Red Hat Enterprise Linux 10-beta

Building, running, and managing containers

Using Podman, Buildah, and Skopeo on Red Hat Enterprise Linux

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Abstract

Red Hat Enterprise Linux (RHEL) provides a number of command-line tools for working with container images. You can manage pods and container images using Podman. To build, update, and manage container images you can use Buildah. To copy and inspect images in remote repositories, you can use Skopeo.

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RHEL BETA RELEASE

Red Hat provides Red Hat Enterprise Linux Beta access to all subscribed Red Hat accounts. The purpose of Beta access is to:

- Provide an opportunity to customers to test major features and capabilities prior to the general availability release and provide feedback or report issues.
- Provide Beta product documentation as a preview. Beta product documentation is under development and is subject to substantial change.

Note that Red Hat does not support the usage of RHEL Beta releases in production use cases. For more information, see the Red Hat Knowledgebase solution What does Beta mean in Red Hat Enterprise Linux and can I upgrade a RHEL Beta installation to a General Availability (GA) release?.

CHAPTER 1. INTRODUCTION TO CONTAINERS

Linux containers have emerged as a key open source application packaging and delivery technology, combining lightweight application isolation with the flexibility of image-based deployment methods. Red Hat Enterprise Linux implements Linux containers using core technologies such as:

- Control groups (cgroups) for resource management
- Namespaces for process isolation
- SELinux for security
- Secure multi-tenancy

These technologies reduce the potential for security exploits and provide you with an environment for producing and running enterprise-quality containers.

Red Hat OpenShift provides powerful command-line and Web UI tools for building, managing, and running containers in units referred to as pods. Red Hat allows you to build and manage individual containers and container images outside of OpenShift. This guide describes the tools provided to perform those tasks that run directly on Red Hat Enterprise Linux systems.

Unlike other container tools implementations, the tools described here do not center around the monolithic Docker container engine and **docker** command. Instead, Red Hat provides a set of command-line tools that can operate without a container engine. These include:

- **podman** - for directly managing pods and container images (**run**, **stop**, **start**, **ps**, **attach**, **exec**, and so on)
- **buildah** - for building, pushing, and signing container images
- **skopeo** - for copying, inspecting, deleting, and signing images
- **runc** - for providing container run and build features to podman and buildah
- **crun** - an optional runtime that can be configured and gives greater flexibility, control, and security for rootless containers

Because these tools are compatible with the Open Container Initiative (OCI), they can be used to manage the same Linux containers that are produced and managed by Docker and other OCI-compatible container engines. However, they are especially suited to run directly on Red Hat Enterprise Linux, in single-node use cases.

For a multi-node container platform, see OpenShift and Using the CRI-O Container Engine for details.

1.1. CHARACTERISTICS OF PODMAN, BUILDAH, AND SKOPEO

The Podman, Skopeo, and Buildah tools were developed to replace Docker command features. Each tool in this scenario is more lightweight and focused on a subset of features.

The main advantages of Podman, Skopeo and Buildah tools include:

- Running in rootless mode - rootless containers are much more secure, as they run without any added privileges

- No daemon required - these tools have much lower resource requirements at idle, because if you are not running containers, Podman is not running. Docker, conversely, have a daemon always running

- Native **systemd** integration - Podman allows you to create **systemd** unit files and run containers as system services

The characteristics of Podman, Skopeo, and Buildah include:

- Podman, Buildah, and the CRI-O container engine all use the same back-end store directory, **/var/lib/containers**, instead of using the Docker storage location **/var/lib/docker**, by default.

- Although Podman, Buildah, and CRI-O share the same storage directory, they cannot interact with each other's containers. Those tools can share images.

- To interact programmatically with Podman, you can use the Podman v2.0 RESTful API, it works in both a rootful and a rootless environment. For more information, see Using the container-tools API chapter.

1.2. RUNNING CONTAINERS WITHOUT DOCKER

Red Hat removed the Docker container engine and the docker command from RHEL 10.

If you still want to use Docker in RHEL, you can get Docker from different upstream projects, but it is unsupported in RHEL 10.

- You can install the **podman-docker** package, every time you run a **docker** command, it actually runs a **podman** command.

- Podman also supports the Docker Socket API, so the **podman-docker** package also sets up a link between **/var/run/docker.sock** and **/var/run/podman/podman.sock**. As a result, you can continue to run your Docker API commands with **docker-py** and **docker-compose** tools without requiring the Docker daemon. Podman will service the requests.

- The **podman** command, like the **docker** command, can build container images from a **Containerfile** or **Dockerfile**. The available commands that are usable inside a **Containerfile** and a **Dockerfile** are equivalent.

- Options to the **docker** command that are not supported by **podman** include network, node, plugin (**podman** does not support plugins), rename (use rm and create to rename containers with **podman**), secret, service, stack, and swarm (**podman** does not support Docker Swarm). The container and image options are used to run subcommands that are used directly in **podman**.

1.3. SUPPORTED ARCHITECTURES FOR CONTAINER DEPLOYMENT IN RHEL

Red Hat provides container images and container-related software for the following computer architectures:

- AMD64 and Intel 64 (base and layered images; no support for 32-bit architectures)

- PowerPC 8 and 9 64-bit (base image and most layered images)

- 64-bit IBM Z (base image and most layered images)

- ARM 64-bit (base image only)

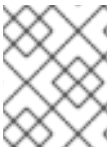
Although not all Red Hat images were supported across all architectures at first, nearly all are now available on all listed architectures.

Additional resources

- Universal Base Images (UBI): Images, repositories, and packages

1.4. INSTALLING CONTAINER TOOLS

This procedure shows how you can install the **container-tools** meta-package which contains the Podman, Buildah, Skopeo, CRIU, Udica, and all required libraries.



NOTE

The stable streams are not available on RHEL 9. To receive stable access to Podman, Buildah, Skopeo, and others, use the RHEL EUS subscription.

Procedure

1. Install RHEL.
2. Register RHEL: Enter your user name and password. The user name and password are the same as your login credentials for Red Hat Customer Portal:

```
# subscription-manager register
Registering to: subscription.rhsm.redhat.com:443/subscription
Username: <username>
Password: <password>
```

3. Subscribe to RHEL.
   - To auto-subscribe to RHEL:

```
# subscription-manager attach --auto
```

   - To subscribe to RHEL by Pool ID:

```
# subscription-manager attach --pool <PoolID>
```

4. Install the **container-tools** meta-package:

```
# dnf install container-tools
```

   You can also install **podman**, **buildah**, and **skopeo** individually if you prefer.

5. Optional: Install the **podman-docker** package:

```
# dnf install podman-docker
```

   The **podman-docker** package replaces the Docker command-line interface and **docker-api** with the matching Podman commands instead.

1.5. SPECIAL CONSIDERATIONS FOR ROOTLESS CONTAINERS

There are several considerations when running containers as a non-root user:

- The path to the host container storage is different for root users (**/var/lib/containers/storage**) and non-root users (**$HOME/.local/share/containers/storage**).
- Users running rootless containers are given special permission to run as a range of user and group IDs on the host system. However, they have no root privileges to the operating system on the host.
- If you change the **/etc/subuid** or **/etc/subgid** manually, you have to run the **podman system migrate** command to allow the new changes to be applied.
- If you need to configure your rootless container environment, create configuration files in your home directory (**$HOME/.config/containers**). Configuration files include **storage.conf** (for configuring storage) and **containers.conf** (for a variety of container settings). You could also create a **registries.conf** file to identify container registries that are available when you use Podman to pull, search, or run images.
- There are some system features you cannot change without root privileges. For example, you cannot change the system clock by setting a **SYS_TIME** capability inside a container and running the network time service (**ntpd**). You have to run that container as root, bypassing your rootless container environment and using the root user's environment. For example:

  ```
  # podman run -d --cap-add SYS_TIME ntpd
  ```

  Note that this example allows **ntpd** to adjust time for the entire system, and not just within the container.
- A rootless container cannot access a port numbered less than 1024. Inside the rootless container namespace it can, for example, start a service that exposes port 80 from an httpd service from the container, but it is not accessible outside of the namespace:

  ```
  $ podman run -d httpd
  ```

  However, a container would need root privileges, using the root user's container environment, to expose that port to the host system:

  ```
  # podman run -d -p 80:80 httpd
  ```
- The administrator of a workstation can allow users to expose services on ports numbered lower than 1024, but they should understand the security implications. A regular user could, for example, run a web server on the official port 80 and make external users believe that it was configured by the administrator. This is acceptable on a workstation for testing, but might not be a good idea on a network-accessible development server, and definitely should not be done on production servers. To allow users to bind to ports down to port 80 run the following command:

  ```
  # echo 80 > /proc/sys/net/ipv4/ip_unprivileged_port_start
  ```

1.6. USING MODULES FOR ADVANCED PODMAN CONFIGURATION

You can use Podman modules to load a predetermined set of configurations. Podman modules are **containers.conf** files in the Tom's Obvious Minimal Language (TOML) format.

These modules are located in the following directories, or their subdirectories:

- For rootless users: **$HOME/.config/containers/containers.conf.modules**
- For root users: **/etc/containers/containers.conf.modules**, or **/usr/share/containers/containers.conf.modules**

You can load the modules on-demand with the **podman --module <your_module_name>** command to override the system and user configuration files. Working with modules involve the following facts:

- You can specify modules multiple times by using the **--module** option.
- If **<your_module_name>** is the absolute path, the configuration file will be loaded directly.
- The relative paths are resolved relative to the three module directories mentioned previously.
- Modules in **$HOME** override those in the **/etc/** and **/usr/share/** directories.

Additional resources

- **containers.conf(5)** man page on your system

1.7. ADDITIONAL RESOURCES

- A Practical Introduction to Container Terminology

CHAPTER 2. TYPES OF CONTAINER IMAGES

The container image is a binary that includes all of the requirements for running a single container, and metadata describing its needs and capabilities.

There are two types of container images:

- Red Hat Enterprise Linux Base Images (RHEL base images)
- Red Hat Universal Base Images (UBI images)

Both types of container images are built from portions of Red Hat Enterprise Linux. By using these containers, users can benefit from great reliability, security, performance and life cycles.

The main difference between the two types of container images is that the UBI images allow you to share container images with others. You can build a containerized application using UBI, push it to your choice of registry server, easily share it with others, and even deploy it on non-Red Hat platforms. The UBI images are designed to be a foundation for cloud-native and web applications use cases developed in containers.

2.1. GENERAL CHARACTERISTICS OF RHEL CONTAINER IMAGES

Following characteristics apply to both RHEL base images and UBI images.

In general, RHEL container images are:

- **Supported**: Supported by Red Hat for use with containerized applications. They contain the same secured, tested, and certified software packages found in Red Hat Enterprise Linux.
- **Cataloged**: Listed in the Red Hat Container Catalog , with descriptions, technical details, and a health index for each image.
- **Updated**: Offered with a well-defined update schedule, to get the latest software, see Red Hat Container Image Updates article.
- **Tracked**: Tracked by Red Hat Product Errata to help understand the changes that are added into each update.
- **Reusable**: The container images need to be downloaded and cached in your production environment once. Each container image can be reused by all containers that include it as their foundation.

2.2. CHARACTERISTICS OF UBI IMAGES

The UBI images allow you to share container images with others. Four UBI images are offered: micro, minimal, standard, and init. Pre-build language runtime images and DNF repositories are available to build your applications.

