift-storage.noobaa.io** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: noobaatest
  namespace: openshift-storage 1
spec:
  storageClassName: openshift-storage.noobaa.io
  generateBucketName: noobaatest
EOF
```

- Alternatively, you can use the **openshift-image-registry** namespace.

- Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage noobaatest -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage noobaatest -o yaml | grep -w "AWS_ACCESS_KEY_ID:" | head -n1 | awk '{print $2}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage noobaatest -o yaml | grep -w "AWS_SECRET_ACCESS_KEY:" | head -n1 | awk '{print $2}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --namespace openshift-image-registry
```

5. Get the route host by entering the following command:

```
$ route_host=$(oc get route s3 -n openshift-storage -o=jsonpath='{.spec.host}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/$(oc get ingresscontroller -n openshift-ingress-operator default -o json | jq '.spec.defaultCertificate.name // "router-certs-default" -r) -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n openshift-config
```

7. Configure the image registry to use the Nooba object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec": {"managementState":"Managed","replicas":2,"storage": {"managementState":"Unmanaged","s3":{"bucket":"${bucket_name}","region":"us-east-1","regionEndpoint":"https://${route_host}","virtualHostedStyle":false,"encrypt":false,"trustedCA":{"name":"image-registry-s3-bundle"}}}}}' --type=merge
```

3.7.4. Configuring the Image Registry Operator to use CephFS storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use CephFS storage.



NOTE

CephFS uses persistent volume claim (PVC) storage. It is not recommended to use PVCs for image registry storage if there are other options available, such as Ceph RGW or Noobaa.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and CephFS file storage.

Procedure

1. Create a PVC to use the **cephfs** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: registry-storage-pvc
  namespace: openshift-image-registry
spec:
  accessModes:
  - ReadWriteMany
  resources:
    requests:
      storage: 100Gi
  storageClassName: ocs-storagecluster-cephfs
EOF
```

2. Configure the image registry to use the CephFS file system storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","pvc":{"claim":"registry-storage-pvc"}}}' --type=merge
```

3.7.5. Additional resources

- [Recommended configurable storage technology](#)
- [Configuring Image Registry to use OpenShift Data Foundation](#)

3.8. CONFIGURING THE REGISTRY FOR RED HAT OPENSIFT DATA FOUNDATION

To configure the OpenShift image registry on bare metal and vSphere to use Red Hat OpenShift Data Foundation storage, you must install OpenShift Data Foundation and then configure image registry using Ceph or Noobaa.

3.8.1. Configuring the Image Registry Operator to use Ceph RGW storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Ceph RGW storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Ceph RGW object storage.

Procedure

1. Create the object bucket claim using the **ocs-storagecluster-ceph-rgw** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: rgwbucket
  namespace: openshift-storage 1
spec:
  storageClassName: ocs-storagecluster-ceph-rgw
  generateBucketName: rgwbucket
EOF
```

- 1** Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage rgwbucket -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_ACCESS_KEY_ID}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_SECRET_ACCESS_KEY}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-
literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-
literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --
namespace openshift-image-registry
```

5. Get the **route** host by entering the following command:

```
$ route_host=$(oc get route ocs-storagecluster-cephobjectstore -n openshift-storage --
template='{ .spec.host }')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/router-certs-default -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n
openshift-config
```

7. Configure the image registry to use the Ceph RGW object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","s3":{"bucket":"${bucket_name}","region":"us-east-
1","regionEndpoint":"https://${route_host}","virtualHostedStyle":false,"encrypt":false,"trustedC
A":{"name":"image-registry-s3-bundle"}}}}' --type=merge
```

3.8.2. Configuring the Image Registry Operator to use Noobaa storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Noobaa storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.

- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Noobaa object storage.

