



## Red Hat Quay 3.8

# Deploy Red Hat Quay for proof-of-concept (non-production) purposes

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## Abstract

Get started with Red Hat Quay

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## PREFACE

Red Hat Quay is an enterprise-quality registry for building, securing and serving container images. This procedure describes how to deploy Red Hat Quay for proof-of-concept (non-production) purposes.



# CHAPTER 1. OVERVIEW

Red Hat Quay includes the following features:

- High availability
- Geo-replication
- Repository mirroring
- Docker v2, schema 2 (multi-arch) support
- Continuous integration
- Security scanning with Clair
- Custom log rotation
- Zero downtime garbage collection
- 24/7 support

Red Hat Quay provides support for the following:

- Multiple authentication and access methods
- Multiple storage backends
- Custom certificates for Quay, Clair, and storage backends
- Application registries
- Different container image types

## 1.1. ARCHITECTURE

Red Hat Quay includes several core components, both internal and external.

### 1.1.1. Internal components

Red Hat Quay includes the following internal components:

- **Quay (container registry)**. Runs the **Quay** container as a service, consisting of several components in the pod.
- **Clair**. Scans container images for vulnerabilities and suggests fixes.

### 1.1.2. External components

Red Hat Quay includes the following external components:

- **Database**. Used by Red Hat Quay as its primary metadata storage. Note that this is not for image storage.
- **Redis (key-value store)**. Stores live builder logs and the Red Hat Quay tutorial. Also includes the locking mechanism that is required for garbage collection.

- **Cloud storage.** For supported deployments, one of the following storage types must be used:
  - **Public cloud storage.** In public cloud environments, you should use the cloud provider's object storage, such as Amazon Web Services's Amazon S3 or Google Cloud's Google Cloud Storage.
  - **Private cloud storage.** In private clouds, an S3 or Swift compliant Object Store is needed, such as Ceph RADOS, or OpenStack Swift.



#### **WARNING**

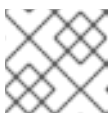
Do not use "Locally mounted directory" Storage Engine for any production configurations. Mounted NFS volumes are not supported. Local storage is meant for Red Hat Quay test-only installations.

## CHAPTER 2. GETTING STARTED WITH RED HAT QUAY

The Red Hat Quay registry can be deployed for non-production purposes on a single machine, either physical or virtual.

### 2.1. PREREQUISITES

- Red Hat Enterprise Linux (RHEL) 8
  - To obtain the latest version of Red Hat Enterprise Linux (RHEL) 8, see [Download Red Hat Enterprise Linux](#).
  - For installation instructions, see the [Product Documentation for Red Hat Enterprise Linux 8](#).
- An active subscription to Red Hat
- Two or more virtual CPUs
- 4 GB or more of RAM
- Approximately 30 GB of disk space on your test system, which can be broken down as follows:
  - Approximately 10 GB of disk space for the Red Hat Enterprise Linux (RHEL) operating system.
  - Approximately 10 GB of disk space for Docker storage for running three containers.
  - Approximately 10 GB of disk space for Red Hat Quay local storage.



#### NOTE

CEPH or other local storage might require more memory.

More information on sizing can be found at [Quay 3.x Sizing Guidelines](#).



#### NOTE

Red Hat Enterprise Linux (RHEL) 8 is recommended for highly available, production quality deployments of Red Hat Quay 3.8. RHEL 7 has not been tested with Red Hat Quay 3.8, and will be deprecated in a future release.

#### 2.1.1. Using Podman

This document uses Podman for creating and deploying containers. For more information on Podman and related technologies, see [Building, running, and managing Linux containers on Red Hat Enterprise Linux 8](#).



#### IMPORTANT

If you do not have Podman installed on your system, the use of equivalent Docker commands might be possible, however this is not recommended. Docker has not been tested with Red Hat Quay 3.8, and will be deprecated in a future release. Podman is recommended for highly available, production quality deployments of Red Hat Quay 3.8.

## 2.2. PREPARING RED HAT ENTERPRISE LINUX FOR A RED HAT QUAY PROOF OF CONCEPT DEPLOYMENT

Use the following procedures to configure Red Hat Enterprise Linux (RHEL) for a Red Hat Quay proof of concept deployment.

### 2.2.1. Install and register the RHEL server

Use the following procedure to configure the Red Hat Enterprise Linux (RHEL) server for a Red Hat Quay proof of concept deployment.

#### Procedure

1. Install the latest RHEL 8 server. You can do a minimal, shell-access only install, or Server plus GUI if you want a desktop.
2. Register and subscribe your RHEL server system as described in [How to register and subscribe a RHEL system to the Red Hat Customer Portal using Red Hat Subscription-Manager](#)
3. Enter the following commands to register your system and list available subscriptions. Choose an available RHEL server subscription, attach to its pool ID, and upgrade to the latest software:

```
# subscription-manager register --username=<user_name> --password=<password>
# subscription-manager refresh
# subscription-manager list --available
# subscription-manager attach --pool=<pool_id>
# yum update -y
```

### 2.2.2. Installing Podman

Use the following procedure to install Podman.

#### Procedure

- Enter the following command to install Podman:

```
$ sudo yum install -y podman
```

- Alternatively, you can install the **container-tools** module, which pulls in the full set of container software packages:

```
$ sudo yum module install -y container-tools
```

### 2.2.3. Registry authentication

Use the following procedure to authenticate your registry for a Red Hat Quay proof of concept.

#### Procedure

1. Set up authentication to **registry.redhat.io** by following the [Red Hat Container Registry Authentication](#) procedure. Setting up authentication allows you to pull the **Quay** container.

**NOTE**

This differs from earlier versions of Red Hat Quay, when the images were hosted on Quay.io.

2. Enter the following command to log in to the registry:

```
$ sudo podman login registry.redhat.io
```

You are prompted to enter your **username** and **password**.

### 2.2.4. Firewall configuration

If you have a firewall running on your system, you might have to add rules that allow access to Red Hat Quay. Use the following procedure to configure your firewall for a proof of concept deployment.

#### Procedure

- The commands required depend on the ports that you have mapped on your system, for example:

```
$ firewall-cmd --permanent --add-port=80/tcp
$ firewall-cmd --permanent --add-port=443/tcp
$ firewall-cmd --permanent --add-port=5432/tcp
$ firewall-cmd --permanent --add-port=5433/tcp
$ firewall-cmd --permanent --add-port=6379/tcp
$ firewall-cmd --reload
```

### 2.2.5. IP addressing and naming services

There are several ways to configure the component containers in Red Hat Quay so that they can communicate with each other, for example:

- **Using the IP addresses for the containers** You can determine the IP address for containers with **podman inspect** and then use the values in the configuration tool when specifying the connection strings, for example:

```
$ sudo podman inspect -f "{{.NetworkSettings.IPAddress}}" postgresql-quay
```

This approach is susceptible to host restarts, as the IP addresses for the containers will change after a reboot.

- **Using a naming service.** If you want your deployment to survive container restarts, which typically result in changed IP addresses, you can implement a naming service. For example, the [dnsname](#) plugin is used to allow containers to resolve each other by name.
- **Using the host network** You can use the **podman run** command with the **--net=host** option and then use container ports on the host when specifying the addresses in the configuration. This option is susceptible to port conflicts when two containers want to use the same port. This method is not recommended.
- **Configuring port mapping.** You can use port mappings to expose ports on the host and then use these ports in combination with the host IP address or host name.

This document uses port mapping and assumes a static IP address for your host system. Throughout the deployment, **quay-sever.example.com** is used with the **192.168.1.112** IP address. This information is established in the **/etc/hosts** file, for example:

```
$ cat /etc/hosts
```

Example output:

```
192.168.1.112 quay-server.example.com
```

**Table 2.1. Sample proof of concept port mapping**

Component	Port mapping	Address
Quay	<b>-p 80:8080 -p 443:8443</b>	http://quay-server.example.com
Postgres for Quay	<b>-p 5432:5432</b>	quay-server.example.com:5432
Redis	<b>-p 6379:6379</b>	quay-server.example.com:6379
Postgres for Clair V4	<b>-p 5433:5432</b>	quay-server.example.com:5433
Clair V4	<b>-p 8081:8080</b>	http://quay-server.example.com:8081

## 2.3. CONFIGURING THE DATABASE

Red Hat Quay requires a database for storing metadata. Postgres is used throughout this document and is recommended for highly available configurations. Alternatively, you can use MySQL with a similar approach to configuration as described below.

### 2.3.1. Setting up Postgres

For the Red Hat Quay proof of concept, a directory on the local file system to persist database data is used.

#### Procedure

1. In the installation folder, denoted here by the **\$QUAY** variable, create a directory for the database data by entering the following command:

```
$ mkdir -p $QUAY/postgres-quay
```

2. Set the appropriate permissions by entering the following command:

```
$ setfacl -m u:26:-wx $QUAY/postgres-quay
```

3. Start the **Postgres** container, specifying the username, password, and database name and port, with the volume definition for database data:

```
$ sudo podman run -d --rm --name postgresql-quay \
-e POSTGRESQL_USER=quayuser \
-e POSTGRESQL_PASSWORD=quaypass \
-e POSTGRESQL_DATABASE=quay \
-e POSTGRESQL_ADMIN_PASSWORD=adminpass \
-p 5432:5432 \
-v $QUAY/postgres-quay:/var/lib/pgsql/data:Z \
registry.redhat.io/rhel8/postgresql-10
```

4. Ensure that the Postgres **pg\_trgm** module is installed by running the following command:

```
$ sudo podman exec -it postgresql-quay /bin/bash -c 'echo "CREATE EXTENSION IF NOT EXISTS pg_trgm" | psql -d quay -U postgres'
```



#### NOTE

The **pg\_trgm** module is required for the **Quay** container.