Following characteristics apply to UBI images:

- **Built from a subset of RHEL content** Red Hat Universal Base images are built from a subset of normal Red Hat Enterprise Linux content.
- **Redistributable**: UBI images allow standardization for Red Hat customers, partners, ISVs, and others. With UBI images, you can build your container images on a foundation of official Red Hat software that can be freely shared and deployed.

- **Provide a set of four base images** micro, minimal, standard, and init.
- **Provide a set of pre-built language runtime container images**The runtime images based on Application Streams provide a foundation for applications that can benefit from standard, supported runtimes such as python, perl, php, dotnet, nodejs, and ruby.
- **Provide a set of associated DNF repositories** DNF repositories include RPM packages and updates that allow you to add application dependencies and rebuild UBI container images.
    - The **ubi-10-baseos** repository holds the redistributable subset of RHEL packages you can include in your container.
    - The **ubi-10-appstream** repository holds Application streams packages that you can add to a UBI image to help you standardize the environments you use with applications that require particular runtimes.
    - **Adding UBI RPMs**: You can add RPM packages to UBI images from preconfigured UBI repositories. If you happen to be in a disconnected environment, you must allowlist the UBI Content Delivery Network (**https://cdn-ubi.redhat.com**) to use that feature. See the Connect to https://cdn-ubi.redhat.com solution for details.
- **Licensing**: You are free to use and redistribute UBI images, provided you adhere to the Red Hat Universal Base Image End User Licensing Agreement.

NOTE

All of the layered images are based on UBI images. To check on which UBI image is your image based, display the Containerfile in the Red Hat Container Catalog and ensure that the UBI image contains all required content.

Additional resources

- (Re)introducing the Red Hat Universal Base Image
- Universal Base Images (UBI): Images, repositories, and packages
- All You Need to Know About Red Hat Universal Base Image

2.3. UNDERSTANDING THE UBI STANDARD IMAGES

The standard images (named **ubi**) are designed for any application that runs on RHEL. The key features of UBI standard images include:

- **init system**: All the features of the **systemd** initialization system you need to manage **systemd** services are available in the standard base images. These init systems let you install RPM packages that are pre-configured to start up services automatically, such as a Web server (**httpd**) or FTP server (**vsftpd**).
- **dnf**: You have access to free DNF repositories for adding and updating software. You can use the standard set of **dnf** commands (**dnf**, **dnf-config-manager**, **dnfdownloader**, and so on).
- **utilities**: Utilities include **tar**, **dmidecode**, **gzip**, **getfacl** and further ACL commands, **dmsetup** and further device mapper commands, between other utilities not mentioned here.

2.4. UNDERSTANDING THE UBI INIT IMAGES

The UBI init images, named **ubi-init**, contain the **systemd** initialization system, making them useful for building images in which you want to run **systemd** services, such as a web server or file server. The init image contains more content than minimal images but less than standard images.

Because the **ubi10-beta-init** image builds on top of the **ubi10-beta** image, their contents are mostly the same. However, there are a few critical differences:

- **ubi10-beta-init**:
  - CMD is set to /**sbin**/**init** to start the **systemd** Init service by default
  - includes **ps** and process related commands (**procps-ng** package)
  - sets **SIGRTMIN+3** as the **StopSignal**, as **systemd** in **ubi10-beta-init** ignores normal signals to exit (**SIGTERM** and **SIGKILL**), but will terminate if it receives **SIGRTMIN+3**
- **ubi10-beta**:
  - CMD is set to /**bin**/**bash**
  - does not include **ps** and process related commands (**procps-ng** package)
  - does not ignore normal signals to exit (**SIGTERM** and **SIGKILL**)

2.5. UNDERSTANDING THE UBI MINIMAL IMAGES

The UBI minimal images, named **ubi-minimal** offer a minimized pre-installed content set and a package manager (**microdnf**). As a result, you can use a **Containerfile** while minimizing the dependencies included in the image.

The key features of UBI minimal images include:

- **Small size**: Minimal images are about 92M on disk and 32M, when compressed. This makes it less than half the size of the standard images.
- **Software installation (microdnf)**: Instead of including the fully-developed **dnf** facility for working with software repositories and RPM software packages, the minimal images includes the **microdnf** utility. The **microdnf** is a scaled-down version of **dnf** allowing you to enable and disable repositories, remove and update packages, and clean out cache after packages have been installed.
- **Based on RHEL packaging**: Minimal images incorporate regular RHEL software RPM packages, with a few features removed. Minimal images do not include initialization and service management system, such as **systemd** or System V init, Python run-time environment, and some shell utilities. You can rely on RHEL repositories for building your images, while carrying the smallest possible amount of overhead.
- **Modules for microdnf are supported**: Modules used with **microdnf** command let you install multiple versions of the same software, when available. You can use **microdnf module enable**, **microdnf module disable**, and **microdnf module reset** to enable, disable, and reset a module stream, respectively.
  - For example, to enable the **nodejs:14** module stream inside the UBI minimal container, enter:

```
# microdnf module enable nodejs:14
Downloading metadata...
```

```
...
Enabling module streams:
   nodejs:14

Running transaction test...
```

Red Hat only supports the latest version of UBI and does not support parking on a dot release. If you need to park on a specific dot release, please take a look at Extended Update Support.

2.6. UNDERSTANDING THE UBI MICRO IMAGES

The **ubi-micro** is the smallest possible UBI image, obtained by excluding a package manager and all of its dependencies which are normally included in a container image. This minimizes the attack surface of container images based on the **ubi-micro** image and is suitable for minimal applications, even if you use UBI Standard, Minimal, or Init for other applications. The container image without the Linux distribution packaging is called a Distroless container image.

CHAPTER 3. WORKING WITH CONTAINER REGISTRIES

A container image registry is a repository or collection of repositories for storing container images and container-based application artifacts. The **/etc/containers/registries.conf** file is a system-wide configuration file containing the container image registries that can be used by the various container tools such as Podman, Buildah, and Skopeo.

If the container image given to a container tool is not fully qualified, then the container tool references the **registries.conf** file. Within the **registries.conf** file, you can specify aliases for short names, granting administrators full control over where images are pulled from when not fully qualified. For example, the **podman pull example.com/example_image** command pulls a container image from the **example.com** registry to your local system as specified in the **registries.conf file**.

3.1. CONTAINER REGISTRIES

A container registry is a repository or collection of repositories for storing container images and container-based application artifacts. The registries that Red Hat provides are:

- registry.redhat.io (requires authentication)
- registry.access.redhat.com (requires no authentication)
- registry.connect.redhat.com (holds Red Hat Partner Connect program images)

To get container images from a remote registry, such as Red Hat's own container registry, and add them to your local system, use the **podman pull** command:

```
# podman pull <registry>[:<port>]/[<namespace>/]<name>:<tag>
```

where **<registry>[:<port>]/[<namespace>/]<name>:<tag>** is the name of the container image.

For example, the **registry.redhat.io/ubi10-beta/ubi** container image is identified by:

- Registry server (**registry.redhat.io**)
- Namespace (**ubi10-beta**)
- Image name (**ubi**)

If there are multiple versions of the same image, add a tag to explicitly specify the image name. By default, Podman uses the **:latest** tag, for example **ubi10-beta/ubi:latest**.

Some registries also use *<namespace>* to distinguish between images with the same *<name>* owned by different users or organizations. For example:

Namespace	Examples (*<namespace>*/*<name>*)
organization	**redhat/kubernetes**, **google/kubernetes**
login (user name)	**alice/application**, **bob/application**
role	**devel/database**, **test/database**, **prod/database**

NOTE

Use fully qualified image names including registry, namespace, image name, and tag. When using short names, there is always an inherent risk of spoofing. Add registries that are trusted, that is, registries that do not allow unknown or anonymous users to create accounts with arbitrary names. For example, a user wants to pull the example container image from **example.registry.com registry**. If **example.registry.com** is not first in the search list, an attacker could place a different example image at a registry earlier in the search list. The user would accidentally pull and run the attacker image rather than the intended content.

For details on the transition to registry.redhat.io, see Red Hat Container Registry Authentication . Before you can pull containers from registry.redhat.io, you need to authenticate using your RHEL Subscription credentials.

3.2. CONFIGURING CONTAINER REGISTRIES

You can display the container registries by using the **podman info --format** command:

```
$ podman info -f json | jq '.registries["search"]'
[
  "registry.access.redhat.com",
  "registry.redhat.io",
  "docker.io"
]
```

NOTE

The **podman info** command is available in Podman 4.0.0 or later.

You can edit the list of container registries in the **registries.conf** configuration file. As a root user, edit the **/etc/containers/registries.conf** file to change the default system-wide search settings.

As a user, create the **$HOME/.config/containers/registries.conf** file to override the system-wide settings.

```
unqualified-search-registries = ["registry.access.redhat.com", "registry.redhat.io", "docker.io"]
short-name-mode = "enforcing"
```

By default, the **podman pull** and **podman search** commands search for container images from registries listed in the **unqualified-search-registries** list in the given order.

Configuring a local container registry

You can configure a local container registry without the TLS verification. You have two options on how to disable TLS verification. First, you can use the **--tls-verify=false** option in Podman. Second, you can set **insecure=true** in the **registries.conf** file:

```
[[registry]]
location="localhost:5000"
insecure=true
```

Blocking a registry, namespace, or image

You can define registries the local system is not allowed to access. You can block a specific registry by setting **blocked=true**.

```
[[registry]]
location = "registry.example.org"
blocked = true
```

You can also block a namespace by setting the prefix to **prefix="registry.example.org/namespace"**. For example, pulling the image by using the **podman pull registry. example.org/example/image:latest** command will be blocked, because the specified prefix is matched.

```
[[registry]]
location = "registry.example.org"
prefix="registry.example.org/namespace"
blocked = true
```

NOTE

prefix is optional, default value is the same as the **location** value.

You can block a specific image by setting **prefix="registry.example.org/namespace/image"**.

```
[[registry]]
location = "registry.example.org"
prefix="registry.example.org/namespace/image"
blocked = true
```

Mirroring registries

You can set a registry mirror in cases you cannot access the original registry. For example, you cannot connect to the internet, because you work in a highly-sensitive environment. You can specify multiple mirrors that are contacted in the specified order. For example, when you run **podman pull registry.example.com/myimage:latest** command, the **mirror-1.com** is tried first, then **mirror-2.com**.

```
[[registry]]
location="registry.example.com"
[[registry.mirror]]
location="mirror-1.com"
[[registry.mirror]]
location="mirror-2.com"
```

Additional resources

- **podman-pull(1)** and **podman-info(1)** man pages on your system

3.3. SEARCHING FOR CONTAINER IMAGES

Using the **podman search** command you can search selected container registries for images. You can also search for images in the Red Hat Container Catalog . The Red Hat Container Registry includes the image description, contents, health index, and other information.

NOTE

The **podman search** command is not a reliable way to determine the presence or existence of an image. The **podman search** behavior of the v1 and v2 Docker distribution API is specific to the implementation of each registry. Some registries may not support searching at all. Searching without a search term only works for registries that implement the v2 API. The same holds for the **docker search** command.

To search for the **postgresql-10** images in the quay.io registry, follow the steps.

Prerequisites

- The **container-tools** meta-package is installed.
- The registry is configured.