Procedure

1. Create the object bucket claim using the **openshift-storage.noobaa.io** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: noobaatest
  namespace: openshift-storage 1
spec:
  storageClassName: openshift-storage.noobaa.io
  generateBucketName: noobaatest
EOF
```

- 1** Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage noobaatest -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage noobaatest -o yaml | grep -w
"AWS_ACCESS_KEY_ID:" | head -n1 | awk '{print $2}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage noobaatest -o yaml |
grep -w "AWS_SECRET_ACCESS_KEY:" | head -n1 | awk '{print $2}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-
literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-
literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --
namespace openshift-image-registry
```

5. Get the route host by entering the following command:

```
$ route_host=$(oc get route s3 -n openshift-storage -o=jsonpath='{.spec.host}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/$(oc get ingresscontroller -n openshift-ingress-operator default -o json | jq
'.spec.defaultCertificate.name // "router-certs-default"' -r) -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n
openshift-config
```

- Configure the image registry to use the Nooba object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","s3":{"bucket":"\${bucket_name}\/","region":"us-east-
1","regionEndpoint":"\${route_host}\/","virtualHostedStyle":false,"encrypt":false,"trustedC
A":{"name":"image-registry-s3-bundle"}}}}' --type=merge
```

3.8.3. Configuring the Image Registry Operator to use CephFS storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use CephFS storage.



NOTE

CephFS uses persistent volume claim (PVC) storage. It is not recommended to use PVCs for image registry storage if there are other options available, such as Ceph RGW or Noobaa.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and CephFS file storage.

Procedure

- Create a PVC to use the **cephfs** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: registry-storage-pvc
  namespace: openshift-image-registry
spec:
  accessModes:
  - ReadWriteMany
```



```
resources:
  requests:
    storage: 100Gi
  storageClassName: ocs-storagecluster-cephfs
EOF
```

2. Configure the image registry to use the CephFS file system storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","pvc":{"claim":"registry-storage-pvc"}}}' --type=merge
```

3.8.4. Additional resources

- [Configuring Image Registry to use OpenShift Data Foundation](#)
- [Performance tuning guide for Multicloud Object Gateway \(NooBaa\)](#)

3.9. CONFIGURING THE REGISTRY FOR NUTANIX

By following the steps outlined in this documentation, users can optimize container image distribution, security, and access controls, enabling a robust foundation for Nutanix applications on OpenShift Container Platform

3.9.1. Image registry removed during installation

On platforms that do not provide shareable object storage, the OpenShift Image Registry Operator bootstraps itself as **Removed**. This allows **openshift-installer** to complete installations on these platform types.

After installation, you must edit the Image Registry Operator configuration to switch the **managementState** from **Removed** to **Managed**.

3.9.2. Changing the image registry's management state

To start the image registry, you must change the Image Registry Operator configuration's **managementState** from **Removed** to **Managed**.

Procedure

- Change **managementState** Image Registry Operator configuration from **Removed** to **Managed**. For example:

```
$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec":
{"managementState":"Managed"}}'
```

3.9.3. Image registry storage configuration

The Image Registry Operator is not initially available for platforms that do not provide default storage. After installation, you must configure your registry to use storage so that the Registry Operator is made available.

Instructions are shown for configuring a persistent volume, which is required for production clusters. Where applicable, instructions are shown for configuring an empty directory as the storage location, which is available for only non-production clusters.

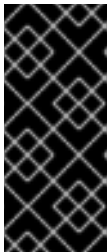
Additional instructions are provided for allowing the image registry to use block storage types by using the **Recreate** rollout strategy during upgrades.

3.9.3.1. Configuring registry storage for Nutanix

As a cluster administrator, following installation you must configure your registry to use storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have a cluster on Nutanix.
- You have provisioned persistent storage for your cluster, such as Red Hat OpenShift Data Foundation.



IMPORTANT

OpenShift Container Platform supports **ReadWriteOnce** access for image registry storage when you have only one replica. **ReadWriteOnce** access also requires that the registry uses the **Recreate** rollout strategy. To deploy an image registry that supports high availability with two or more replicas, **ReadWriteMany** access is required.

- You must have 100 Gi capacity.

Procedure

1. To configure your registry to use storage, change the **spec.storage.pvc** in the **configs.imageregistry/cluster** resource.



NOTE

When you use shared storage, review your security settings to prevent outside access.

2. Verify that you do not have a registry pod:

```
$ oc get pod -n openshift-image-registry -l docker-registry=default
```

Example output

```
No resources found in openshift-image-registry namespace
```



NOTE

If you do have a registry pod in your output, you do not need to continue with this procedure.

3. Check the registry configuration:

```
$ oc edit configs.imageregistry.operator.openshift.io
```

Example output

```
storage:
  pvc:
    claim: 1
```

- 1 Leave the **claim** field blank to allow the automatic creation of an **image-registry-storage** persistent volume claim (PVC). The PVC is generated based on the default storage class. However, be aware that the default storage class might provide ReadWriteOnce (RWO) volumes, such as a RADOS Block Device (RBD), which can cause issues when you replicate to more than one replica.

4. Check the **clusteroperator** status:

```
$ oc get clusteroperator image-registry
```

Example output

NAME	VERSION	AVAILABLE	PROGRESSING	DEGRADED
image-registry	4.13	True	False	False 6h50m

3.9.3.2. Configuring storage for the image registry in non-production clusters

You must configure storage for the Image Registry Operator. For non-production clusters, you can set the image registry to an empty directory. If you do so, all images are lost if you restart the registry.

Procedure

- To set the image registry storage to an empty directory:

```
$ oc patch configs.imageregistry.operator.openshift.io cluster --type merge --patch '{"spec": {"storage":{"emptyDir":{}}}'
```



WARNING

Configure this option for only non-production clusters.

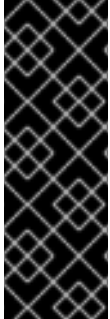
If you run this command before the Image Registry Operator initializes its components, the **oc patch** command fails with the following error:

```
Error from server (NotFound): configs.imageregistry.operator.openshift.io "cluster" not found
```

Wait a few minutes and run the command again.

3.9.3.3. Configuring block registry storage for Nutanix volumes

To allow the image registry to use block storage types such as Nutanix volumes during upgrades as a cluster administrator, you can use the **Recreate** rollout strategy.



IMPORTANT

Block storage volumes, or block persistent volumes, are supported but not recommended for use with the image registry on production clusters. An installation where the registry is configured on block storage is not highly available because the registry cannot have more than one replica.

If you choose to use a block storage volume with the image registry, you must use a filesystem persistent volume claim (PVC).

Procedure

1. Enter the following command to set the image registry storage as a block storage type, patch the registry so that it uses the **Recreate** rollout strategy, and runs with only one (**1**) replica:

```
$ oc patch config.imageregistry.operator.openshift.io/cluster --type=merge -p '{"spec": {"rolloutStrategy": "Recreate", "replicas": 1}}'
```

2. Provision the PV for the block storage device, and create a PVC for that volume. The requested block volume uses the ReadWriteOnce (RWO) access mode.
 - a. Create a **pvc.yaml** file with the following contents to define a Nutanix **PersistentVolumeClaim** object:

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: image-registry-storage 1
  namespace: openshift-image-registry 2
spec:
  accessModes:
  - ReadWriteOnce 3
  resources:
    requests:
      storage: 100Gi 4
```

- 1** A unique name that represents the **PersistentVolumeClaim** object.
- 2** The namespace for the **PersistentVolumeClaim** object, which is **openshift-image-registry**.
- 3** The access mode of the persistent volume claim. With **ReadWriteOnce**, the volume can be mounted with read and write permissions by a single node.
- 4** The size of the persistent volume claim.

- b. Enter the following command to create the **PersistentVolumeClaim** object from the file:

```
$ oc create -f pvc.yaml -n openshift-image-registry
```

- Enter the following command to edit the registry configuration so that it references the correct PVC:

```
$ oc edit config.imageregistry.operator.openshift.io -o yaml
```

Example output

```
storage:
  pvc:
    claim: 1
```

- By creating a custom PVC, you can leave the **claim** field blank for the default automatic creation of an **image-registry-storage** PVC.

3.9.3.4. Configuring the Image Registry Operator to use Ceph RGW storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Ceph RGW storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Ceph RGW object storage.