## 2.4. CONFIGURING REDIS

Redis is a key-value store that is used by Red Hat Quay for live builder logs and the Red Hat Quay tutorial.

### 2.4.1. Setting up Redis

Use the following procedure to deploy the **Redis** container for the Red Hat Quay proof of concept.

#### Procedure

- Start the **Redis** container, specifying the port and password, by entering the following command:

```
$ sudo podman run -d --rm --name redis \
-p 6379:6379 \
-e REDIS_PASSWORD=strongpassword \
registry.redhat.io/rhel8/redis-6
```

## 2.5. CONFIGURING RED HAT QUAY

Use the following procedure to generate a configuration file that details all components, including registry settings, the database, and Redis connection parameters.

#### Procedure

1. To generate a configuration file, enter the following command to run the **Quay** container in **config** mode. You must specify a password, for example, the string **secret**:

```
$ sudo podman run --rm -it --name quay_config -p 80:8080 -p 443:8443 registry.redhat.io/quay/quay-rhel8:v3.8.15 config secret
```

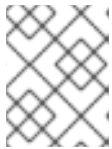
2. Use your browser to access the user interface for the configuration tool at **http://quay-server.example.com**.



#### NOTE

This documentation assumes that you have configured the **quay-server.example.com** hostname in your **/etc/hosts** file.

3. Log in with username and password specified
4. Log in with the username and password you set in Step 1 of [Configuring Red Hat Quay](#).



#### NOTE

If you followed this procedure, the username is **quayconfig** and the password is **secret**.

## 2.5.1. Red Hat Quay setup

In the Red Hat Quay configuration editor, you must enter the following credentials:

- Basic configuration
- Server configuration
- Database
- Redis

### 2.5.1.1. Basic configuration

Under **Basic Configuration**, populate the **Registry Title** and **Registry Title Short** fields. The default values can be used if they are populated.

### 2.5.1.2. Server configuration

Under **Server Hostname**, specify the HTTP host and port for the location where the registry will be accessible on the network.

If you followed the instructions in this documenter, enter **quay-server.example.com**.

### 2.5.1.3. Database

In the **Database** section, specify the connection details for the database that Red Hat Quay uses to store metadata.

If you followed the instructions in this document for deploying a proof of concept system, enter the following values:



- **Database Type:** Postgres
- **Database Server:** quay-server.example.com:5432
- **Username:** quayuser
- **Password:** quaypass
- **Database Name:** quay

#### 2.5.1.4. Redis

The Redis key-value store is used to store real-time events and build logs.

If you followed the instructions in this document for deploying a proof-of-concept system, enter the following credentials under the **Redis** section:

- **Redis Hostname:** quay-server.example.com
- **Redis port:** 6379 (default)
- **Redis password:** strongpassword

#### 2.5.2. Validate and download configuration

After all required fields have been set, validate your settings by clicking **Validate Configuration Changes**. If any errors are reported, continue editing your configuration until the settings are valid and Red Hat Quay can connect to your database and Redis servers.

After validation, download the **Configuration** file. Stop the **Quay** container that is running the configuration editor.

## 2.6. DEPLOYING RED HAT QUAY

### 2.6.1. Prerequisites

- The Red Hat Quay database is running.
- The Redis server is running.
- You have generated a valid configuration file.
- You have stopped the **Quay** container that was running the configuration editor.

### 2.6.2. Preparing the configuration folder

Use the following procedure to prepare your Red Hat Quay configuration folder.

#### Procedure

1. Create a directory to copy the Red Hat Quay configuration bundle to:

```
$ mkdir $QUAY/config
```

2. Copy the generated Red Hat Quay configuration bundle to the directory:

```
$ cp ~/Downloads/quay-config.tar.gz ~/config
```

3. Change into the the directory:

```
$ cd $QUAY/config
```

4. Unpack the Red Hat Quay configuration bundle:

```
$ tar xvf quay-config.tar.gz
```

### 2.6.3. Prepare local storage for image data

Use the following procedure to set your local file system to store registry images.

#### Procedure

1. Create a local directory that will store registry images by entering the following command:

```
$ mkdir $QUAY/storage
```

2. Set the directory to store registry images:

```
$ setfacl -m u:1001:-wx $QUAY/storage
```

### 2.6.4. Deploy the Red Hat Quay registry

1. Use the following procedure to deploy the **Quay** registry container.
2. Enter the following command to start the **Quay** registry container, specifying the appropriate volumes for configuration data and local storage for image data:

```
$ sudo podman run -d --rm -p 80:8080 -p 443:8443 \  
  --name=quay \  
  -v $QUAY/config:/conf/stack:Z \  
  -v $QUAY/storage:/datastorage:Z \  
  registry.redhat.io/quay/quay-rhel8:v3.8.15
```

## 2.7. USING RED HAT QUAY

The following steps allow you to use the interface and create new organizations and repositories, and to search and browse existing repositories. Following step 3, you can use the command line interface to interact with the registry, and to push and pull images.

1. Use your browser to access the user interface for the Red Hat Quay registry at **<http://quay-server.example.com>**, assuming you have configured **quay-server.example.com** as your hostname in your **/etc/hosts** file.
2. Click **Create Account** and add a user, for example, **quayadmin** with a password **password**.
3. From the command line, log in to the registry:

```
$ sudo podman login --tls-verify=false quay-server.example.com
Username: quayadmin
Password: password
Login Succeeded!
```

### 2.7.1. Push and pull images

1. To test pushing and pulling images from the Red Hat Quay registry, first pull a sample image from an external registry:

```
$ sudo podman pull busybox
Trying to pull docker.io/library/busybox...
Getting image source signatures
Copying blob 4c892f00285e done
Copying config 22667f5368 done
Writing manifest to image destination
Storing signatures
22667f53682a2920948d19c7133ab1c9c3f745805c14125859d20cede07f11f9
```

2. Use the **podman images** command to see the local copy:

```
$ sudo podman images
REPOSITORY          TAG      IMAGE ID      CREATED      SIZE
docker.io/library/busybox  latest  22667f53682a  14 hours ago  1.45 MB
...
```

3. Tag this image, in preparation for pushing it to the Red Hat Quay registry:

```
$ sudo podman tag docker.io/library/busybox quay-
server.example.com/quayadmin/busybox:test
```

4. Next, push the image to the Red Hat Quay registry. Following this step, you can use your browser to see the tagged image in your repository.

```
$ sudo podman push --tls-verify=false quay-server.example.com/quayadmin/busybox:test
Getting image source signatures
Copying blob 6b245f040973 done
Copying config 22667f5368 done
Writing manifest to image destination
Storing signatures
```

5. To test access to the image from the command line, first delete the local copy of the image:

```
$ sudo podman rmi quay-server.example.com/quayadmin/busybox:test
Untagged: quay-server.example.com/quayadmin/busybox:test
```

6. Pull the image again, this time from your Red Hat Quay registry:

```
$ sudo podman pull --tls-verify=false quay-server.example.com/quayadmin/busybox:test
Trying to pull quay-server.example.com/quayadmin/busybox:test...
Getting image source signatures
Copying blob 6ef22a7134ba [-----] 0.0b / 0.0b
Copying config 22667f5368 done
```

Writing manifest to image destination

Storing signatures

22667f53682a2920948d19c7133ab1c9c3f745805c14125859d20cede07f11f9

## CHAPTER 3. ADVANCED RED HAT QUAY DEPLOYMENT

Use the following sections to configure advanced Red Hat Quay settings.

### 3.1. USING SSL/TLS

To configure Red Hat Quay with a [self-signed certificate](#), you must create a Certificate Authority (CA) and then generate the required key and certificate files.



#### NOTE

The following examples assume you have configured the server hostname **quay-server.example.com** using DNS or another naming mechanism, such as adding an entry in your **/etc/hosts** file:

```
$ cat /etc/hosts
...
192.168.1.112 quay-server.example.com
```

#### 3.1.1. Creating a certificate authority and signing a certificate

Use the following procedures to create a certificate file and a primary key file named **ssl.cert** and **ssl.key**.

##### 3.1.1.1. Creating a certificate authority

Use the following procedure to create a certificate authority (CA)

#### Procedure

1. Generate the root CA key by entering the following command:

```
$ openssl genrsa -out rootCA.key 2048
```

2. Generate the root CA certificate by entering the following command:

```
$ openssl req -x509 -new -nodes -key rootCA.key -sha256 -days 1024 -out rootCA.pem
```

3. Enter the information that will be incorporated into your certificate request, including the server hostname, for example:

```
Country Name (2 letter code) [XX]:IE
State or Province Name (full name) []:GALWAY
Locality Name (eg, city) [Default City]:GALWAY
Organization Name (eg, company) [Default Company Ltd]:QUAY
Organizational Unit Name (eg, section) []:DOCS
Common Name (eg, your name or your server's hostname) []:quay-server.example.com
```

##### 3.1.1.2. Signing a certificate

Use the following procedure to sign a certificate.