Procedure

1. Authenticate to the registry:

```
# podman login quay.io
```

2. Search for the image:
   - To search for a particular image on a specific registry, enter:

```
# podman search quay.io/postgresql-10
INDEX       NAME                                        DESCRIPTION          STARS   OFFICIAL
AUTOMATED
redhat.io   registry.redhat.io/rhel10-beta/postgresql-10        This container image ...  0
redhat.io   registry.redhat.io/rhscl/postgresql-10-rhel7   PostgreSQL is an  ...     0
```

   - Alternatively, to display all images provided by a particular registry, enter:

```
# podman search quay.io/
```

   - To search for the image name in all registries, enter:

```
# podman search postgresql-10
```

     To display the full descriptions, pass the **--no-trunc** option to the command.

Additional resources

- **podman-search(1)** man page on your system

3.4. CONFIGURING SHORT-NAME ALIASES

Always to pull an image by its fully-qualified name. However, it is customary to pull images by short names. For example, you can use **ubi10-beta** instead of **registry.access.redhat.com/ubi10-beta:latest**.

The **registries.conf** file allows to specify aliases for short names, giving administrators full control over where images are pulled from. Aliases are specified in the table in the form **"name" = "value"**. You can

see the lists of aliases in the **/etc/containers/registries.conf.d** directory. Red Hat ships a set of aliases in this directory. For example, **podman pull ubi10-beta** directly resolves to the right image, that is **registry.access.redhat.com/ubi10-beta:latest**.

For example:

```
unqualified-search-registries=["registry.fedoraproject.org", "quay.io"]

[aliases]
"fedora"="registry.fedoraproject.org/fedora"
```

The short-names modes are:

- **enforcing**: If no matching alias is found during the image pull, Podman prompts the user to choose one of the unqualified-search registries. If the selected image is pulled successfully, Podman automatically records a new short-name alias in the **$HOME/.cache/containers/short-name-aliases.conf** file (rootless user) or in the **/var/cache/containers/short-name-aliases.conf** (root user). If the user cannot be prompted (for example, stdin or stdout are not a TTY), Podman fails. Note that the **short-name-aliases.conf** file has precedence over the **registries.conf** file if both specify the same alias.

- **permissive**: Similar to enforcing mode, but Podman does not fail if the user cannot be prompted. Instead, Podman searches in all unqualified-search registries in the given order. Note that no alias is recorded.

- **disabled**: All unqualified-search registries are tried in a given order, no alias is recorded.

CHAPTER 4. WORKING WITH CONTAINER IMAGES

The Podman tool is designed to work with container images. You can use this tool to pull the image, inspect, tag, save, load, redistribute, and define the image signature.

4.1. PULLING IMAGES FROM REGISTRIES

Use the **podman pull** command to get the image to your local system.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Log in to the registry.redhat.io registry:

```
$ podman login registry.redhat.io
Username: <username>
Password: <password>
Login Succeeded!
```

2. Pull the registry.redhat.io/ubi10-beta/ubi container image:

```
$ podman pull registry.redhat.io/ubi10-beta/ubi
```

Verification

- List all images pulled to your local system:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED      SIZE
registry.redhat.io/ubi10-beta/ubi   latest  3269c37eae33  7 weeks ago  208 MB
```

Additional resources

- **podman-pull(1)** man page on your system

4.2. PULLING CONTAINER IMAGES USING SHORT-NAME ALIASES

You can use secure short names to get the image to your local system. The following procedure describes how to pull a **fedora** or **nginx** container image.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Pull the container image:
  - Pull the **fedora** image:

```
$ podman pull fedora
Resolved "fedora" as an alias (/etc/containers/registries.conf.d/000-shortnames.conf)
Trying to pull registry.fedoraproject.org/fedora:latest…
...
Storing signatures
...
```

Alias is found and the **registry.fedoraproject.org/fedora** image is securely pulled. The **unqualified-search-registries** list is not used to resolve **fedora** image name.

- Pull the **nginx** image:

```
$ podman pull nginx
? Please select an image:
registry.access.redhat.com/nginx:latest
registry.redhat.io/nginx:latest
  ▸ docker.io/library/nginx:latest
✔ docker.io/library/nginx:latest
Trying to pull docker.io/library/nginx:latest…
...
Storing signatures
...
```

If no matching alias is found, you are prompted to choose one of the **unqualified-search-registries** list. If the selected image is pulled successfully, a new short-name alias is recorded locally, otherwise an error occurs.

Verification

- List all images pulled to your local system:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED       SIZE
registry.fedoraproject.org/fedora   latest  28317703decd  12 days ago   184 MB
docker.io/library/nginx             latest  08b152afcfae  13 days ago   137 MB
```

4.3. LISTING IMAGES

Use the **podman images** command to list images in your local storage.

Prerequisites

- The **container-tools** meta-package is installed.
- A pulled image is available on the local system.

Procedure

- List all images in the local storage:

```
$ podman images
REPOSITORY                                  TAG     IMAGE ID      CREATED      SIZE
registry.access.redhat.com/ubi10-beta/ubi   latest  3269c37eae33  6 weeks ago  208 MB
```

Additional resources

- **podman-images(1)** man page on your system

4.4. INSPECTING LOCAL IMAGES

After you pull an image to your local system and run it, you can use the **podman inspect** command to investigate the image. For example, use it to understand what the image does and check what software is inside the image. The **podman inspect** command displays information about containers and images identified by name or ID.

Prerequisites

- The **container-tools** meta-package is installed.
- A pulled image is available on the local system.

Procedure

- Inspect the **registry.redhat.io/ubi10-beta/ubi** image:

```
$ podman inspect registry.redhat.io/ubi10-beta/ubi
…
 "Cmd": [
        "/bin/bash"
    ],
    "Labels": {
        "architecture": "x86_64",
        "build-date": "2020-12-10T01:59:40.343735",
        "com.redhat.build-host": "cpt-1002.osbs.prod.upshift.rdu2.redhat.com",
        "com.redhat.component": "ubi10-beta-container",
        "com.redhat.license_terms": "https://www.redhat.com/...,
    "description": "The Universal Base Image is ...
    }
...
```

The **"Cmd"** key specifies a default command to run within a container. You can override this command by specifying a command as an argument to the **podman run** command. This ubi10-beta/ubi container will execute the bash shell if no other argument is given when you start it with **podman run**. If an **"Entrypoint"** key was set, its value would be used instead of the **"Cmd"** value, and the value of **"Cmd"** is used as an argument to the Entrypoint command.

Additional resources

- **podman-inspect(1)** man page on your system

4.5. INSPECTING REMOTE IMAGES

Use the **skopeo inspect** command to display information about an image from a remote container registry before you pull the image to your system.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Inspect the **registry.redhat.io/ubi10-beta/ubi-init** image:

```
# skopeo inspect docker://registry.redhat.io/ubi10-beta/ubi-init
{
    "Name": "registry.redhat.io/ubi10-beta/ubi10-beta-init",
    "Digest": "sha256:c6d1e50ab...",
    "RepoTags": [
        ...
        "latest"
    ],
   "Created": "2020-12-10T07:16:37.250312Z",
    "DockerVersion": "1.13.1",
    "Labels": {
        "architecture": "x86_64",
        "build-date": "2020-12-10T07:16:11.378348",
        "com.redhat.build-host": "cpt-1007.osbs.prod.upshift.rdu2.redhat.com",
        "com.redhat.component": "ubi10-beta-init-container",
        "com.redhat.license_terms": "https://www.redhat.com/en/about/red-hat-end-user-
license-agreements#UBI",
        "description": "The Universal Base Image Init is designed to run an init system as PID 1
for running multi-services inside a container
        ...
    }
}
```

Additional resources

- **skopeo-inspect(1)** man page on your system

4.6. COPYING CONTAINER IMAGES

You can use the **skopeo copy** command to copy a container image from one registry to another. For example, you can populate an internal repository with images from external registries, or sync image registries in two different locations.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Copy the **skopeo** container image from **docker://quay.io** to **docker://registry.example.com**:

```
$ skopeo copy docker://quay.io/skopeo/stable:latest
docker://registry.example.com/skopeo:latest
```

Additional resources

- **skopeo-copy(1)** man page on your system

4.7. COPYING IMAGE LAYERS TO A LOCAL DIRECTORY

You can use the **skopeo copy** command to copy the layers of a container image to a local directory.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create the **/var/lib/images/nginx** directory:

```
$ mkdir -p /var/lib/images/nginx
```

2. Copy the layers of the **docker://docker.io/nginx:latest image** to the newly created directory:

```
$ skopeo copy docker://docker.io/nginx:latest dir:/var/lib/images/nginx
```

Verification

- Display the content of the **/var/lib/images/nginx** directory:

```
$ ls /var/lib/images/nginx
08b11a3d692c1a2e15ae840f2c15c18308dcb079aa5320e15d46b62015c0f6f3
...
4fcb23e29ba19bf305d0d4b35412625fea51e82292ec7312f9be724cb6e31ffd  manifest.json
version
```

Additional resources

- **skopeo-copy(1)** man page on your system

4.8. TAGGING IMAGES

Use the **podman tag** command to add an additional name to a local image. This additional name can consist of several parts: *<registryhost>/<username>/<name>:<tag>*.

Prerequisites

- The **container-tools** meta-package is installed.
- A pulled image is available on the local system.

Procedure

1. List all images:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED      SIZE
registry.redhat.io/ubi10-beta/ubi         latest  3269c37eae33  7 weeks ago  208 MB
```

2. Assign the **myubi** name to the **registry.redhat.io/ubi10-beta/ubi** image using one of the following options:

   - The image name:

```
$ podman tag registry.redhat.io/ubi10-beta/ubi myubi
```

- The image ID:

```
$ podman tag 3269c37eae33 myubi
```

Both commands give you the same result.

3. List all images:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED       SIZE
registry.redhat.io/ubi10-beta/ubi   latest  3269c37eae33  2 months ago  208 MB
localhost/myubi                     latest  3269c37eae33  2 months ago  208 MB
```

Notice that the default tag is **latest** for both images. You can see all the image names are assigned to the single image ID 3269c37eae33.

4. Add the **10-beta** tag to the **registry.redhat.io/ubi10-beta/ubi** image using either:

- The image name:

```
$ podman tag registry.redhat.io/ubi10-beta/ubi myubi:10-beta
```

- The image ID:

```
$ podman tag 3269c37eae33 myubi:10-beta
```

Both commands give you the same result.