Procedure

- Create the object bucket claim using the **ocs-storagecluster-ceph-rgw** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: rgwbucket
  namespace: openshift-storage 1
spec:
```

```
storageClassName: ocs-storagecluster-ceph-rgw
generateBucketName: rgwbucket
EOF
```

- 1 Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage rgwbucket -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_ACCESS_KEY_ID}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage rgwbucket -o
jsonpath='{.data.AWS_SECRET_ACCESS_KEY}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

```
$ oc create secret generic image-registry-private-configuration-user --from-
literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-
literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --
namespace openshift-image-registry
```

5. Get the **route** host by entering the following command:

```
$ route_host=$(oc get route ocs-storagecluster-cephobjectstore -n openshift-storage --
template='{{ .spec.host }}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/router-certs-default -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n
openshift-config
```

7. Configure the image registry to use the Ceph RGW object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","s3":{"bucket":"${bucket_name}","region":"us-east-
1","regionEndpoint":"https://${route_host}","virtualHostedStyle":false,"encrypt":false,"trustedC
A":{"name":"image-registry-s3-bundle"}}}}' --type=merge
```

3.9.3.5. Configuring the Image Registry Operator to use Noobaa storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use Noobaa storage.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.
- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and Noobaa object storage.

Procedure

1. Create the object bucket claim using the **openshift-storage.noobaa.io** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: noobaatest
  namespace: openshift-storage 1
spec:
  storageClassName: openshift-storage.noobaa.io
  generateBucketName: noobaatest
EOF
```

- 1** Alternatively, you can use the **openshift-image-registry** namespace.

2. Get the bucket name by entering the following command:

```
$ bucket_name=$(oc get obc -n openshift-storage noobaatest -o
jsonpath='{.spec.bucketName}')
```

3. Get the AWS credentials by entering the following commands:

```
$ AWS_ACCESS_KEY_ID=$(oc get secret -n openshift-storage noobaatest -o yaml | grep -w
"AWS_ACCESS_KEY_ID:" | head -n1 | awk '{print $2}' | base64 --decode)
```

```
$ AWS_SECRET_ACCESS_KEY=$(oc get secret -n openshift-storage noobaatest -o yaml |
grep -w "AWS_SECRET_ACCESS_KEY:" | head -n1 | awk '{print $2}' | base64 --decode)
```

4. Create the secret **image-registry-private-configuration-user** with the AWS credentials for the new bucket under **openshift-image-registry project** by entering the following command:

■

```
$ oc create secret generic image-registry-private-configuration-user --from-literal=REGISTRY_STORAGE_S3_ACCESSKEY=${AWS_ACCESS_KEY_ID} --from-literal=REGISTRY_STORAGE_S3_SECRETKEY=${AWS_SECRET_ACCESS_KEY} --namespace openshift-image-registry
```

5. Get the route host by entering the following command:

```
$ route_host=$(oc get route s3 -n openshift-storage -o=jsonpath='{.spec.host}')
```

6. Create a config map that uses an ingress certificate by entering the following commands:

```
$ oc extract secret/$(oc get ingresscontroller -n openshift-ingress-operator default -o json | jq '.spec.defaultCertificate.name // "router-certs-default"' -r) -n openshift-ingress --confirm
```

```
$ oc create configmap image-registry-s3-bundle --from-file=ca-bundle.crt=./tls.crt -n openshift-config
```

7. Configure the image registry to use the Nooba object storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec": {"managementState": "Managed", "replicas": 2, "storage": {"managementState": "Unmanaged", "s3": {"bucket": "${bucket_name}", "region": "us-east-1", "regionEndpoint": "https://${route_host}", "virtualHostedStyle": false, "encrypt": false, "trustedCA": {"name": "image-registry-s3-bundle"}}}}}' --type=merge
```

3.9.4. Configuring the Image Registry Operator to use CephFS storage with Red Hat OpenShift Data Foundation

Red Hat OpenShift Data Foundation integrates multiple storage types that you can use with the OpenShift image registry:

- Ceph, a shared and distributed file system and on-premises object storage
- NooBaa, providing a Multicloud Object Gateway

This document outlines the procedure to configure the image registry to use CephFS storage.



NOTE

CephFS uses persistent volume claim (PVC) storage. It is not recommended to use PVCs for image registry storage if there are other options available, such as Ceph RGW or Noobaa.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift Container Platform web console.
- You installed the **oc** CLI.

- You installed the [OpenShift Data Foundation Operator](#) to provide object storage and CephFS file storage.