## Procedure

1. Generate the server key by entering the following command:

```
$ openssl genrsa -out ssl.key 2048
```

2. Generate a signing request by entering the following command:

```
$ openssl req -new -key ssl.key -out ssl.csr
```

3. Enter the information that will be incorporated into your certificate request, including the server hostname, for example:

```
Country Name (2 letter code) [XX]:IE
State or Province Name (full name) []:GALWAY
Locality Name (eg, city) [Default City]:GALWAY
Organization Name (eg, company) [Default Company Ltd]:QUAY
Organizational Unit Name (eg, section) []:DOCS
Common Name (eg, your name or your server's hostname) []:quay-server.example.com
```

4. Create a configuration file **openssl.cnf**, specifying the server hostname, for example:

### openssl.cnf

```
[req]
req_extensions = v3_req
distinguished_name = req_distinguished_name
[req_distinguished_name]
[v3_req ]
basicConstraints = CA:FALSE
keyUsage = nonRepudiation, digitalSignature, keyEncipherment
subjectAltName = @alt_names
[alt_names]
DNS.1 = quay-server.example.com
IP.1 = 192.168.1.112
```

5. Use the configuration file to generate the certificate **ssl.cert**:

```
$ openssl x509 -req -in ssl.csr -CA rootCA.pem -CAkey rootCA.key -CAcreateserial -out
ssl.cert -days 356 -extensions v3_req -extfile openssl.cnf
```

## 3.1.2. Configuring SSL/TLS using the Red Hat Quay UI

Use the following procedure to configure SSL/TLS using the Red Hat Quay UI.

To configure SSL using the command line interface, see "Configuring SSL/TLS using the command line interface".

### Prerequisites

- You have created a certificate authority and signed the certificate.

### Procedure

1. Start the **Quay** container in configuration mode:

```
$ sudo podman run --rm -it --name quay_config -p 80:8080 -p 443:8443
registry.redhat.io/quay/quay-rhel8:v3.8.15 config secret
```

2. In the **Server Configuration** section, select **Red Hat Quay handles TLS** for SSL/TLS. Upload the certificate file and private key file created earlier, ensuring that the **Server Hostname** matches the value used when the certificates were created.
3. Validate and download the updated configuration.
4. Stop the **Quay** container and then restart the registry by entering the following command:

```
$ sudo podman rm -f quay
$ sudo podman run -d --rm -p 80:8080 -p 443:8443 \
--name=quay \
-v $QUAY/config:/conf/stack:Z \
-v $QUAY/storage:/datastorage:Z \
registry.redhat.io/quay/quay-rhel8:v3.8.15
```

### 3.1.3. Configuring SSL using the command line interface

Use the following procedure to configure SSL/TLS using the command line interface.

#### Prerequisites

- You have created a certificate authority and signed the certificate.

#### Procedure

1. Copy the certificate file and primary key file to your configuration directory, ensuring they are named **ssl.cert** and **ssl.key** respectively:

```
cp ~/ssl.cert ~/ssl.key $QUAY/config
```

2. Change into the **\$QUAY/config** directory by entering the following command:

```
$ cd $QUAY/config
```

3. Edit the **config.yaml** file and specify that you want Red Hat Quay to handle TLS/SSL:

#### config.yaml

```
...
SERVER_HOSTNAME: quay-server.example.com
...
PREFERRED_URL_SCHEME: https
...
```

4. Optional: Append the contents of the rootCA.pem file to the end of the ssl.cert file by entering the following command:

```
$ cat rootCA.pem >> ssl.cert
```

5. Stop the **Quay** container by entering the following command:

```
$ sudo podman stop quay
```

6. Restart the registry by entering the following command:

```
$ sudo podman run -d --rm -p 80:8080 -p 443:8443 \  
--name=quay \  
-v $QUAY/config:/conf/stack:Z \  
-v $QUAY/storage:/datastorage:Z \  
registry.redhat.io/quay/quay-rhel8:v3.8.15
```

### 3.1.4. Testing SSL configuration using the command line

- Use the **podman login** command to attempt to log in to the Quay registry with SSL enabled:

```
$ sudo podman login quay-server.example.com  
Username: quayadmin  
Password:
```

```
Error: error authenticating creds for "quay-server.example.com": error pinging docker registry  
quay-server.example.com: Get "https://quay-server.example.com/v2/": x509: certificate  
signed by unknown authority
```

- Podman does not trust self-signed certificates. As a workaround, use the **--tls-verify** option:

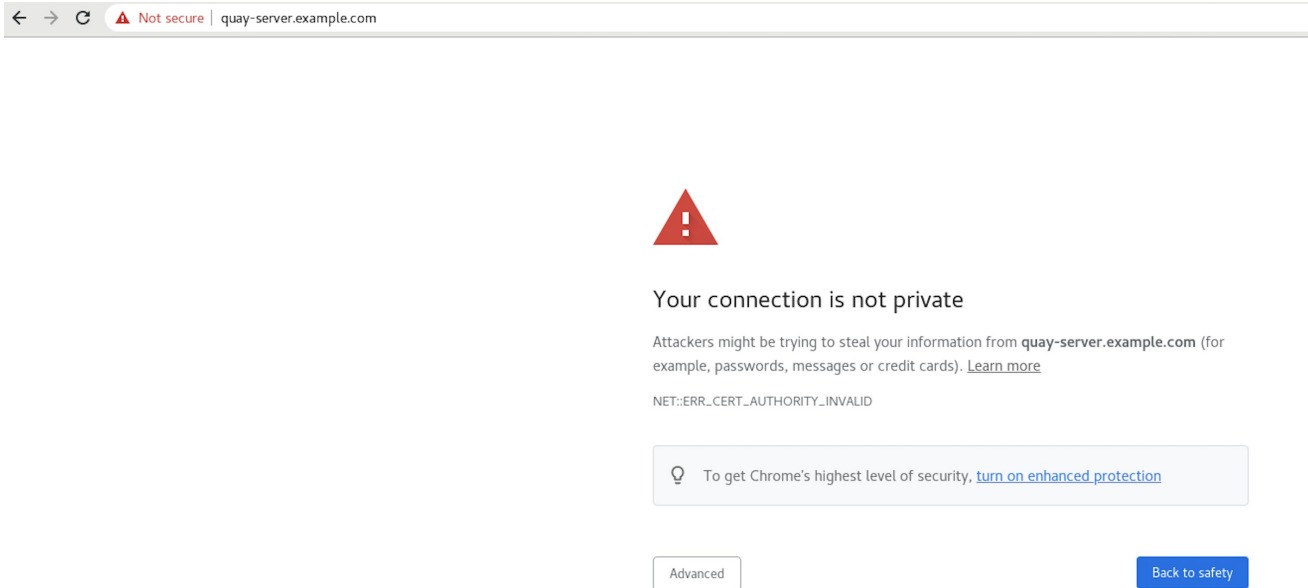
```
$ sudo podman login --tls-verify=false quay-server.example.com  
Username: quayadmin  
Password:  
  
Login Succeeded!
```

Configuring Podman to trust the root Certificate Authority (CA) is covered in a subsequent section.

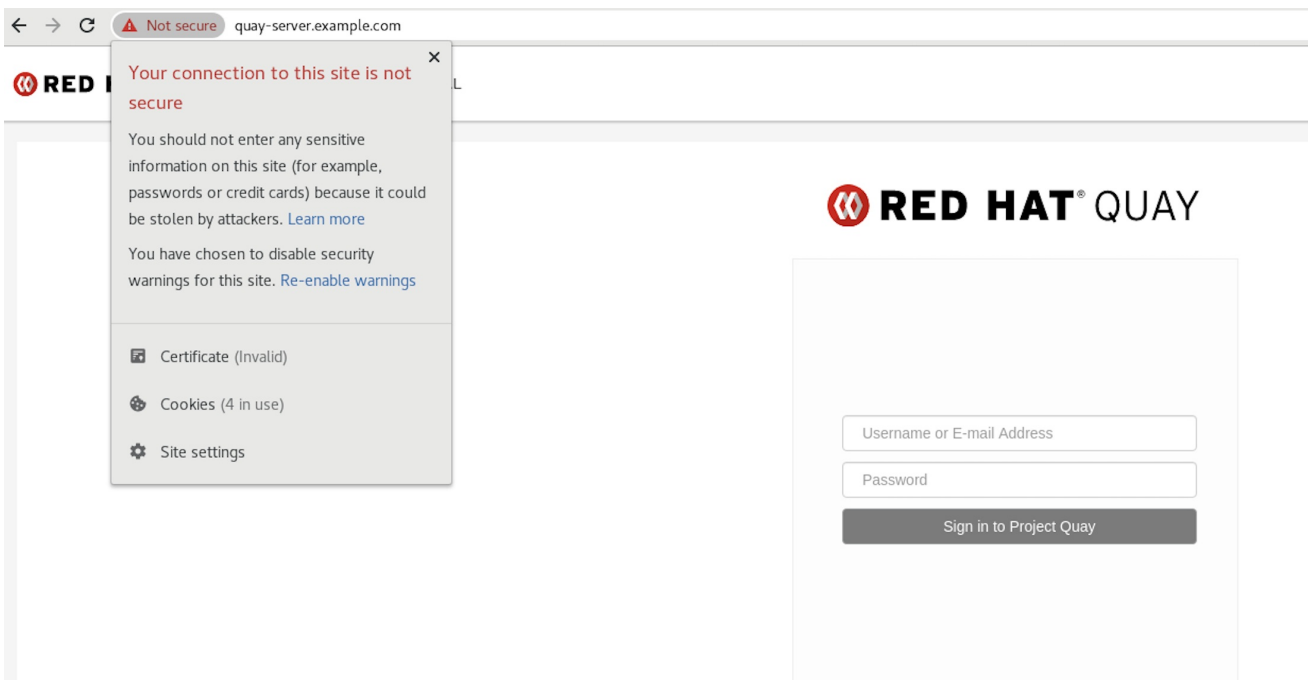
### 3.1.5. Testing SSL configuration using the browser

When you attempt to access the Quay registry, in this case, <https://quay-server.example.com>, the browser warns of the potential risk:





Proceed to the log in screen, and the browser will notify you that the connection is not secure:



Configuring the system to trust the root Certificate Authority (CA) is covered in the subsequent section.