Verification

- List all images:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED       SIZE
registry.redhat.io/ubi10-beta/ubi   latest  3269c37eae33  2 months ago  208 MB
localhost/myubi                     latest  3269c37eae33  2 months ago  208 MB
localhost/myubi                     10-beta 3269c37eae33  2 months ago  208 MB
```

Notice that the default tag is **latest** for both images. You can see all the image names are assigned to the single image ID 3269c37eae33.

After tagging the **registry.redhat.io/ubi10-beta/ubi** image, you have three options to run the container:

- by ID (**3269c37eae33**)
- by name (**localhost/myubi:latest**)
- by name (**localhost/myubi:10-beta**)

Additional resources

- **podman-tag(1)** man page on your system

4.9. BUILDING MULTI-ARCHITECTURE IMAGES

Prerequisites

- The **container-tools** meta-package is installed.

1. Create **Containerfiles** for each architecture you want to support.
2. Build images for each architecture. For example:

```
$ podman build --platform linux/arm64,linux/amd64 --manifest <registry>/<image> .
```

   - The **--platform linux/arm64,linux/amd64** option specifies the target platforms for which the container image is being built.
   - The **--manifest *<registry>/<image>*** option creates a manifest list with the specified name, that is ***<registry>/<image>***, and adds the newly-built images to them. A manifest list is a collection of image manifests, each one targeting a different architecture.

3. Push the manifest list to the registry:

```
$ podman manifest push <registry>/<image>
```

   This manifest list acts as a single entry point for pulling the multi-architecture container.

As a result, you can pull the appropriate container image for your platform, based on a single manifest list.

You can also remove items from the manifest list by using the **podman manifest remove *<manifest_list> <digest_ID>*** command, where ***<digest_ID>*** is the SHA-256 checksum of the container image. For example: **podman manifest remove *<registry>/<image>* sha256:cb8a924afdf…**.

Verification

- Display the manifest list:

```
$ podman manifest inspect <registry>/<image>
```

Additional resources

- **podman-build(1)** man page
- **podman-manifest(1)** man page
- How to build multi-architecture container images article

4.10. SAVING AND LOADING IMAGES

Use the **podman save** command to save an image to a container archive. You can restore it later to another container environment or send it to someone else. You can use **--format** option to specify the archive format. The supported formats are:

- **docker-archive**

- **oci-archive**
- **oci-dir** (directory with oci manifest type)
- **docker-dir** (directory with v2s2 manifest type)

The default format is the **docker-dir** format.

Use the **podman load** command to load an image from the container image archive into the container storage.

Prerequisites

- The **container-tools** meta-package is installed.
- A pulled image is available on the local system.

Procedure

1. Save the **registry.redhat.io/rhel10-beta/rsyslog** image as a tarball:
   - In the default **docker-dir** format:

     ```
     $ podman save -o myrsyslog.tar registry.redhat.io/rhel10-beta/rsyslog:latest
     ```

   - In the **oci-archive** format, using the **--format** option:

     ```
     $ podman save -o myrsyslog-oci.tar --format=oci-archive registry.redhat.io/rhel10-beta/rsyslog
     ```

     The **myrsyslog.tar** and **myrsyslog-oci.tar** archives are stored in your current directory. The next steps are performed with the **myrsyslog.tar** tarball.
2. Check the file type of **myrsyslog.tar**:

   ```
   $ file myrsyslog.tar
   myrsyslog.tar: POSIX tar archive
   ```

3. To load the **registry.redhat.io/rhel10-beta/rsyslog:latest** image from the **myrsyslog.tar**:

   ```
   $ podman load -i myrsyslog.tar
   ...
   Loaded image(s): registry.redhat.io/rhel10-beta/rsyslog:latest
   ```

Additional resources

- **podman-save(1)** and **podman-load(1)** man pages on your system

4.11. REDISTRIBUTING UBI IMAGES

Use **podman push** command to push a UBI image to your own, or a third party, registry and share it with others. You can upgrade or add to that image from UBI dnf repositories as you like.

Prerequisites

- The **container-tools** meta-package is installed.
- A pulled image is available on the local system.

Procedure

1. Optional: Add an additional name to the **ubi** image:

```
# podman tag registry.redhat.io/ubi10-beta/ubi registry.example.com:5000/ubi10-beta/ubi
```

2. Push the **registry.example.com:5000/ubi10-beta/ubi** image from your local storage to a registry:

```
# podman push registry.example.com:5000/ubi10-beta/ubi
```

IMPORTANT

While there are few restrictions on how you use these images, there are some restrictions about how you can refer to them. For example, you cannot call those images Red Hat certified or Red Hat supported unless you certify it through the Red Hat Partner Connect Program, either with Red Hat Container Certification or Red Hat OpenShift Operator Certification.

4.12. REMOVING IMAGES

Use the **podman rmi** command to remove locally stored container images. You can remove an image by its ID or name.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. List all images on your local system:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED      SIZE
registry.redhat.io/rhel10-beta/rsyslog     latest  4b32d14201de  7 weeks ago  228 MB
registry.redhat.io/ubi10-beta/ubi          latest  3269c37eae33  7 weeks ago  208 MB
localhost/myubi                     X.Y     3269c37eae33  7 weeks ago  208 MB
```

2. List all containers:

```
$ podman ps -a
CONTAINER ID  IMAGE                                    COMMAND         CREATED        STATUS
PORTS   NAMES
7ccd6001166e  registry.redhat.io/rhel10-beta/rsyslog:latest  /bin/rsyslog.sh  6 seconds ago
Up 5 seconds ago          mysyslog
```

To remove the **registry.redhat.io/rhel10-beta/rsyslog** image, you have to stop all containers running from this image by using the **podman stop** command. You can stop a container by its ID or name.

3. Stop the **mysyslog** container:

```
$ podman stop mysyslog
7ccd6001166e9720c47fbeb077e0afd0bb635e74a1b0ede3fd34d09eaf5a52e9
```

4. Remove the **registry.redhat.io/rhel10-beta/rsyslog** image:

```
$ podman rmi registry.redhat.io/rhel10-beta/rsyslog
```

- To remove multiple images:

```
$ podman rmi registry.redhat.io/rhel8/rsyslog registry.redhat.io/ubi10-beta/ubi
```

- To remove all images from your system:

```
$ podman rmi -a
```

- To remove images that have multiple names (tags) associated with them, add the **-f** option to remove them:

```
$ podman rmi -f 1de7d7b3f531
1de7d7b3f531...
```

Verification

- List all images by using the **podman images** command to verify that container images were removed.

Additional resources

- **podman-rmi(1)** man page on your system

CHAPTER 5. WORKING WITH CONTAINERS

Containers represent a running or stopped process created from the files located in a decompressed container image. You can use the Podman tool to work with containers.

5.1. PODMAN RUN COMMAND

The **podman run** command runs a process in a new container based on the container image. If the container image is not already loaded then **podman run** pulls the image, and all image dependencies, from the repository in the same way running **podman pull *image***, before it starts the container from that image. The container process has its own file system, its own networking, and its own isolated process tree.

The **podman run** command has the form:

```
podman run [options] image [command [arg ...]]
```

Basic options are:

- **--detach (-d)**: Runs the container in the background and prints the new container ID.
- **--attach (-a)**: Runs the container in the foreground mode.
- **--name (-n)**: Assigns a name to the container. If a name is not assigned to the container with **--name** then it generates a random string name. This works for both background and foreground containers.
- **--rm**: Automatically remove the container when it exits. Note that the container will not be removed when it could not be created or started successfully.
- **--tty (-t)**: Allocates and attaches the pseudo-terminal to the standard input of the container.
- **--interactive (-i)**: For interactive processes, use **-i** and **-t** together to allocate a terminal for the container process. The **-i -t** is often written as **-it**.

5.2. RUNNING COMMANDS IN A CONTAINER FROM THE HOST

Use the **podman run** command to display the type of operating system of the container.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Display the type of operating system of the container based on the **registry.access.redhat.com/ubi10-beta/ubi** container image using the **cat /etc/os-release** command:

```
$ podman run --rm registry.access.redhat.com/ubi10-beta/ubi cat /etc/os-release
NAME="Red Hat Enterprise Linux"
...
ID="rhel"
...
```

```
HOME_URL="https://www.redhat.com/"
BUG_REPORT_URL="https://bugzilla.redhat.com/"

REDHAT_BUGZILLA_PRODUCT=" Red Hat Enterprise Linux 10"
...
```

2. Optional: List all containers.

```
$ podman ps
CONTAINER ID  IMAGE   COMMAND  CREATED  STATUS  PORTS   NAMES
```

Because of the **--rm** option you should not see any container. The container was removed.

Additional resources

- **podman-run(1)** man page on your system

5.3. RUNNING COMMANDS INSIDE THE CONTAINER

Use the **podman run** command to run a container interactively.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Run the container named **myubi** based on the **registry.redhat.io/ubi10-beta/ubi** image:

```
$ podman run --name=myubi -it registry.access.redhat.com/ubi10-beta/ubi /bin/bash
[root@6ccffd0f6421 /]#
```

   - The **-i** option creates an interactive session. Without the **-t** option, the shell stays open, but you cannot type anything to the shell.
   - The **-t** option opens a terminal session. Without the **-i** option, the shell opens and then exits.

2. Install the **procps-ng** package containing a set of system utilities (for example **ps**, **top**, **uptime**, and so on):

```
[root@6ccffd0f6421 /]# dnf install procps-ng
```

3. Use the **ps -ef** command to list current processes:

```
# ps -ef
UID          PID    PPID  C STIME TTY          TIME CMD
root           1       0  0 12:55 pts/0    00:00:00 /bin/bash
root          31       1  0 13:07 pts/0    00:00:00 ps -ef
```

4. Enter **exit** to exit the container and return to the host:

```
# exit
```

5. Optional: List all containers:

```
$ podman ps
CONTAINER ID  IMAGE                                  COMMAND    CREATED         STATUS
PORTS   NAMES
1984555a2c27  registry.redhat.io/ubi10-beta/ubi:latest  /bin/bash  21 minutes ago  Exited (0)
21 minutes ago          myubi
```

You can see that the container is in Exited status.

Additional resources

- **podman-run(1)** man page on your system

5.4. LISTING CONTAINERS

Use the **podman ps** command to list the running containers on the system.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Run the container based on **registry.redhat.io/rhel10-beta/rsyslog** image:

```
$ podman run -d registry.redhat.io/rhel8/rsyslog
```

2. List all containers:
   - To list all running containers:

```
$ podman ps
CONTAINER ID IMAGE              COMMAND        CREATED       STATUS
PORTS NAMES
74b1da000a11 rhel10-beta/rsyslog /bin/rsyslog.sh 2 minutes ago Up About a minute
musing_brown
```

   - To list all containers, running or stopped:

```
$ podman ps -a
CONTAINER ID IMAGE         COMMAND    CREATED    STATUS              PORTS
NAMES     IS INFRA
d65aecc325a4 ubi10-beta/ubi      /bin/bash  3 secs ago Exited (0) 5 secs ago
peaceful_hopper false
74b1da000a11 rhel10-beta/rsyslog rsyslog.sh 2 mins ago Up About a minute
musing_brown    false
```

If there are containers that are not running, but were not removed (**--rm** option), the containers are present and can be restarted.

Additional resources

- **podman-ps(1)** man page on your system

5.5. STARTING CONTAINERS

If you run the container and then stop it, and not remove it, the container is stored on your local system ready to run again. You can use the **podman start** command to re-run the containers. You can specify the containers by their container ID or name.

Prerequisites

- The **container-tools** meta-package is installed.
- At least one container has been stopped.