Procedure

1. Create a PVC to use the **cephfs** storage class. For example:

```
cat <<EOF | oc apply -f -
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: registry-storage-pvc
  namespace: openshift-image-registry
spec:
  accessModes:
  - ReadWriteMany
  resources:
    requests:
      storage: 100Gi
  storageClassName: ocs-storagecluster-cephfs
EOF
```

2. Configure the image registry to use the CephFS file system storage by entering the following command:

```
$ oc patch config.image/cluster -p '{"spec":
{"managementState":"Managed","replicas":2,"storage":
{"managementState":"Unmanaged","pvc":{"claim":"registry-storage-pvc"}}}' --type=merge
```

3.9.5. Additional resources

- [Recommended configurable storage technology](#)
- [Configuring Image Registry to use OpenShift Data Foundation](#)

CHAPTER 4. ACCESSING THE REGISTRY

Use the following sections for instructions on accessing the registry, including viewing logs and metrics, as well as securing and exposing the registry.

You can access the registry directly to invoke **podman** commands. This allows you to push images to or pull them from the integrated registry directly using operations like **podman push** or **podman pull**. To do so, you must be logged in to the registry using the **podman login** command. The operations you can perform depend on your user permissions, as described in the following sections.

4.1. PREREQUISITES

- You have access to the cluster as a user with the **cluster-admin** role.
- You must have configured an identity provider (IDP).
- For pulling images, for example when using the **podman pull** command, the user must have the **registry-viewer** role. To add this role, run the following command:

```
$ oc policy add-role-to-user registry-viewer <user_name>
```

- For writing or pushing images, for example when using the **podman push** command:
 - The user must have the **registry-editor** role. To add this role, run the following command:

```
$ oc policy add-role-to-user registry-editor <user_name>
```

- Your cluster must have an existing project where the images can be pushed to.

4.2. ACCESSING THE REGISTRY DIRECTLY FROM THE CLUSTER

You can access the registry from inside the cluster.

Procedure

Access the registry from the cluster by using internal routes:

1. Access the node by getting the node's name:

```
$ oc get nodes
```

```
$ oc debug nodes/<node_name>
```

2. To enable access to tools such as **oc** and **podman** on the node, change your root directory to **/host**:

```
sh-4.2# chroot /host
```

3. Log in to the container image registry by using your access token:

```
sh-4.2# oc login -u kubeadmin -p <password_from_install_log> https://api-int.  
<cluster_name>.<base_domain>:6443
```

```
sh-4.2# podman login -u kubeadmin -p $(oc whoami -t) image-registry.openshift-image-registry.svc:5000
```

You should see a message confirming login, such as:

```
Login Succeeded!
```



NOTE

You can pass any value for the user name; the token contains all necessary information. Passing a user name that contains colons will result in a login failure.

Since the Image Registry Operator creates the route, it will likely be similar to **default-route-openshift-image-registry.<cluster_name>**.

4. Perform **podman pull** and **podman push** operations against your registry:



IMPORTANT

You can pull arbitrary images, but if you have the **system:registry** role added, you can only push images to the registry in your project.

In the following examples, use:

Component	Value
<registry_ip>	172.30.124.220
<port>	5000
<project>	openshift
<image>	image
<tag>	omitted (defaults to latest)

- a. Pull an arbitrary image:

```
sh-4.2# podman pull <name.io>/<image>
```

- b. Tag the new image with the form **<registry_ip>:<port>/<project>/<image>**. The project name must appear in this pull specification for OpenShift Container Platform to correctly place and later access the image in the registry:

```
sh-4.2# podman tag <name.io>/<image> image-registry.openshift-image-registry.svc:5000/openshift/<image>
```

**NOTE**

You must have the **system:image-builder** role for the specified project, which allows the user to write or push an image. Otherwise, the **podman push** in the next step will fail. To test, you can create a new project to push the image.

- c. Push the newly tagged image to your registry:

```
sh-4.2# podman push image-registry.openshift-image-registry.svc:5000/openshift/<image>
```

**NOTE**

When pushing images to the internal registry, the repository name must use the **<project>/<name>** format. Using multiple project levels in the repository name results in an authentication error.

4.3. CHECKING THE STATUS OF THE REGISTRY PODS

As a cluster administrator, you can list the image registry pods running in the **openshift-image-registry** project and check their status.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.