### 3.1.6. Configuring podman to trust the Certificate Authority

Podman uses two paths to locate the CA file, namely, `/etc/containers/certs.d/` and `/etc/docker/certs.d/`.

- Copy the root CA file to one of these locations, with the exact path determined by the server hostname, and naming the file **ca.crt**:

```
$ sudo cp rootCA.pem /etc/containers/certs.d/quay-server.example.com/ca.crt
```

- Alternatively, if you are using Docker, you can copy the root CA file to the equivalent Docker directory:

■

```
$ sudo cp rootCA.pem /etc/docker/certs.d/quay-server.example.com/ca.crt
```

You should no longer need to use the `--tls-verify=false` option when logging in to the registry:

```
$ sudo podman login quay-server.example.com
```

```
Username: quayadmin
```

```
Password:
```

```
Login Succeeded!
```

### 3.1.7. Configuring the system to trust the certificate authority

Use the following procedure to configure your system to trust the certificate authority.

#### Procedure

1. Enter the following command to copy the **rootCA.pem** file to the consolidated system-wide trust store:

```
$ sudo cp rootCA.pem /etc/pki/ca-trust/source/anchors/
```

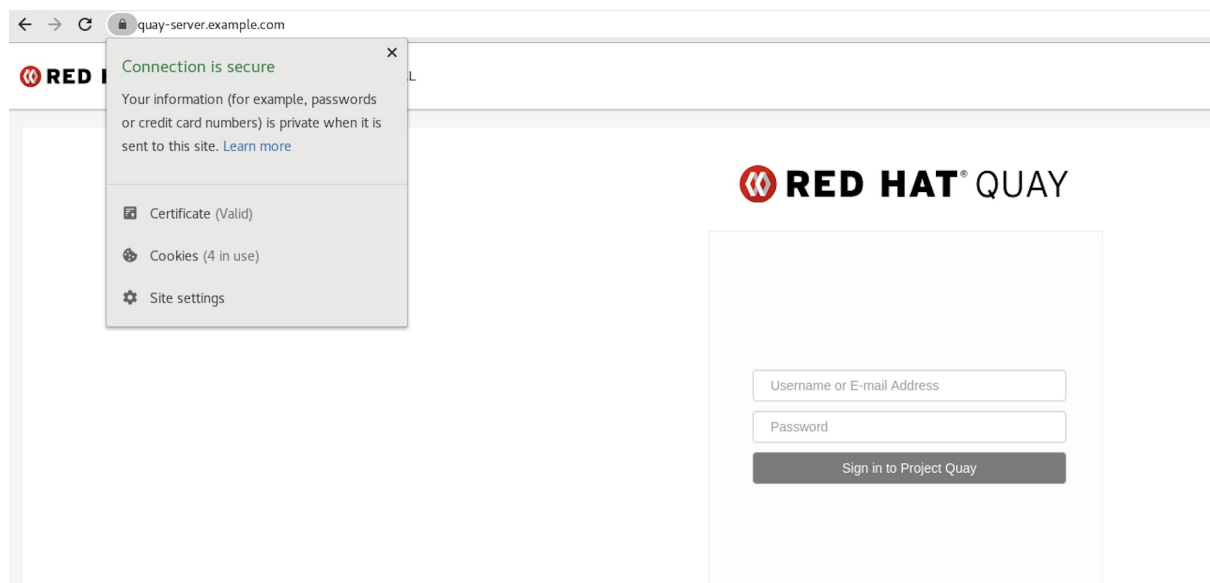
2. Enter the following command to update the system-wide trust store configuration:

```
$ sudo update-ca-trust extract
```

3. Optional. You can use the **trust list** command to ensure that the **Quay** server has been configured:

```
$ trust list | grep quay
label: quay-server.example.com
```

Now, when you browse to the registry at <https://quay-server.example.com>, the lock icon shows that the connection is secure:



4. To remove the **rootCA.pem** file from system-wide trust, delete the file and update the configuration:

```
$ sudo rm /etc/pki/ca-trust/source/anchors/rootCA.pem
```

```
$ sudo update-ca-trust extract
```

```
$ trust list | grep quay
```

More information can be found in the RHEL 8 documentation in the chapter [Using shared system certificates](#).

## 3.2. RED HAT QUAY SUPERUSER

A **superuser** is a Quay user account that has extended privileges, including the ability to:

- Manage users
- Manage organizations
- Manage service keys
- View the change log
- Query the usage logs
- Create globally visible user messages

### 3.2.1. Adding a superuser to Quay using the UI

This section covers how to add a superuser using the Quay UI. To add a superuser using the command line interface, see the following section.

1. Start the **Quay** container in configuration mode, loading the existing configuration as a volume:

```
$ sudo podman run --rm -it --name quay_config \
  -p 8080:8080 \
  -p 443:8443 \
  -v $QUAY/config:/conf/stack:Z \
  registry.redhat.io/quay/quay-rhel8:v3.8.15 config secret
```

2. Under the **Access Settings** section of the UI, enter the name of the user (in this instance, **quayadmin**) in the **Super Users** field and click **Add**.
3. Validate and download the **configuration** file and then terminate the **Quay** container that is running in config mode. Extract the **config.yaml** file to the configuration directory and restart the **Quay** container in registry mode:

```
$ sudo podman rm -f quay
$ sudo podman run -d --rm -p 80:8080 -p 443:8443 \
  --name=quay \
  -v $QUAY/config:/conf/stack:Z \
  -v $QUAY/storage:/datastorage:Z \
  registry.redhat.io/quay/quay-rhel8:v3.8.15
```

### 3.2.2. Editing the config.yaml file to add a superuser

You can also add a superuser by editing the **config.yaml** file directly. The list of superuser accounts is stored as an array in the field **SUPER\_USERS**.

- Stop the container registry if it is running, and add the **SUPER\_USERS** array to the **config.yaml** file:

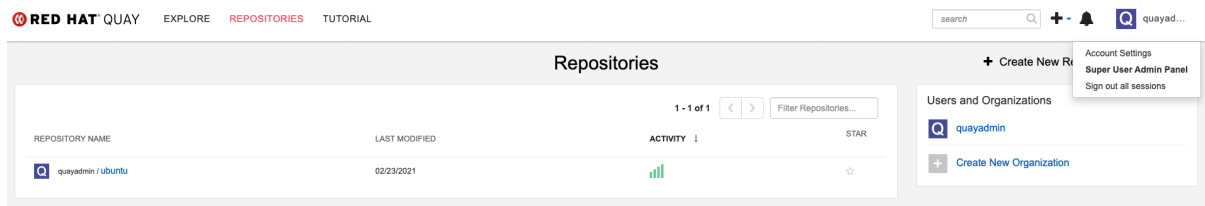
```
SERVER_HOSTNAME: quay-server.example.com
SETUP_COMPLETE: true
SUPER_USERS:
  - quayadmin
  ...
```

### 3.2.3. Accessing the superuser admin panel

1. Restart the Quay registry:

```
$ sudo podman rm -f quay
$ sudo podman run -d --rm -p 80:8080 -p 443:8443 \
--name=quay \
-v $QUAY/config:/conf/stack:Z \
-v $QUAY/storage:/datastorage:Z \
registry.redhat.io/quay/quay-rhel8:v3.8.15
```

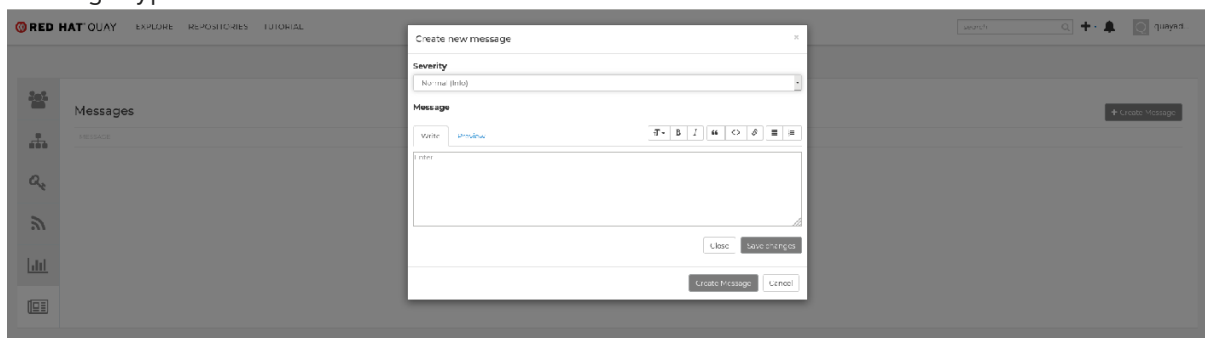
2. Access the Super User Admin Panel by clicking on the current user's name or avatar in the top right-hand corner of the UI. If the user has been added as a superuser, an extra item is presented in the drop-down list called Super User Admin Panel.