Procedure

1. Start the **myubi** container:
   - In the non interactive mode:

     ```
     $ podman start myubi
     ```

     Alternatively, you can use **podman start 1984555a2c27**.
   - In the interactive mode, use **-a** (**--attach**) and **-i** (**--interactive**) options to work with container bash shell:

     ```
     $ podman start -a -i myubi
     ```

     Alternatively, you can use **podman start -a -i 1984555a2c27**.
2. Enter **exit** to exit the container and return to the host:

   ```
   [root@6ccffd0f6421 /]# exit
   ```

Additional resources

- **podman-start(1)** man page on your system

5.6. INSPECTING CONTAINERS FROM THE HOST

Use the **podman inspect** command to inspect the metadata of an existing container in a JSON format. You can specify the containers by their container ID or name.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Inspect the container defined by ID 64ad95327c74:
  - To get all metadata:

```
$ podman inspect 64ad95327c74
[
    {
        "Id":
"64ad95327c740ad9de468d551c50b6d906344027a0e645927256cd061049f681",
        "Created": "2021-03-02T11:23:54.591685515+01:00",
        "Path": "/bin/rsyslog.sh",
        "Args": [
            "/bin/rsyslog.sh"
        ],
        "State": {
            "OciVersion": "1.0.2-dev",
            "Status": "running",
            ...
```

- To get particular items from the JSON file, for example, the **StartedAt** timestamp:

```
$ podman inspect --format='{{.State.StartedAt}}' 64ad95327c74
2021-03-02 11:23:54.945071961 +0100 CET
```

The information is stored in a hierarchy. To see the container **StartedAt** timestamp (**StartedAt** is under **State**), use the **--format** option and the container ID or name.

Examples of other items you might want to inspect include:

- **.Path** to see the command run with the container
- **.Args** arguments to the command
- **.Config.ExposedPorts** TCP or UDP ports exposed from the container
- **.State.Pid** to see the process id of the container
- **.HostConfig.PortBindings** port mapping from container to host

Additional resources

- **podman-inspect(1)** man page on your system

5.7. MOUNTING DIRECTORY ON LOCALHOST TO THE CONTAINER

You can make log messages from inside a container available to the host system by mounting the host **/dev/log** device inside the container.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Run the container named **log_test** and mount the host **/dev/log** device inside the container:

```
# podman run --name="log_test" -v /dev/log:/dev/log --rm \
  registry.redhat.io/ubi10-beta/ubi logger "Testing logging to the host"
```

2. Use the **journalctl** utility to display logs:

```
# journalctl -b | grep Testing
Dec 09 16:55:00 localhost.localdomain root[14634]: Testing logging to the host
```

The **--rm** option removes the container when it exits.

Additional resources

- **podman-run(1)** man page on your system

5.8. MOUNTING A CONTAINER FILESYSTEM

Use the **podman mount** command to mount a working container root filesystem in a location accessible from the host.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Run the container named **mysyslog**:

```
# podman run -d --name=mysyslog registry.redhat.io/rhel10-beta/rsyslog
```

2. Optional: List all containers:

```
# podman ps -a
CONTAINER ID  IMAGE                                  COMMAND         CREATED         STATUS
PORTS   NAMES
c56ef6a256f8  registry.redhat.io/rhel10-beta/rsyslog:latest  /bin/rsyslog.sh  20 minutes ago
Up 20 minutes ago                mysyslog
```

3. Mount the **mysyslog** container:

```
# podman mount mysyslog
/var/lib/containers/storage/overlay/990b5c6ddcdeed4bde7b245885ce4544c553d108310e2b797
d7be46750894719/merged
```

4. Display the content of the mount point using **ls** command:

```
# ls
/var/lib/containers/storage/overlay/990b5c6ddcdeed4bde7b245885ce4544c553d108310
e2b797d7be46750894719/merged
bin  boot  dev  etc  home  lib  lib64  lost+found  media  mnt  opt  proc  root  run  sbin  srv  sys
tmp  usr  var
```

5. Display the OS version:

```
# cat
/var/lib/containers/storage/overlay/990b5c6ddcdeed4bde7b245885ce4544c553d108310
e2b797d7be46750894719/merged/etc/os-release
```

```
NAME="Red Hat Enterprise Linux"
VERSION="10-beta (Ootpa)"
ID="rhel"
ID_LIKE="fedora"
...
```

Additional resources

- **podman-mount(1)** man page on your system

5.9. RUNNING A SERVICE AS A DAEMON WITH A STATIC IP

The following example runs the **rsyslog** service as a daemon process in the background. The **--ip** option sets the container network interface to a particular IP address (for example, 10.88.0.44). After that, you can run the **podman inspect** command to check that you set the IP address properly.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Set the container network interface to the IP address 10.88.0.44:

```
# podman run -d --ip=10.88.0.44 registry.access.redhat.com/rhel10-beta/rsyslog
efde5f0a8c723f70dd5cb5dc3d5039df3b962fae65575b08662e0d5b5f9fbe85
```

2. Check that the IP address is set properly:

```
# podman inspect efde5f0a8c723 | grep 10.88.0.44
"IPAddress": "10.88.0.44",
```

Additional resources

- **podman-inspect(1)** and **podman-run(1)** man pages on your system

5.10. EXECUTING COMMANDS INSIDE A RUNNING CONTAINER

Use the **podman exec** command to execute a command in a running container and investigate that container. The reason for using the **podman exec** command instead of **podman run** command is that you can investigate the running container without interrupting the container activity.

Prerequisites

- The **container-tools** meta-package is installed.
- The container is running.

Procedure

1. Execute the **rpm -qa** command inside the **myrsyslog** container to list all installed packages:

```
$ podman exec -it myrsyslog rpm -qa
tzdata-2020d-1.el8.noarch
python3-pip-wheel-9.0.3-18.el8.noarch
redhat-release-8.3-1.0.el8.x86_64
filesystem-3.8-3.el8.x86_64
...
```

2. Execute a **/bin/bash** command in the **myrsyslog** container:

```
$ podman exec -it myrsyslog /bin/bash
```

3. Install the **procps-ng** package containing a set of system utilities (for example **ps**, **top**, **uptime**, and so on):

```
# dnf install procps-ng
```

4. Inspect the container:

- To list every process on the system:

```
# ps -ef
UID          PID    PPID  C STIME TTY          TIME CMD
root           1       0  0 10:23 ?        00:00:01 /usr/sbin/rsyslogd -n
root           8       0  0 11:07 pts/0    00:00:00 /bin/bash
root          47       8  0 11:13 pts/0    00:00:00 ps -ef
```

- To display file system disk space usage:

```
# df -h
Filesystem      Size  Used Avail Use% Mounted on
fuse-overlayfs   27G  7.1G   20G  27% /
tmpfs            64M     0   64M   0% /dev
tmpfs           269M  936K  268M   1% /etc/hosts
shm              63M     0   63M   0% /dev/shm
...
```

- To display system information:

```
# uname -r
4.18.0-240.10.1.el8_3.x86_64
```

- To display amount of free and used memory in megabytes:

```
# free --mega
total        used        free      shared  buff/cache   available
Mem:         2818         615        1183          12        1020        1957
Swap:        3124           0        3124
```

Additional resources

- **podman-exec(1)** man page on your system

5.11. SHARING FILES BETWEEN TWO CONTAINERS

You can use volumes to persist data in containers even when a container is deleted. Volumes can be used for sharing data among multiple containers. The volume is a folder which is stored on the host machine. The volume can be shared between the container and the host.

Main advantages are:

- Volumes can be shared among the containers.
- Volumes are easier to back up or migrate.
- Volumes do not increase the size of the containers.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create a volume:

```
$ podman volume create hostvolume
```

2. Display information about the volume:

```
$ podman volume inspect hostvolume
[
    {
        "name": "hostvolume",
        "labels": {},
        "mountpoint":
"/home/username/.local/share/containers/storage/volumes/hostvolume/_data",
        "driver": "local",
        "options": {},
        "scope": "local"
    }
]
```

Notice that it creates a volume in the volumes directory. You can save the mount point path to the variable for easier manipulation: **$ mntPoint=$(podman volume inspect hostvolume --format {{.Mountpoint}})**.

Notice that if you run **sudo podman volume create hostvolume**, then the mount point changes to **/var/lib/containers/storage/volumes/hostvolume/_data**.

3. Create a text file inside the directory using the path that is stored in the **mntPoint** variable:

```
$ echo "Hello from host" >> $mntPoint/host.txt
```

4. List all files in the directory defined by the **mntPoint** variable:

```
$ ls $mntPoint/
host.txt
```

5. Run the container named **myubi1** and map the directory defined by the **hostvolume** volume name on the host to the /**containervolume1** directory on the container:

```
$ podman run -it --name myubi1 -v hostvolume:/containervolume1
registry.access.redhat.com/ubi10-beta/ubi /bin/bash
```

Note that if you use the volume path defined by the **mntPoint** variable (**-v $mntPoint:/containervolume1**), data can be lost when running **podman volume prune** command, which removes unused volumes. Always use **-v *hostvolume_name:/containervolume_name***.

6. List the files in the shared volume on the container:

```
# ls /containervolume1
host.txt
```

You can see the **host.txt** file which you created on the host.

7. Create a text file inside the /**containervolume1** directory:

```
# echo "Hello from container 1" >> /containervolume1/container1.txt
```

8. Detach from the container with **CTRL+p** and **CTRL+q**.

9. List the files in the shared volume on the host, you should see two files:

```
$ ls $mntPoint
container1.rxt  host.txt
```

At this point, you are sharing files between the container and host. To share files between two containers, run another container named **myubi2**.

10. Run the container named **myubi2** and map the directory defined by the **hostvolume** volume name on the host to the /**containervolume2** directory on the container:

```
$ podman run -it --name myubi2 -v hostvolume:/containervolume2
registry.access.redhat.com/ubi10-beta/ubi /bin/bash
```

11. List the files in the shared volume on the container:

```
# ls /containervolume2
container1.txt host.txt
```

You can see the **host.txt** file which you created on the host and **container1.txt** which you created inside the **myubi1** container.

12. Create a text file inside the /**containervolume2** directory:

```
# echo "Hello from container 2" >> /containervolume2/container2.txt
```

13. Detach from the container with **CTRL+p** and **CTRL+q**.

14. List the files in the shared volume on the host, you should see three files:

```
$ ls $mntPoint
container1.rxt  container2.txt host.txt
```

Additional resources

- **podman-volume(1)** man page on your system

5.12. EXPORTING AND IMPORTING CONTAINERS

You can use the **podman export** command to export the file system of a running container to a tarball on your local machine. For example, if you have a large container that you use infrequently or one that you want to save a snapshot of in order to revert back to it later, you can use the **podman export** command to export a current snapshot of your running container into a tarball.

You can use the **podman import** command to import a tarball and save it as a filesystem image. Then you can run this filesystem image or you can use it as a layer for other images.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Run the **myubi** container based on the **registry.access.redhat.com/ubi10-beta/ubi** image:

```
$ podman run -dt --name=myubi registry.access.redhat.com/10-beta/ubi
```

2. Optional: List all containers:

```
$ podman ps -a
CONTAINER ID  IMAGE                                COMMAND         CREATED     STATUS
PORTS   NAMES
a6a6d4896142  registry.access.redhat.com/10-beta:latest   /bin/bash       7 seconds ago  Up
7 seconds ago          myubi
```

3. Attach to the **myubi** container:

```
$ podman attach myubi
```

4. Create a file named **testfile**:

```
[root@a6a6d4896142 /]# echo "hello" > testfile
```

5. Detach from the container with **CTRL+p** and **CTRL+q**.

6. Export the file system of the **myubi** as a **myubi-container.tar** on the local machine:

```
$ podman export -o myubi.tar a6a6d4896142
```

7. Optional: List the current directory content:

```
$ ls -l
-rw-r--r--. 1 user user 210885120 Apr  6 10:50 myubi-container.tar
...
```

8. Optional: Create a **myubi-container** directory, extract all files from the **myubi-container.tar** archive. List a content of the **myubi-directory** in a tree-like format:

```
$ mkdir myubi-container
$ tar -xf myubi-container.tar -C myubi-container
$ tree -L 1 myubi-container
├── bin -> usr/bin
├── boot
├── dev
├── etc
├── home
├── lib -> usr/lib
├── lib64 -> usr/lib64
├── lost+found
├── media
├── mnt
├── opt
├── proc
├── root
├── run
├── sbin -> usr/sbin
├── srv
├── sys
├── testfile
├── tmp
├── usr
└── var

20 directories, 1 file
```

You can see that the **myubi-container.tar** contains the container file system.