Procedure

- List the pods in the **openshift-image-registry** project and view their status:

```
$ oc get pods -n openshift-image-registry
```

Example output

```
NAME READY STATUS RESTARTS AGE
cluster-image-registry-operator-764bd7f846-qqtqb 1/1 Running 0 78m
image-registry-79fb4469f6-lrlrn 1/1 Running 0 77m
node-ca-hjksc 1/1 Running 0 73m
node-ca-tftj6 1/1 Running 0 77m
node-ca-wb6ht 1/1 Running 0 77m
node-ca-zvt9q 1/1 Running 0 74m
```

4.4. VIEWING REGISTRY LOGS

You can view the logs for the registry by using the **oc logs** command.

Procedure

- Use the **oc logs** command with deployments to view the logs for the container image registry:

```
$ oc logs deployments/image-registry -n openshift-image-registry
```

Example output

```

2015-05-01T19:48:36.300593110Z time="2015-05-01T19:48:36Z" level=info
msg="version=v2.0.0+unknown"
2015-05-01T19:48:36.303294724Z time="2015-05-01T19:48:36Z" level=info msg="redis not
configured" instance.id=9ed6c43d-23ee-453f-9a4b-031fea646002
2015-05-01T19:48:36.303422845Z time="2015-05-01T19:48:36Z" level=info msg="using
inmemory layerinfo cache" instance.id=9ed6c43d-23ee-453f-9a4b-031fea646002
2015-05-01T19:48:36.303433991Z time="2015-05-01T19:48:36Z" level=info msg="Using
OpenShift Auth handler"
2015-05-01T19:48:36.303439084Z time="2015-05-01T19:48:36Z" level=info msg="listening
on :5000" instance.id=9ed6c43d-23ee-453f-9a4b-031fea646002

```

4.5. ACCESSING REGISTRY METRICS

The OpenShift Container Registry provides an endpoint for [Prometheus metrics](#). Prometheus is a stand-alone, open source systems monitoring and alerting toolkit.

The metrics are exposed at the `/extensions/v2/metrics` path of the registry endpoint.

Procedure

You can access the metrics by running a metrics query using a cluster role.

Cluster role

1. Create a cluster role if you do not already have one to access the metrics:

```

$ cat <<EOF | oc create -f -
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: prometheus-scraper
rules:
- apiGroups:
  - image.openshift.io
  resources:
  - registry/metrics
verbs:
  - get
EOF

```

2. Add this role to a user, run the following command:

```
$ oc adm policy add-cluster-role-to-user prometheus-scraper <username>
```

Metrics query

1. Get the user token.

```

openshift:
$ oc whoami -t

```

2. Run a metrics query in node or inside a pod, for example:

```
$ curl --insecure -s -u <user>:<secret> \ 1
https://image-registry.openshift-image-registry.svc:5000/extensions/v2/metrics | grep
imageregistry | head -n 20
```

Example output

```
# HELP imageregistry_build_info A metric with a constant '1' value labeled by major, minor,
git commit & git version from which the image registry was built.
# TYPE imageregistry_build_info gauge
imageregistry_build_info{gitCommit="9f72191",gitVersion="v3.11.0+9f72191-135-
dirty",major="3",minor="11+"} 1
# HELP imageregistry_digest_cache_requests_total Total number of requests without scope
to the digest cache.
# TYPE imageregistry_digest_cache_requests_total counter
imageregistry_digest_cache_requests_total{type="Hit"} 5
imageregistry_digest_cache_requests_total{type="Miss"} 24
# HELP imageregistry_digest_cache_scoped_requests_total Total number of scoped
requests to the digest cache.
# TYPE imageregistry_digest_cache_scoped_requests_total counter
imageregistry_digest_cache_scoped_requests_total{type="Hit"} 33
imageregistry_digest_cache_scoped_requests_total{type="Miss"} 44
# HELP imageregistry_http_in_flight_requests A gauge of requests currently being served by
the registry.
# TYPE imageregistry_http_in_flight_requests gauge
imageregistry_http_in_flight_requests 1
# HELP imageregistry_http_request_duration_seconds A histogram of latencies for requests
to the registry.
# TYPE imageregistry_http_request_duration_seconds summary
imageregistry_http_request_duration_seconds{method="get",quantile="0.5"} 0.01296087
imageregistry_http_request_duration_seconds{method="get",quantile="0.9"} 0.014847248
imageregistry_http_request_duration_seconds{method="get",quantile="0.99"} 0.015981195
imageregistry_http_request_duration_seconds_sum{method="get"} 12.260727916000022
```

1 The `<user>` object can be arbitrary, but `<secret>` tag must use the user token.

4.6. ADDITIONAL RESOURCES

- For more information on allowing pods in a project to reference images in another project, see [Allowing pods to reference images across projects](#) .
- A **kubeadmin** can access the registry until deleted. See [Removing the kubeadmin user](#) for more information.
- For more information on configuring an identity provider, see [Understanding identity provider configuration](#).