#### 3.2.3.1. Creating a globally visible user message

Using the Superuser Admin Panel, you can create **Normal**, **Warning**, or **Error** messages for your organization.

1. Click your user name in the top right-hand corner of the UI. Select **Super User Admin Panel**.
2. On the Red Hat Quay Management page, click **Globally visible user messages** on the left hand pane.
3. Click **Create Message** to show a drop-down menu containing **Normal**, **Warning**, and **Error** message types:



4. Enter a message by selecting **Click to set message**, then click **Create Message**.

Messages can be deleted by clicking **Options** and then **Delete Message**.

## 3.3. REPOSITORY MIRRORING

### 3.3.1. Repository mirroring

Red Hat Quay repository mirroring lets you mirror images from external container registries, or another local registry, into your Red Hat Quay cluster. Using repository mirroring, you can synchronize images to Red Hat Quay based on repository names and tags.

From your Red Hat Quay cluster with repository mirroring enabled, you can perform the following:

- Choose a repository from an external registry to mirror
- Add credentials to access the external registry
- Identify specific container image repository names and tags to sync
- Set intervals at which a repository is synced
- Check the current state of synchronization

To use the mirroring functionality, you need to perform the following actions:

- Enable repository mirroring in the Red Hat Quay configuration file
- Run a repository mirroring worker
- Create mirrored repositories

All repository mirroring configurations can be performed using the configuration tool UI or by the Red Hat Quay API.

### 3.3.2. Mirroring configuration UI

1. Start the **Quay** container in configuration mode and select the Enable Repository Mirroring check box. If you want to require HTTPS communications and verify certificates during mirroring, select the HTTPS and cert verification check box.

 Repository Mirroring

If enabled, scheduled mirroring of repositories from remote registries will be available.

Enable Repository Mirroring



A repository mirror service must be running to use this feature. Documentation on setting up and running this service can be found at [Running Repository Mirroring Service](#).

Require HTTPS and verify certificates of Quay registry during mirror.

2. Validate and download the **configuration** file, and then restart Quay in registry mode using the updated config file.

### 3.3.3. Mirroring worker

Use the following procedure to start the repository mirroring worker.

## Procedure

- If you have not configured TLS communications using a **/root/ca.crt** certificate, enter the following command to start a **Quay** pod with the **repomirror** option:

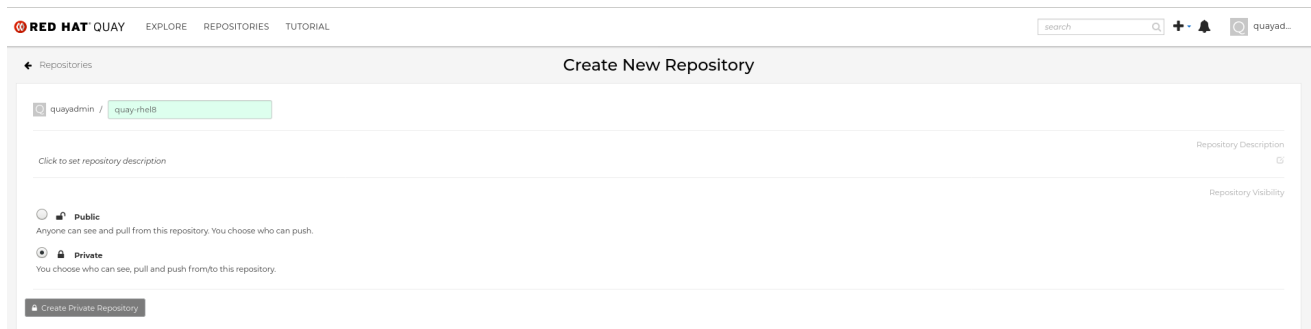
```
$ sudo podman run -d --name mirroring-worker \
-v $QUAY/config:/conf/stack:Z \
registry.redhat.io/quay/quay-rhel8:v3.8.15 repomirror
```

- If you have configured TLS communications using a **/root/ca.crt** certificate, enter the following command to start the repository mirroring worker:

```
$ sudo podman run -d --name mirroring-worker \
-v $QUAY/config:/conf/stack:Z \
-v /root/ca.crt:/etc/pki/ca-trust/source/anchors/ca.crt:Z \
registry.redhat.io/quay/quay-rhel8:v3.8.15 repomirror
```

### 3.3.4. Creating a mirrored repository

When mirroring a repository from an external container registry, you must create a new private repository. Typically, the same name is used as the target repository, for example, **quay-rhel8**.



#### 3.3.4.1. Repository mirroring settings

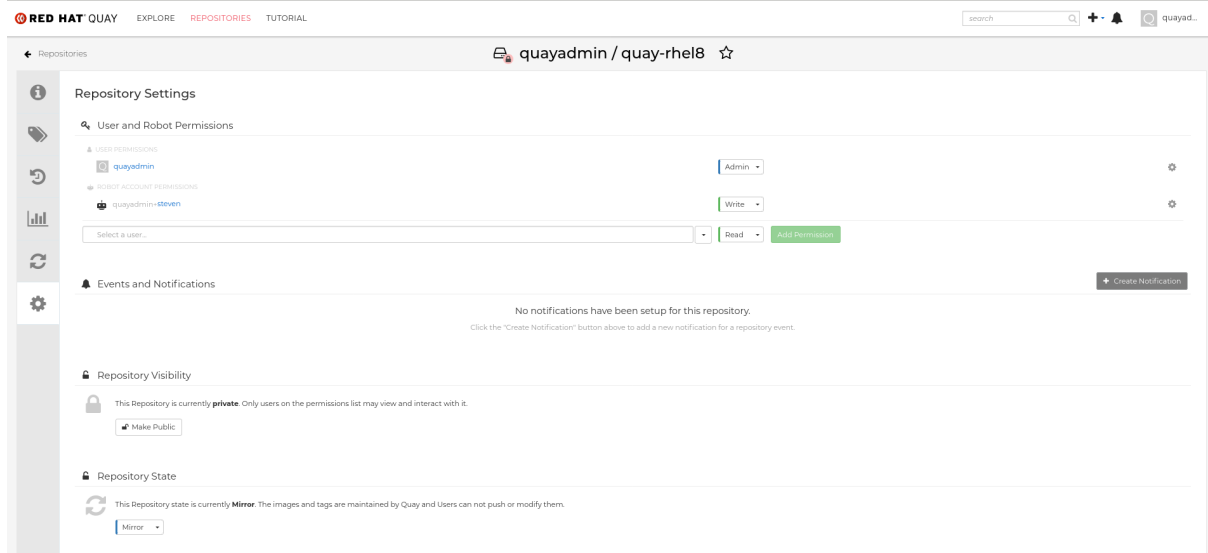
Use the following procedure to adjust the settings of your mirrored repository.

### Prerequisites

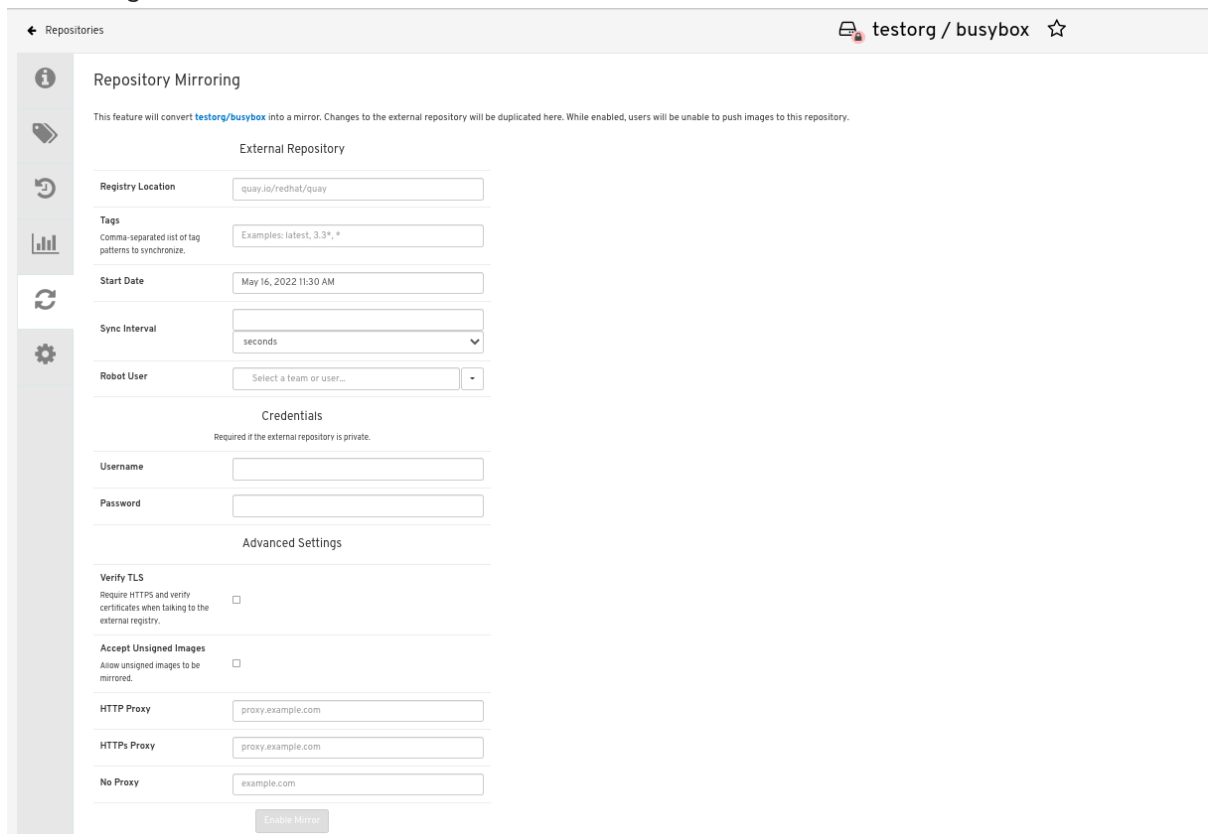
- You have enabled repository mirroring in your Red Hat Quay configuration file.
- You have deployed a mirroring worker.