9. Import the **myubi.tar** and saves it as a filesystem image:

```
$ podman import myubi.tar myubi-imported
Getting image source signatures
Copying blob 277cab30fe96 done
Copying config c296689a17 done
Writing manifest to image destination
Storing signatures
c296689a17da2f33bf9d16071911636d7ce4d63f329741db679c3f41537e7cbf
```

10. List all images:

```
$ podman images
REPOSITORY                          TAG     IMAGE ID      CREATED         SIZE
docker.io/library/myubi-imported    latest  c296689a17da  51 seconds ago  211 MB
```

11. Display the content of the **testfile** file:

```
$ podman run -it --name=myubi-imported docker.io/library/myubi-imported cat testfile
hello
```

Additional resources

- **podman-export (1)** and **podman-import(1)** man pages on your system

5.13. STOPPING CONTAINERS

Use the **podman stop** command to stop a running container. You can specify the containers by their container ID or name.

Prerequisites

- The **container-tools** meta-package is installed.
- At least one container is running.

Procedure

- Stop the **myubi** container:
  - By using the container name:

    ```
    $ podman stop myubi
    ```

  - By using the container ID:

    ```
    $ podman stop 1984555a2c27
    ```

To stop a running container that is attached to a terminal session, you can enter the **exit** command inside the container.

The **podman stop** command sends a SIGTERM signal to terminate a running container. If the container does not stop after a defined period (10 seconds by default), Podman sends a SIGKILL signal.

You can also use the **podman kill** command to kill a container (SIGKILL) or send a different signal to a container. Here is an example of sending a SIGHUP signal to a container (if supported by the application, a SIGHUP causes the application to re-read its configuration files):

```
# *podman kill --signal="SIGHUP" 74b1da000a11*
74b1da000a114015886c557deec8bed9dfb80c888097aa83f30ca4074ff55fb2
```

Additional resources

- **podman-stop(1)** and **podman-kill(1)** man pages on your system

5.14. REMOVING CONTAINERS

Use the **podman rm** command to remove containers. You can specify containers with the container ID or name.

Prerequisites

Prerequisites

- The **container-tools** meta-package is installed.
- At least one container has been stopped.

Procedure

1. List all containers, running or stopped:

```
$ podman ps -a
CONTAINER ID IMAGE          COMMAND    CREATED    STATUS                PORTS NAMES
IS INFRA
d65aecc325a4 ubi10-beta/ubi      /bin/bash  3 secs ago Exited (0) 5 secs ago
peaceful_hopper false
74b1da000a11 rhel10-beta/rsyslog rsyslog.sh 2 mins ago Up About a minute
musing_brown    false
```

2. Remove the containers:
   - To remove the **peaceful_hopper** container:

     ```
     $ podman rm peaceful_hopper
     ```

     Notice that the **peaceful_hopper** container was in Exited status, which means it was stopped and it can be removed immediately.
   - To remove the **musing_brown** container, first stop the container and then remove it:

     ```
     $ podman stop musing_brown
     $ podman rm musing_brown
     ```
   - To remove multiple containers:

     ```
     $ podman rm clever_yonath furious_shockley
     ```
   - To remove all containers from your local system:

     ```
     $ podman rm -a
     ```

Verification

- List all images by using the **podman ps -a** command to verify that containers were removed.

Additional resources

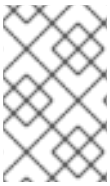
- **podman-rm(1)** man page on your system

5.15. CREATING SELINUX POLICIES FOR CONTAINERS

To generate SELinux policies for containers, use the UDICA tool. For more information, see Introduction to the udica SELinux policy generator.

5.16. CONFIGURING PRE-EXECUTION HOOKS IN PODMAN

You can create plugin scripts to define a fine-control over container operations, especially blocking unauthorized actions, for example pulling, running, or listing container images.

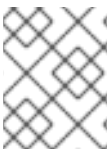


NOTE

The file **/etc/containers/podman_preexec_hooks.txt** must be created by an administrator and can be empty. If the **/etc/containers/podman_preexec_hooks.txt** does not exist, the plugin scripts will not be executed.

The following rules apply to the plugin scripts:

- Have to be root-owned and not writable.
- Have to be located in the **/usr/libexec/podman/pre-exec-hooks** and **/etc/containers/pre-exec-hooks** directories.
- Execute in sequentially and alphanumeric order.
- If all plugin scripts return zero value, then the **podman** command is executed.
- If any of the plugin scripts return a non-zero value, it indicates a failure. The **podman** command exits and returns the non-zero value of the first-failed script.
- Red Hat recommends to use the following naming convention to execute the scripts in the correct order: ***DDD_name.lang***, where:
  - The ***DDD*** is the decimal number indicating the order of script execution. Use one or two leading zeros if necessary.
  - The ***name*** is the name of the plugin script.
  - The ***lang*** (optional) is the file extension for the given programming language. For example, the name of the plugin script can be: **001-check-groups.sh**.



NOTE

The plugin scripts are valid at the time of creation. Containers created before plugin scripts are not affected.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Create the script plugin named **001-check-groups.sh**. For example:

```
#!/bin/bash
if id -nG "$USER" 2> /dev/null | grep -qw "$GROUP" 2> /dev/null ; then
    exit 0
else
    exit 1
fi
```

- The script checks if a user is in a specified group.
- The **USER** and **GROUP** are environment variables set by Podman.
- Exit code provided by the **001-check-groups.sh** script would be provided to the **podman** binary.
- The **podman** command exits and returns the non-zero value of the first-failed script.

Verification

- Check if the **001-check-groups.sh** script works correctly:

```
$ podman run image
...
```

If the user is not in the correct group, the following error appears:

```
external preexec hook /etc/containers/pre-exec-hooks/001-check-groups.sh failed
```

5.17. DEBUGGING APPLICATIONS IN CONTAINERS

You can use various command-line tools tailored to different aspects of troubleshooting. For more information, see Debugging applications in containers.

CHAPTER 6. ADDING SOFTWARE TO A UBI CONTAINER

Red Hat Universal Base Images (UBIs) are built from a subset of the RHEL content. UBIs also provide a subset of RHEL packages that are freely available to install for use with UBI. To add or update software to a running container, you can use the DNF repositories that include RPM packages and updates. UBIs provide a set of pre-built language runtime container images such as Python, Perl, Node.js, Ruby, and so on.

To add packages from UBI repositories to running UBI containers:

- On UBI init and UBI standard images, use the **dnf** command
- On UBI minimal images, use the **microdnf** command

NOTE

Installing and working with software packages directly in running containers adds packages temporarily. The changes are not saved in the container image. To make package changes persistent, see section Building an image from a Containerfile with Buildah.

6.1. USING THE UBI INIT IMAGES

You can build a container by using a **Containerfile** that installs and configures a Web server (**httpd**) to start automatically by the **systemd** service (**/sbin/init**) when the container is run on a host system. The **podman build** command builds an image by using instructions in one or more **Containerfiles** and a specified build context directory. The context directory can be specified as the URL of an archive, Git repository or **Containerfile**. If no context directory is specified, then the current working directory is considered as the build context, and must contain the **Containerfile**. You can also specify a **Containerfile** with the **--file** option.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create a **Containerfile** with the following contents to a new directory:

```
FROM registry.access.redhat.com/ubi10-beta/ubi-init
RUN dnf -y install httpd; dnf clean all; systemctl enable httpd;
RUN echo "Successful Web Server Test" > /var/www/html/index.html
RUN mkdir /etc/systemd/system/httpd.service.d/; echo -e '[Service]\nRestart=always' >
/etc/systemd/system/httpd.service.d/httpd.conf
EXPOSE 80
CMD [ "/sbin/init" ]
```

   The **Containerfile** installs the **httpd** package, enables the **httpd** service to start at boot time, creates a test file (**index.html**), exposes the Web server to the host (port 80), and starts the **systemd** init service (**/sbin/init**) when the container starts.

2. Build the container:

```
# podman build --format=docker -t mysysd .
```

3. Optional: If you want to run containers with **systemd** and SELinux is enabled on your system, you must set the **container_manage_cgroup** boolean variable:

```
# setsebool -P container_manage_cgroup 1
```

4. Run the container named **mysysd_run**:

```
# podman run -d --name=mysysd_run -p 80:80 mysysd
```

The **mysysd** image runs as the **mysysd_run** container as a daemon process, with port 80 from the container exposed to port 80 on the host system.

NOTE

In rootless mode, you have to choose host port number >= 1024. For example:

```
$ podman run -d --name=mysysd -p 8081:80 mysysd
```

To use port numbers < 1024, you have to modify the **net.ipv4.ip_unprivileged_port_start** variable:

```
# sysctl net.ipv4.ip_unprivileged_port_start=80
```

5. Check that the container is running:

```
# podman ps
a282b0c2ad3d  localhost/mysysd:latest  /sbin/init  15 seconds ago  Up 14 seconds ago
0.0.0.0:80->80/tcp  mysysd_run
```

6. Test the web server:

```
# curl localhost/index.html
Successful Web Server Test
```

Additional resources

- Shortcomings of Rootless Podman

6.2. USING THE UBI MICRO IMAGES

You can build a **ubi-micro** container image by using the Buildah tool.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Pull and build the **registry.access.redhat.com/ubi10-beta/ubi-micro** image:

```
# microcontainer=$(buildah from registry.access.redhat.com/ubi10-beta/ubi-micro)
```

2. Mount a working container root filesystem:

```
# micromount=$(buildah mount $microcontainer)
```

3. Install the **httpd** service to the **micromount** directory:

```
# dnf install \
   --installroot $micromount \
   --releasever=/ \
   --setopt install_weak_deps=false \
   --setopt=reposdir=/etc/yum.repos.d/ \
   --nodocs -y \
   httpd
# dnf clean all \
   --installroot $micromount
```

4. Unmount the root file system on the working container:

```
# buildah umount $microcontainer
```

5. Create the **ubi-micro-httpd** image from a working container:

```
# buildah commit $microcontainer ubi-micro-httpd
```

Verification

1. Display details about the **ubi-micro-httpd** image:

```
# podman images ubi-micro-httpd
localhost/ubi-micro-httpd latest 7c557e7fbe9f  22 minutes ago  151 MB
```

6.3. ADDING SOFTWARE TO A UBI CONTAINER ON A SUBSCRIBED HOST

If you are running a UBI container on a registered and subscribed RHEL host, the RHEL Base and AppStream repositories are enabled inside the standard UBI container, along with all the UBI repositories.