CHAPTER 5. EXPOSING THE REGISTRY

By default, the OpenShift image registry is secured during cluster installation so that it serves traffic through TLS. Unlike previous versions of OpenShift Container Platform, the registry is not exposed outside of the cluster at the time of installation.

5.1. EXPOSING A DEFAULT REGISTRY MANUALLY

Instead of logging in to the default OpenShift image registry from within the cluster, you can gain external access to it by exposing it with a route. This external access enables you to log in to the registry from outside the cluster using the route address and to tag and push images to an existing project by using the route host.

Prerequisites:

- The following prerequisites are automatically performed:
 - Deploy the Registry Operator.
 - Deploy the Ingress Operator.
- You have access to the cluster as a user with the **cluster-admin** role.

Procedure

You can expose the route by using the **defaultRoute** parameter in the **configs.imageregistry.operator.openshift.io** resource.

To expose the registry using the **defaultRoute**:

1. Set **defaultRoute** to **true**:

```
$ oc patch configs.imageregistry.operator.openshift.io/cluster --patch '{"spec": {"defaultRoute":true}}' --type=merge
```

2. Get the default registry route:

```
$ HOST=$(oc get route default-route -n openshift-image-registry --template='{{ .spec.host }}')
```

3. Get the certificate of the Ingress Operator:

```
$ oc get secret -n openshift-ingress router-certs-default -o go-template='{{index .data "tls.crt"}}' | base64 -d | sudo tee /etc/pki/ca-trust/source/anchors/${HOST}.cert > /dev/null
```

4. Enable the cluster's default certificate to trust the route using the following commands:

```
$ sudo update-ca-trust enable
```

5. Log in with podman using the default route:

```
$ sudo podman login -u kubeadmin -p $(oc whoami -t) $HOST
```

5.2. EXPOSING A SECURE REGISTRY MANUALLY

Instead of logging in to the OpenShift image registry from within the cluster, you can gain external access to it by exposing it with a route. This allows you to log in to the registry from outside the cluster using the route address, and to tag and push images to an existing project by using the route host.

Prerequisites:

- The following prerequisites are automatically performed:
 - Deploy the Registry Operator.
 - Deploy the Ingress Operator.
- You have access to the cluster as a user with the **cluster-admin** role.

Procedure

You can expose the route by using **DefaultRoute** parameter in the **configs.imageregistry.operator.openshift.io** resource or by using custom routes.

To expose the registry using **DefaultRoute**:

1. Set **DefaultRoute** to **True**:

```
$ oc patch configs.imageregistry.operator.openshift.io/cluster --patch '{"spec": {"defaultRoute":true}}' --type=merge
```

2. Log in with **podman**:

```
$ HOST=$(oc get route default-route -n openshift-image-registry --template='{{ .spec.host }}')
```

```
$ podman login -u kubeadmin -p $(oc whoami -t) --tls-verify=false $HOST 1
```

- 1** **--tls-verify=false** is needed if the cluster's default certificate for routes is untrusted. You can set a custom, trusted certificate as the default certificate with the Ingress Operator.

To expose the registry using custom routes:

1. Create a secret with your route's TLS keys:

```
$ oc create secret tls public-route-tls \
  -n openshift-image-registry \
  --cert=</path/to/tls.crt> \
  --key=</path/to/tls.key>
```

This step is optional. If you do not create a secret, the route uses the default TLS configuration from the Ingress Operator.

2. On the Registry Operator:

```
$ oc edit configs.imageregistry.operator.openshift.io/cluster
```

```
spec:
  routes:
    - name: public-routes
```



```
hostname: myregistry.mycorp.organization  
secretName: public-route-tls
```

...



NOTE

Only set **secretName** if you are providing a custom TLS configuration for the registry's route.

Troubleshooting

- [Error creating TLS secret](#)