### Procedure

1. In the Settings tab, set the Repository State to **Mirror**:



- In the Mirror tab, enter the details for connecting to the external registry, along with the tags, scheduling and access information:



- Enter the details as required in the following fields:

- **Registry Location:** The external repository you want to mirror, for example, **registry.redhat.io/quay/quay-rhel8**
- **Tags:** This field is required. You may enter a comma-separated list of individual tags or tag patterns. (See *Tag Patterns* section for details.)
- **Start Date:** The date on which mirroring begins. The current date and time is used by default.
- **Sync Interval:** Defaults to syncing every 24 hours. You can change that based on hours or days.

- **Robot User:** Create a new robot account or choose an existing robot account to do the mirroring.
- **Username:** The username for accessing the external registry holding the repository you are mirroring.
- **Password:** The password associated with the Username. Note that the password cannot include characters that require an escape character (\).

### 3.3.4.2. Advanced settings

In the **Advanced Settings** section, you can configure SSL/TLS and proxy with the following options:

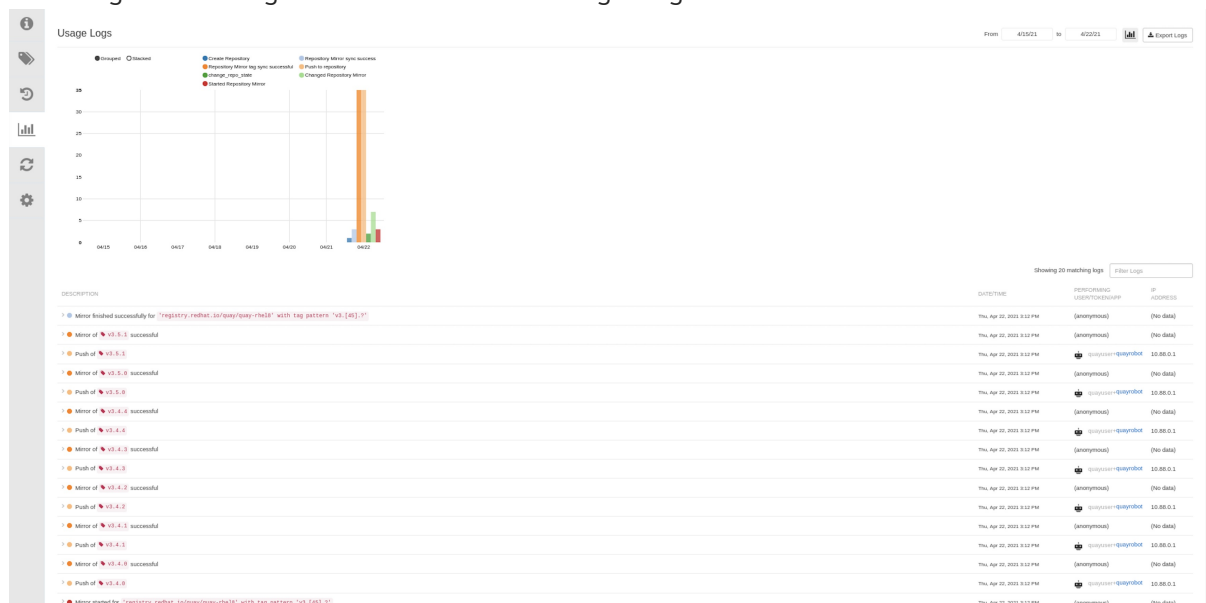
- **Verify TLS:** Select this option if you want to require HTTPS and to verify certificates when communicating with the target remote registry.
- **Accept Unsigned Images:** Selecting this option allows unsigned images to be mirrored.
- **HTTP Proxy:** Select this option if you want to require HTTPS and to verify certificates when communicating with the target remote registry.
- **HTTPS PROXY:** Identify the HTTPS proxy server needed to access the remote site, if a proxy server is needed.
- **No Proxy:** List of locations that do not require proxy.

### 3.3.4.3. Synchronize now

Use the following procedure to initiate the mirroring operation.

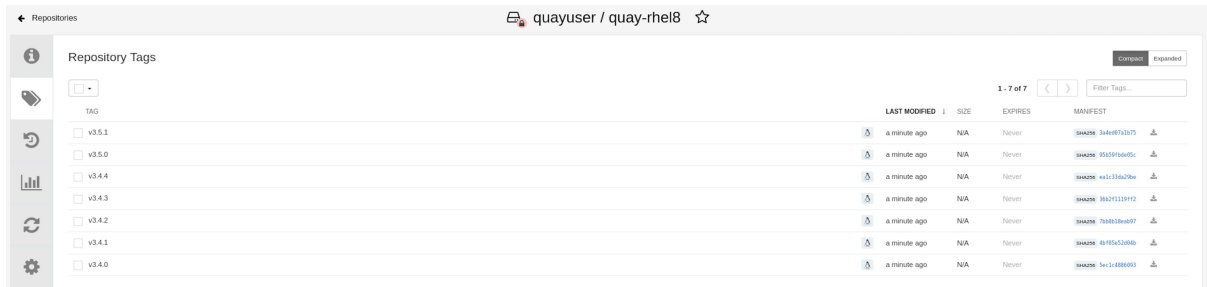
#### Procedure

- To perform an immediate mirroring operation, press the Sync Now button on the repository's Mirroring tab. The logs are available on the Usage Logs tab:

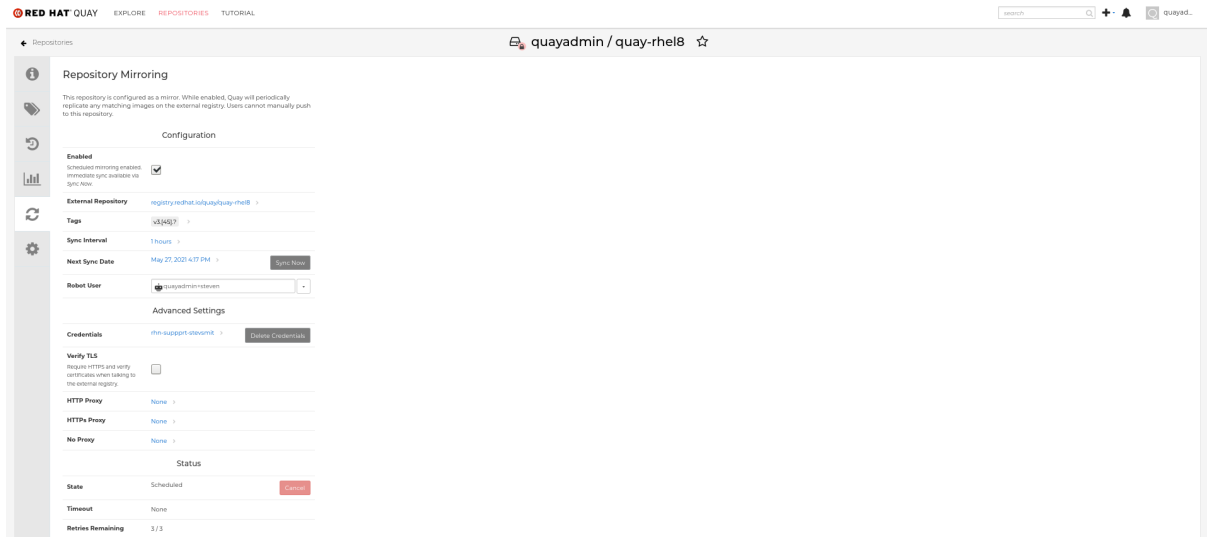


When the mirroring is complete, the images will appear in the Tags tab:





Below is an example of a completed Repository Mirroring screen:



### 3.3.5. Mirroring tag patterns

At least one tag must be entered. The following table references possible image tag patterns.

#### 3.3.5.1. Pattern syntax

Pattern	Description
*	Matches all characters
?	Matches any single character
[seq]	Matches any character in seq
[!seq]	Matches any character not in seq

#### 3.3.5.2. Example tag patterns

Example Pattern	Example Matches
v3*	v32, v3.1, v3.2, v3.2-4beta, v3.3
v3.*	v3.1, v3.2, v3.2-4beta

v3.?	v3.1, v3.2, v3.3
v3.[12]	v3.1, v3.2
v3.[12]*	v3.1, v3.2, v3.2-4beta
v3.[!1]*	v3.2, v3.2-4beta, v3.3

## 3.4. CLAIR FOR RED HAT QUAY

Clair v4 (Clair) is an open source application that leverages static code analyses for parsing image content and reporting vulnerabilities affecting the content. Clair is packaged with Red Hat Quay and can be used in both standalone and Operator deployments. It can be run in highly scalable configurations, where components can be scaled separately as appropriate for enterprise environments.