- Red Hat entitlements are passed from a subscribed Red Hat host as a secrets mount defined in **/usr/share/containers/mounts.conf** on the host running Podman.
  Verify the mounts configuration:

```
$ cat /usr/share/containers/mounts.conf
/usr/share/rhel/secrets:/run/secrets
```

- The **yum**, **dnf**, and **microdnf** commands should search for entitlement data at this path.
- If the path is not present, the commands cannot use Red Hat entitled content, such as the RHV repositories, because they lack the keys or content access the host has.
- This is applicable only for Red Hat shipped or provided Podman on a RHEL host.

- If you installed Podman not shipped by Red Hat, follow the instructions in How do I attach subscription data to containers running in Docker not provided by Red Hat? article.

6.4. ADDING SOFTWARE IN A STANDARD UBI CONTAINER

To add software inside the standard UBI container, disable non-UBI dnf repositories to ensure the containers you build can be redistributed.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Pull and run the **registry.access.redhat.com/ubi10-beta/ubi** image:

```
$ podman run -it --name myubi registry.access.redhat.com/ubi10-beta/ubi
```

2. Add a package to the **myubi** container.
   - To add a package that is in the UBI repository, disable all dnf repositories except for UBI repositories. For example, to add the **bzip2** package:

```
# dnf install --disablerepo=* --enablerepo=ubi-8-appstream-rpms --enablerepo=ubi-8-baseos-rpms bzip2
```

   - To add a package that is not in the UBI repository, do not disable any repositories. For example, to add the **zsh** package:

```
# dnf install zsh
```

   - To add a package that is in a different host repository, explicitly enable the repository you need. For example, to install the **python38-devel** package from the **codeready-builder-for-rhel-8-x86_64-rpms** repository:

```
# dnf install --enablerepo=codeready-builder-for-rhel-8-x86_64-rpms python38-devel
```

Verification

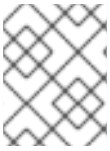
1. List all enabled repositories inside the container:

```
# dnf repolist
```

2. Ensure that the required repositories are listed.
3. List all installed packages:

```
# rpm -qa
```

4. Ensure that the required packages are listed.



NOTE

Installing Red Hat packages that are not inside the Red Hat UBI repositories can limit the ability to distribute the container outside of subscribed RHEL systems.

6.5. ADDING SOFTWARE IN A MINIMAL UBI CONTAINER

UBI dnf repositories are enabled inside UBI Minimal images by default.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Pull and run the **registry.access.redhat.com/ubi10-beta/ubi-minimal** image:

```
$ podman run -it --name myubimin registry.access.redhat.com/ubi10-beta/ubi-minimal
```

2. Add a package to the **myubimin** container:
   - To add a package that is in the UBI repository, do not disable any repositories. For example, to add the **bzip2** package:

```
# microdnf install bzip2 --setopt install_weak_deps=false
```

   - To add a package that is in a different host repository, explicitly enable the repository you need. For example, to install the **python38-devel** package from the **codeready-builder-for-rhel-8-x86_64-rpms** repository:

```
# microdnf install --enablerepo=codeready-builder-for-rhel-8-x86_64-rpms
python38-devel --setopt install_weak_deps=false
```

     The **--setopt install_weak_deps=false** option disables the installation of weak dependencies. Weak dependencies include recommended or suggested packages that are not strictly required but are often installed by default.

Verification

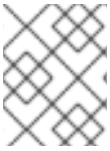
1. List all enabled repositories inside the container:

```
# microdnf repolist
```

2. Ensure that the required repositories are listed.
3. List all installed packages:

```
# rpm -qa
```

4. Ensure that the required packages are listed.



NOTE

Installing Red Hat packages that are not inside the Red Hat UBI repositories can limit the ability to distribute the container outside of subscribed RHEL systems.

6.6. ADDING SOFTWARE TO A UBI CONTAINER ON A UNSUBSCRIBED HOST

You do not have to disable any repositories when adding software packages on unsubscribed RHEL systems.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Add a package to a running container based on the UBI standard or UBI init images. Do not disable any repositories. Use the **podman run** command to run the container. then use the **dnf install** command inside a container.
  - For example, to add the **bzip2** package to the UBI standard based container:

```
$ podman run -it --name myubi registry.access.redhat.com/ubi10-beta/ubi
# dnf install bzip2
```

  - For example, to add the **bzip2** package to the UBI init based container:

```
$ podman run -it --name myubimin registry.access.redhat.com/ubi10-beta/ubi-minimal
# microdnf install bzip2
```

Verification

1. List all enabled repositories:
   - To list all enabled repositories inside the containers based on UBI standard or UBI init images:

```
#  dnf repolist
```

   - To list all enabled repositories inside the containers based on UBI minimal containers:

```
# microdnf repolist
```

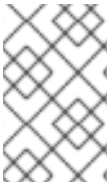
2. Ensure that the required repositories are listed.
3. List all installed packages:

```
# rpm -qa
```

4. Ensure that the required packages are listed.

6.7. BUILDING UBI-BASED IMAGES

You can create a UBI-based web server container from a **Containerfile** by using the Buildah utility. You have to disable all non-UBI dnf repositories to ensure that your image contains only Red Hat software that you can redistribute.



NOTE

For UBI minimal images, use **microdnf** instead of **dnf**: **RUN microdnf update -y && rm -rf /var/cache/yum** and **RUN microdnf install httpd -y && microdnf clean all** commands.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create a **Containerfile**:

```
FROM registry.access.redhat.com/ubi10-beta/ubi
USER root
LABEL maintainer="John Doe"
# Update image
RUN dnf update --disablerepo=* --enablerepo=ubi-8-appstream-rpms --enablerepo=ubi-8-baseos-rpms -y && rm -rf /var/cache/yum
RUN dnf install --disablerepo=* --enablerepo=ubi-8-appstream-rpms --enablerepo=ubi-8-baseos-rpms httpd -y && rm -rf /var/cache/yum
# Add default Web page and expose port
RUN echo "The Web Server is Running" > /var/www/html/index.html
EXPOSE 80
# Start the service
CMD ["-D", "FOREGROUND"]
ENTRYPOINT ["/usr/sbin/httpd"]
```

2. Build the container image:

```
# buildah bud -t johndoe/webserver .
STEP 1: FROM registry.access.redhat.com/ubi10-beta/ubi:latest
STEP 2: USER root
STEP 3: LABEL maintainer="John Doe"
STEP 4: RUN dnf update --disablerepo=* --enablerepo=ubi-8-appstream-rpms --enablerepo=ubi-8-baseos-rpms -y
...
Writing manifest to image destination
Storing signatures
--> f9874f27050
f9874f270500c255b950e751e53d37c6f8f6dba13425d42f30c2a8ef26b769f2
```

Verification

1. Run the web server:

```
# podman run -d --name=myweb -p 80:80 johndoe/webserver
bbe98c71d18720d966e4567949888dc4fb86eec7d304e785d5177168a5965f64
```

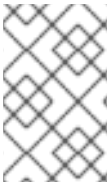
2. Test the web server:

```
# curl http://localhost/index.html
The Web Server is Running
```

6.8. USING APPLICATION STREAM RUNTIME IMAGES

Runtime images based on Application Streams offer a set of container images that you can use as the basis for your container builds.

Supported runtime images are Python, Ruby, s2-core, s2i-base, .NET Core, PHP. The runtime images are available in the Red Hat Container Catalog.



NOTE

Because these UBI images contain the same basic software as their legacy image counterparts, you can learn about those images from the Using Red Hat Software Collections Container Images guide.

Additional resources

- Red Hat Container Catalog
- Red Hat Container Image Updates

6.9. GETTING UBI CONTAINER IMAGE SOURCE CODE

Source code is available for all Red Hat UBI-based images in the form of downloadable container images. Source container images cannot be run, despite being packaged as containers. To install Red Hat source container images on your system, use the **skopeo** command, not the **podman pull** command.

Source container images are named based on the binary containers they represent. For example, for a particular standard RHEL UBI 10-beta container **registry.access.redhat.com/ubi10-beta:8.1-397** append **-source** to get the source container image (**registry.access.redhat.com/ubi10-beta:8.1-397-source**).

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Use the **skopeo copy** command to copy the source container image to a local directory:

```
$ skopeo copy \
docker://registry.access.redhat.com/ubi10-beta:8.1-397-source \
dir:$HOME/TEST
...
Copying blob 477bc8106765 done
```

```
Copying blob c438818481d3 done
...
Writing manifest to image destination
Storing signatures
```

2. Use the **skopeo inspect** command to inspect the source container image:

```
$ skopeo inspect dir:$HOME/TEST
{
    "Digest":
"sha256:7ab721ef3305271bbb629a6db065c59bbeb87bc53e7cbf88e2953a1217ba7322",
    "RepoTags": [],
    "Created": "2020-02-11T12:14:18.612461174Z",
    "DockerVersion": "",
    "Labels": null,
    "Architecture": "amd64",
    "Os": "linux",
    "Layers": [
        "sha256:1ae73d938ab9f11718d0f6a4148eb07d38ac1c0a70b1d03e751de8bf3c2c87fa",
        "sha256:9fe966885cb8712c47efe5ecc2eaa0797a0d5ffb8b119c4bd4b400cc9e255421",
        "sha256:61b2527a4b836a4efbb82dfd449c0556c0f769570a6c02e112f88f8bbcd90166",
        ...
        "sha256:cc56c782b513e2bdd2cc2af77b69e13df4ab624ddb856c4d086206b46b9b9e5f",
        "sha256:dcf9396fdada4e6c1ce667b306b7f08a83c9e6b39d0955c481b8ea5b2a465b32",

"sha256:feb6d2ae252402ea6a6fca8a158a7d32c7e4572db0e6e5a5eab15d4e0777951e"
    ],
    "Env": null
}
```

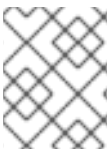
3. Unpack all the content:

```
$ cd $HOME/TEST
$ for f in $(ls); do tar xvf $f; done
```

4. Check the results:

```
$ find blobs/ rpm_dir/
blobs/
blobs/sha256
blobs/sha256/10914f1fff060ce31388f5ab963871870535aaaa551629f5ad182384d60fdf82
rpm_dir/
rpm_dir/gzip-1.9-4.el8.src.rpm
```

If the results are correct, the image is ready to be used.



NOTE

It could take several hours after a container image is released for its associated source container to become available.

Additional resources

- **skopeo-copy (1)** and **skopeo-inspect(1)** man pages on your system

CHAPTER 7. WORKING WITH PODS

Containers are the smallest unit that you can manage with Podman, Skopeo and Buildah container tools. A Podman pod is a group of one or more containers. The Pod concept was introduced by Kubernetes. Podman pods are similar to the Kubernetes definition. Pods are the smallest compute units that you can create, deploy, and manage in OpenShift or Kubernetes environments. Every Podman pod includes an infra container. This container holds the namespaces associated with the pod and allows Podman to connect other containers to the pod. It allows you to start and stop containers within the pod and the pod will stay running. The default infra container on the **registry.access.redhat.com/ubi10-beta/pause** image.

7.1. CREATING PODS

You can create a pod with one container.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create an empty pod:

```
$ podman pod create --name mypod
223df6b390b4ea87a090a4b5207f7b9b003187a6960bd37631ae9bc12c433aff
The pod is in the initial state Created.
```

   The pod is in the initial state Created.

2. Optional: List all pods:

```
$ podman pod ps
POD ID        NAME    STATUS    CREATED               # OF CONTAINERS   INFRA ID
223df6b390b4  mypod   Created   Less than a second ago  1               3afdcd93de3e
```

   Notice that the pod has one container in it.