### 3.4.1. Setting up Clair on standalone Red Hat Quay deployments

For standalone Red Hat Quay deployments, you can set up Clair manually.

#### Procedure

1. In your Red Hat Quay installation directory, create a new directory for the Clair database data:

```
$ mkdir /home/<user-name>/quay-poc/postgres-clairv4
```

2. Set the appropriate permissions for the **postgres-clairv4** file by entering the following command:

```
$ setfacl -m u:26:-wx /home/<user-name>/quay-poc/postgres-clairv4
```

3. Deploy a Clair Postgres database by entering the following command:

```
$ sudo podman run -d --name postgresql-clairv4 \
  -e POSTGRESQL_USER=clairuser \
  -e POSTGRESQL_PASSWORD=clairpass \
  -e POSTGRESQL_DATABASE=clair \
  -e POSTGRESQL_ADMIN_PASSWORD=adminpass \
  -p 5433:5433 \
  -v /home/<user-name>/quay-poc/postgres-clairv4:/var/lib/pgsql/data:Z \
  {postgresimage}
```

4. Install the Postgres **uuid-osp** module for your Clair deployment:

```
$ podman exec -it postgresql-clairv4 /bin/bash -c 'echo "CREATE EXTENSION IF NOT EXISTS \"uuid-osp\"\" | psql -d clair -U postgres'
```

#### Example output

```
CREATE EXTENSION
```



## NOTE

Clair requires the **uuid-oss** extension to be added to its Postgres database. For users with proper privileges, creating the extension will automatically be added by Clair. If users do not have the proper privileges, the extension must be added before start Clair.

If the extension is not present, the following error will be displayed when Clair attempts to start: **ERROR: Please load the "uuid-oss" extension. (SQLSTATE 42501).**

5. Stop the **Quay** container if it is running and restart it in configuration mode, loading the existing configuration as a volume:

```
$ sudo podman run --rm -it --name quay_config \
  -p 80:8080 -p 443:8443 \
  -v $QUAY/config:/conf/stack:Z \
  {productrepo}/{quayimage}:{productminv} config secret
```

6. Log in to the configuration tool and click **Enable Security Scanning** in the **Security Scanner** section of the UI.
7. Set the HTTP endpoint for Clair using a port that is not already in use on the **quay-server** system, for example, **8081**.
8. Create a pre-shared key (PSK) using the **Generate PSK** button.

## Security Scanner UI

### Security Scanner

If enabled, all images pushed to Quay will be scanned via the external security scanning service, with vulnerability information available in the UI and API, as well as async notification support.

**Enable Security Scanning**

**i** A scanner compliant with the Quay Security Scanning API must be running to use this feature. Documentation on running Clair can be found at [Running Clair Security Scanner](#).

**Security Scanner Endpoint:**

The HTTP URL at which the security scanner is running.

**Security Scanner PSK:**

**Generate PSK**

Clair Pre-Shared Key. Make sure to include this value in your Clair config.

9. Validate and download the **config.yaml** file for Red Hat Quay, and then stop the **Quay** container that is running the configuration editor.
10. Extract the new configuration bundle into your Red Hat Quay installation directory, for example:

```
$ tar xvf quay-config.tar.gz -d /home/<user-name>/quay-poc/
```

11. Create a folder for your Clair configuration file, for example:

```
$ mkdir /etc/opt/clairv4/config/
```

12. Change into the Clair configuration folder:

```
$ cd /etc/opt/clairv4/config/
```

13. Create a Clair configuration file, for example:

```

http_listen_addr: :8081
introspection_addr: :8088
log_level: debug
indexer:
  connstring: host=quay-server.example.com port=5433 dbname=clair user=clairuser
  password=clairpass sslmode=disable
  scanlock_retry: 10
  layer_scan_concurrency: 5
  migrations: true
matcher:
  connstring: host=quay-server.example.com port=5433 dbname=clair user=clairuser
  password=clairpass sslmode=disable
  max_conn_pool: 100
  run: ""
  migrations: true
  indexer_addr: clair-indexer
notifier:
  connstring: host=quay-server.example.com port=5433 dbname=clair user=clairuser
  password=clairpass sslmode=disable
  delivery_interval: 1m
  poll_interval: 5m
  migrations: true
auth:
  psk:
    key: "MTU5YzA4Y2ZkNzJoMQ=="
    iss: ["quay"]
# tracing and metrics
trace:
  name: "jaeger"
  probability: 1
  jaeger:
    agent_endpoint: "localhost:6831"
    service_name: "clair"
metrics:
  name: "prometheus"

```

For more information about Clair's configuration format, see [Clair configuration reference](#).

14. Start Clair by using the container image, mounting in the configuration from the file you created:

```

$ sudo podman run -d --name clairv4 \
-p 8081:8081 -p 8088:8088 \
-e CLAIR_CONF=/clair/config.yaml \
-e CLAIR_MODE=combo \
-v /etc/opt/clairv4/config:/clair:Z \
registry.redhat.io/quay/clair-rhel8:v3.8.15

```



#### NOTE

Running multiple Clair containers is also possible, but for deployment scenarios beyond a single container the use of a container orchestrator like Kubernetes or OpenShift Container Platform is strongly recommended.

### 3.4.2. Testing Clair

Use the following procedure to test Clair on either a standalone Red Hat Quay deployment, or on an OpenShift Container Platform Operator-based deployment.

#### Prerequisites

- You have deployed the Clair container image.

#### Procedure

1. Pull a sample image by entering the following command:

```
$ podman pull ubuntu:20.04
```

2. Tag the image to your registry by entering the following command:

```
$ sudo podman tag docker.io/library/ubuntu:20.04 <quay-server.example.com>/<user-name>/ubuntu:20.04
```

3. Push the image to your Red Hat Quay registry by entering the following command:

```
$ sudo podman push --tls-verify=false quay-server.example.com/quayadmin/ubuntu:20.04
```

4. Log in to your Red Hat Quay deployment through the UI.
5. Click the repository name, for example, **quayadmin/ubuntu**.
6. In the navigation pane, click **Tags**.

#### Report summary

TAG	LAST MODIFIED	SECURITY SCAN	SIZE	EXPIRES	MANIFEST
18.04	9 days ago	6 High · 82 fixable	25.5 MB	Never	SHA256 b58746c8a899
19.04	10 days ago	Passed	26.4 MB	Never	SHA256 61844ceb1dd5

7. Click the image report, for example, **45 medium**, to show a more detailed report:

#### Report details

Quay Security Scanner has detected **146** vulnerabilities. Patches are available for **82** vulnerabilities.

- 6 High-level vulnerabilities.
- 45 Medium-level vulnerabilities.
- 57 Low-level vulnerabilities.
- 38 Negligible-level vulnerabilities.

**Vulnerabilities**

CVE	SEVERITY	PACKAGE	CURRENT VERSION	FIXED IN VERSION	INTRODUCED IN LAYER
CVE-2019-3462	High	apt	1.6.12	1.7.0ubuntu0.1	file:c3e6bb316dfa6b81dd4478aaa310df532883...
CVE-2019-3462	High	libapt-pkg5.0	1.6.12	1.7.0ubuntu0.1	file:c3e6bb316dfa6b81dd4478aaa310df532883...
CVE-2018-16864	High	libudev1	237-3ubuntu10.39	239-7ubuntu10.6	file:c3e6bb316dfa6b81dd4478aaa310df532883...

### 3.4.3. CVE ratings from the National Vulnerability Database

As of Clair v4.2, Common Vulnerability Scoring System (CVSS) enrichment data is now viewable in the Red Hat Quay UI. Additionally, Clair v4.2 adds CVSS scores from the National Vulnerability Database for detected vulnerabilities.

With this change, if the vulnerability has a CVSS score that is within 2 levels of the distribution score, the Red Hat Quay UI present's the distribution's score by default. For example:

**DESCRIPTION**  
The SUSE coreutils-118n\_patch for GNU coreutils allows context-dependent attackers to cause a denial of service (segmentation fault and crash) via a long string to the uniq command, which triggers a stack-based buffer overflow in the alloca function.

CVE-2015-4041 Unknown \* coreutils 8.30-3 0:0 ADD roofs.tar / # buildkit

**SEVERITY NOTE**  
Note that this vulnerability was originally given a CVSSv3 score of 7.8 by NVD but was subsequently reclassified as Unknown by Unknown

Attack Vector	Attack Complexity	Privileges Required	User Interaction	Scope	Confidentiality Impact	Integrity Impact	Availability Impact
Local	Low	None	None	Unchanged	High	High	High

**DESCRIPTION**  
The keycompare\_mb function in sort.c in sort in GNU Coreutils through 8.23 on 64-bit platforms performs a size calculation without considering the number of bytes occupied by multibyte characters, which allows attackers to cause a denial of service (heap-based buffer overflow and application crash) or possibly have unspecified other impact via long UTF-8 strings.

This differs from the previous interface, which would only display the following information:

CVE-2015-4041 Unknown coreutils 8.30-3 0:0 ADD roofs.tar / # buildkit

**DESCRIPTION**  
The keycompare\_mb function in sort.c in sort in GNU Coreutils through 8.23 on 64-bit platforms performs a size calculation without considering the number of bytes occupied by multibyte characters, which allows attackers to cause a denial of service (heap-based buffer overflow and application crash) or possibly have unspecified other impact via long UTF-8 strings.

### Additional resources

- Vulnerability reporting with Clair on Red Hat Quay

## 3.5. RESTARTING CONTAINERS

Because the `--restart` option is not fully supported by podman, you can configure **podman** as a systemd service, as described in [Porting containers to systemd using Podman](#)

### 3.5.1. Using systemd unit files with Podman

By default, Podman generates a unit file for existing containers or pods. You can generate more portable systemd unit files using the **podman generate systemd --new** command. The **--new** flag instructs Podman to generate unit files that create, start and remove containers.

1. Create the systemd unit files from a running Red Hat Quay registry as follows:

```
$ sudo podman generate systemd --new --files --name redis
$ sudo podman generate systemd --new --files --name postgresql-quay
$ sudo podman generate systemd --new --files --name quay
$ sudo podman generate systemd --new --files --name postgresql-clairv4
$ sudo podman generate systemd --new --files --name clairv4
```

2. Copy the unit files to **/usr/lib/systemd/system** for installing them as a root user:

```
$ sudo cp -Z container-redis.service /usr/lib/systemd/system
$ sudo cp -Z container-postgresql-quay.service /usr/lib/systemd/system
$ sudo cp -Z container-quay.service /usr/lib/systemd/system
$ sudo cp -Z container-postgresql-clairv4.service /usr/lib/systemd/system
$ sudo cp -Z container-clairv4.service /usr/lib/systemd/system
```

3. Reload systemd manager configuration:

```
$ sudo systemctl daemon-reload
```

4. Enable the services and start them at boot time:

```
$ sudo systemctl enable --now container-redis.service
$ sudo systemctl enable --now container-postgresql-quay.service
$ sudo systemctl enable --now container-quay.service
$ sudo systemctl enable --now container-postgresql-clairv4.service
$ sudo systemctl enable --now container-clairv4.service
```

### 3.5.2. Starting, stopping and checking the status of services

1. Check the status of the Quay components:

```
$ sudo systemctl status container-redis.service
$ sudo systemctl status container-postgresql-quay.service
$ sudo systemctl status container-quay.service
$ sudo systemctl status container-postgresql-clairv4.service
$ sudo systemctl status container-clairv4.service
```

2. To stop the Quay component services:

```
$ sudo systemctl stop container-redis.service
$ sudo systemctl stop container-postgresql-quay.service
$ sudo systemctl stop container-quay.service
$ sudo systemctl stop container-postgresql-clairv4.service
$ sudo systemctl stop container-clairv4.service
```

3. To start the Quay component services:

```
$ sudo systemctl start container-redis.service
```

```
$ sudo systemctl start container-postgresql-quay.service
$ sudo systemctl start container-quay.service
$ sudo systemctl start container-postgresql-clairv4.service
$ sudo systemctl start container-clairv4.service
```

### 3.5.3. Testing restart after reboot

Once you have the services configured and enabled, reboot the system. When the system has re-started, use **podman ps** to check that all the containers for the Quay components have been restarted:

```
$ sudo podman ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS
PORTS NAMES
4e87c7889246 {postgresimage} run-postgresql 19 seconds ago Up 18 seconds ago
0.0.0.0:5432->5432/tcp postgresql-quay
b8fbac1920d4 registry.redhat.io/rhel8/redis-6:1-110) run-redis 19 seconds ago Up 18
seconds ago 0.0.0.0:6379->6379/tcp redis
d959d5bf7a24 {postgresimage} run-postgresql 18 seconds ago Up 18 seconds ago 0.0.0.0:5433-
>5432/tcp postgresql-clairv4
e75ff8651dbd registry.redhat.io/quay/clair-rhel8:v3.4.0 18 seconds ago Up 17 seconds
ago 0.0.0.0:8081->8080/tcp clairv4
```

In this instance, the **Quay** container itself has failed to start up. This is due to the fact that, when security scanning is enabled in Quay, it tries to connect to Clair on startup. However, Clair has not finished initializing and cannot accept connections and, as a result, Quay terminates immediately. To overcome this issue, you need to configure the Quay service to have a dependency on the Clair service, as shown in the following section.

### 3.5.4. Configuring Quay's dependency on Clair

In the **systemd** service file for Quay, set up a dependency on the Clair service in the **[Unit]** section by setting **After=container-clairv4.service**. To give the Clair container time to initialize, add a delay in the **[Service]** section, for example **RestartSec=30**. Here is an example of the modified Quay file, after configuring the dependency on Clair:

**/usr/lib/systemd/system/container-quay.service**

```
# container-quay.service
# autogenerated by Podman 2.0.5
# Tue Feb 16 17:02:26 GMT 2021

[Unit]
Description=Podman container-quay.service
Documentation=man:podman-generate-systemd(1)
Wants=network.target
After=container-clairv4.service

[Service]
Environment=PODMAN_SYSTEMD_UNIT=%n
Restart=on-failure
RestartSec=30
ExecStartPre=/bin/rm -f %t/container-quay.pid %t/container-quay.ctr-id
ExecStart=/usr/bin/podman run --common-pidfile %t/container-quay.pid --cidfile %t/container-
quay.ctr-id --cgroups=no-common -d --rm -p 8080:8080 --name=quay -v
```



```

/home/user1/quay/config:/conf/stack:Z -v /home/user1/quay/storage:/datastorage:Z
registry.redhat.io/quay/quay-rhel8:v3.4.0
ExecStop=/usr/bin/podman stop --ignore --cidfile %t/container-quay.ctr-id -t 10
ExecStopPost=/usr/bin/podman rm --ignore -f --cidfile %t/container-quay.ctr-id
PIDFile=%t/container-quay.pid
KillMode=none
Type=forking

[Install]
WantedBy=multi-user.target default.target

```

Once you have updated the Quay service configuration, reboot the server and immediately run **podman ps**:

```

$ sudo podman ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS
PORTS NAMES
4e87c7889246 {postgresimage} run-postgresql 29 seconds ago Up 28 seconds ago
0.0.0.0:5432->5432/tcp postgresql-quay
b8fbac1920d4 registry.redhat.io/rhel8/redis-6:1-110) run-redis 29 seconds ago Up 28
seconds ago 0.0.0.0:6379->6379/tcp redis
d959d5bf7a24 {postgresimage} run-postgresql 28 seconds ago Up 28 seconds ago 0.0.0.0:5433-
>5432/tcp postgresql-clairv4
e75ff8651dbd registry.redhat.io/quay/clair-rhel8:v3.4.0 28 seconds ago Up 27 seconds
ago 0.0.0.0:8081->8080/tcp clairv4

```

Initially, the **Quay** container will not be available, but once the **RestartSec** delay has expired, it should start up:

```

$ sudo podman ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS
PORTS NAMES
4e87c7889246 {postgresimage} run-postgresql 35 seconds ago Up 34 seconds ago
0.0.0.0:5432->5432/tcp postgresql-quay
ab9f0e6ad7c3 registry.redhat.io/quay/quay-rhel8:v3.4.0 registry 3 seconds ago Up 2 seconds
ago 0.0.0.0:8080->8080/tcp quay
b8fbac1920d4 registry.redhat.io/rhel8/redis-6:1-110) run-redis 35 seconds ago Up 34
seconds ago 0.0.0.0:6379->6379/tcp redis
d959d5bf7a24 {postgresimage} run-postgresql 34 seconds ago Up 34 seconds ago 0.0.0.0:5433-
>5432/tcp postgresql-clairv4
e75ff8651dbd registry.redhat.io/quay/clair-rhel8:v3.4.0 34 seconds ago Up 33 seconds
ago 0.0.0.0:8081->8080/tcp clairv4

```

The **CREATED** field for the **Quay** container shows the 30 second difference in creation time, as configured in the service definition.

Log in to the Red Hat Quay registry at **quay-server.example.com** and ensure that everything has restarted correctly.

## 3.6. FEDERAL INFORMATION PROCESSING STANDARD (FIPS) READINESS AND COMPLIANCE

The Federal Information Processing Standard (FIPS) developed by the National Institute of Standards and Technology (NIST) is regarded as the highly regarded for securing and encrypting sensitive data,

notably in highly regulated areas such as banking, healthcare, and the public sector. Red Hat Enterprise Linux (RHEL) and OpenShift Container Platform support the FIPS standard by providing a *FIPS mode*, in which the system only allows usage of specific FIPS-validated cryptographic modules like **openssl**. This ensures FIPS compliance.

Red Hat Quay supports running on FIPS-enabled RHEL and OpenShift Container Platform environments from Red Hat Quay version 3.5.0.

## CHAPTER 4. NEXT STEPS

This document shows how to configure and deploy a proof-of-concept version of Red Hat Quay. For more information on deploying to a production environment, see the guide "Deploy Red Hat Quay - High Availability".

The "Use Red Hat Quay" guide shows you how to:

- Add users and repositories
- Use tags
- Automatically build Dockerfiles with build workers
- Set up build triggers
- Add notifications for repository events

The "Manage Red Hat Quay" guide shows you how to:

- Use SSL and TLS
- Enable security scanning with Clair
- Use repository mirroring
- Configure LDAP authentication
- Use georeplication of storage