3. Optional: List all pods and containers associated with them:

```
$ podman ps -a --pod
CONTAINER ID  IMAGE                COMMAND  CREATED              STATUS   PORTS
NAMES              POD
3afdcd93de3e  registry.access.redhat.com/ubi10-beta/pause          Less than a second ago
Created        223df6b390b4-infra  223df6b390b4
```

   You can see that the pod ID from **podman ps** command matches the pod ID in the **podman pod ps** command. The default infra container is based on the **registry.access.redhat.com/ubi10-beta/pause** image.

4. Run a container named **myubi** in the existing pod named **mypod**:

```
$ podman run -dt --name myubi --pod mypod registry.access.redhat.com/ubi10-
beta/ubi /bin/bash
5df5c48fea87860cf75822ceab8370548b04c78be9fc156570949013863ccf71
```

5. Optional: List all pods:

```
$ podman pod ps
POD ID        NAME    STATUS    CREATED               # OF CONTAINERS   INFRA ID
223df6b390b4  mypod   Running   Less than a second ago  2               3afdcd93de3e
```

You can see that the pod has two containers in it.

6. Optional: List all pods and containers associated with them:

```
$ podman ps -a --pod
CONTAINER ID  IMAGE                                COMMAND    CREATED
STATUS                  PORTS  NAMES              POD
5df5c48fea87  registry.access.redhat.com/ubi10-beta/ubi:latest  /bin/bash  Less than a
second ago  Up Less than a second ago         myubi              223df6b390b4
3afdcd93de3e  registry.access.redhat.com/ubi10-beta/pause                    Less than
a second ago  Up Less than a second ago         223df6b390b4-infra  223df6b390b4
```

Additional resources

- **podman-pod-create(1)** man page on your system

7.2. DISPLAYING POD INFORMATION

Learn about how to display pod information.

Prerequisites

- The **container-tools** meta-package is installed.
- The pod has been created. For details, see section Creating pods.

Procedure

- Display active processes running in a pod:
  - To display the running processes of containers in a pod, enter:

```
$ podman pod top mypod
USER   PID   PPID   %CPU    ELAPSED         TTY     TIME   COMMAND
0      1     0      0.000   24.077433518s   ?       0s     /pause
root   1     0      0.000   24.078146025s   pts/0   0s     /bin/bash
```

  - To display a live stream of resource usage stats for containers in one or more pods, enter:

```
$ podman pod stats -a --no-stream
ID            NAME             CPU %   MEM USAGE / LIMIT   MEM %   NET IO    BLOCK IO
PIDS
a9f807ffaacd  frosty_hodgkin   --      3.092MB / 16.7GB    0.02%   -- / --   -- / --    2
3b33001239ee  sleepy_stallman  --      -- / --             --      -- / --   -- / --    --
```

  - To display information describing the pod, enter:

```
$ podman pod inspect mypod
{
    "Id": "db99446fa9c6d10b973d1ce55a42a6850357e0cd447d9bac5627bb2516b5b19a",
    "Name": "mypod",
    "Created": "2020-09-08T10:35:07.536541534+02:00",
    "CreateCommand": [
        "podman",
        "pod",
        "create",
        "--name",
        "mypod"
    ],
    "State": "Running",
    "Hostname": "mypod",
    "CreateCgroup": false,
    "CgroupParent": "/libpod_parent",
    "CgroupPath":
"/libpod_parent/db99446fa9c6d10b973d1ce55a42a6850357e0cd447d9bac5627bb2516b5
b19a",
    "CreateInfra": false,
    "InfraContainerID":
"891c54f70783dcad596d888040700d93f3ead01921894bc19c10b0a03c738ff7",
    "SharedNamespaces": [
        "uts",
        "ipc",
        "net"
    ],
    "NumContainers": 2,
    "Containers": [
        {
            "Id":
"891c54f70783dcad596d888040700d93f3ead01921894bc19c10b0a03c738ff7",
            "Name": "db99446fa9c6-infra",
            "State": "running"
        },
        {
            "Id":
"effc5bbcfe505b522e3bf8fbb5705a39f94a455a66fd81e542bcc27d39727d2d",
            "Name": "myubi",
            "State": "running"
        }
    ]
}
```

You can see information about containers in the pod.

Additional resources

- The **podman-pod-top(1)**, **podman-pod-stats(1)**, and **podman-pod-inspect(1)** man pages on your system

7.3. STOPPING PODS

You can stop one or more pods by using the **podman pod stop** command.

Prerequisites

- The **container-tools** meta-package is installed.
- The pod has been created. For details, see section Creating pods.

Procedure

1. Stop the pod **mypod**:

```
$ podman pod stop mypod
```

2. Optional: List all pods and containers associated with them:

```
$ podman ps -a --pod
CONTAINER ID  IMAGE                                  COMMAND    CREATED            STATUS
PORTS   NAMES              POD ID        PODNAME
5df5c48fea87  registry.redhat.io/ubi10-beta/ubi:latest  /bin/bash  About a minute ago  Exited
(0) 7 seconds ago          myubi              223df6b390b4  mypod

3afdcd93de3e  registry.access.redhat.com/10-beta/pause                       About a minute
ago  Exited (0) 7 seconds ago          8a4e6527ac9d-infra  223df6b390b4  mypod
```

You can see that the pod **mypod** and container **myubi** are in "Exited" status.

Additional resources

- **podman-pod-stop(1)** man page on your system

7.4. REMOVING PODS

You can remove one or more stopped pods and containers by using the **podman pod rm** command.

Prerequisites

- The **container-tools** meta-package is installed.
- The pod has been created. For details, see section Creating pods.
- The pod has been stopped. For details, see section Stopping pods.

Procedure

1. Remove the pod **mypod**, type:

```
$ podman pod rm mypod
223df6b390b4ea87a090a4b5207f7b9b003187a6960bd37631ae9bc12c433aff
```

Note that removing the pod automatically removes all containers inside it.

2. Optional: Check that all containers and pods were removed:

```
$ podman ps
$ podman pod ps
```

Additional resources

- **podman-pod-rm(1)** man page on your system

CHAPTER 8. PORTING CONTAINERS TO SYSTEMD USING PODMAN

Podman (Pod Manager) is a simple daemonless tool fully featured container engine. Podman provides a Docker-CLI comparable command line that makes the transition from other container engines easier and enables the management of pods, containers, and images.

Originally, Podman was not designed to provide an entire Linux system or manage services, such as start-up order, dependency checking, and failed service recovery. **systemd** was responsible for a complete system initialization. Due to Red Hat integrating containers with **systemd**, you can manage OCI and Docker-formatted containers built by Podman in the same way as other services and features are managed in a Linux system. You can use the **systemd** initialization service to work with pods and containers.

With **systemd** unit files, you can:

- Set up a container or pod to start as a **systemd** service.
- Define the order in which the containerized service runs and check for dependencies (for example making sure another service is running, a file is available or a resource is mounted).
- Control the state of the **systemd** system by using the **systemctl** command.

You can generate portable descriptions of containers and pods by using **systemd** unit files.

8.1. AUTO-GENERATING A SYSTEMD UNIT FILE USING QUADLETS

With Quadlet, you describe how to run a container in a format that is very similar to regular **systemd** unit files. The container descriptions focus on the relevant container details and hide technical details of running containers under **systemd**. Create the ***<CTRNAME>*.container** unit file in one of the following directories:

- For root users: **/usr/share/containers/systemd/** or **/etc/containers/systemd/**
- For rootless users: **$HOME/.config/containers/systemd/**, **$XDG_CONFIG_HOME/containers/systemd/, /etc/containers/systemd/users/$(UID)**, or **/etc/containers/systemd/users/**

NOTE

Quadlet is available beginning with Podman v4.6.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create the **mysleep.container** unit file:

```
$ cat $HOME/.config/containers/systemd/mysleep.container
[Unit]
Description=The sleep container
After=local-fs.target
```

```
[Container]
Image=registry.access.redhat.com/ubi10-beta-minimal:latest
Exec=sleep 1000

[Install]
# Start by default on boot
WantedBy=multi-user.target default.target
```

In the **[Container]** section you must specify:

- **Image** - container mage you want to tun
- **Exec** - the command you want to run inside the container
  This enables you to use all other fields specified in a **systemd** unit file.

2. Create the **mysleep.service** based on the **mysleep.container** file:

```
$ systemctl --user daemon-reload
```

3. Optional: Check the status of the **mysleep.service**:

```
$ systemctl --user status mysleep.service
○ mysleep.service - The sleep container
  Loaded: loaded (/home/username/.config/containers/systemd/mysleep.container;
generated)
  Active: inactive (dead)
```

4. Start the **mysleep.service**:

```
$ systemctl --user start mysleep.service
```

Verification

1. Check the status of the **mysleep.service**:

```
$ systemctl --user status mysleep.service
● mysleep.service - The sleep container
  Loaded: loaded (/home/username/.config/containers/systemd/mysleep.container;
generated)
  Active: active (running) since Thu 2023-02-09 18:07:23 EST; 2s ago
   Main PID: 265651 (conmon)
      Tasks: 3 (limit: 76815)
  Memory: 1.6M
     CPU: 94ms
  CGroup: ...
```

2. List all containers:

```
$ podman ps -a
CONTAINER ID  IMAGE                                COMMAND           CREATED         STATUS
PORTS   NAMES
421c8293fc1b  registry.access.redhat.com/ubi10-beta-minimal:latest  sleep 1000  30
seconds ago   Up 10 seconds ago systemd-mysleep
```

Note that the name of the created container consists of the following elements:

- a **systemd-** prefix
- a name of the **systemd** unit, that is **systemd-mysleep**
  This naming helps to distinguish common containers from containers running in **systemd** units. It also helps to determine which unit a container runs in. If you want to change the name of the container, use the **ContainerName** field in the **[Container]** section.

Additional resources

- **podman-systemd.unit(5)** man page on your system

8.2. ENABLING SYSTEMD SERVICES

When enabling the service, you have different options.

Procedure

- Enable the service:
  - To enable a service at system start, no matter if user is logged in or not, enter:

    ```
    # systemctl enable <service>
    ```

    You have to copy the **systemd** unit files to the **/etc/systemd/system** directory.
  - To start a service at user login and stop it at user logout, enter:

    ```
    $ systemctl --user enable <service>
    ```

    You have to copy the **systemd** unit files to the **$HOME/.config/systemd/user** directory.
  - To enable users to start a service at system start and persist over logouts, enter:

    ```
    # loginctl enable-linger <username>
    ```

Additional resources

- **systemctl(1)** and **loginctl(1)** man pages on your system
- Enabling a system service to start at boot

8.3. AUTO-STARTING CONTAINERS USING SYSTEMD

You can control the state of the **systemd** system and service manager by using the **systemctl** command. You can enable, start, stop the service as a non-root user. To install the service as a root user, omit the **--user** option.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Reload **systemd** manager configuration:

```
# systemctl --user daemon-reload
```

2. Enable the service **container.service** and start it at boot time:

```
# systemctl --user enable container.service
```

3. Start the service immediately:

```
# systemctl --user start container.service
```

4. Check the status of the service:

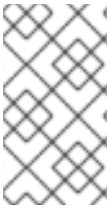
```
$ systemctl --user status container.service
● container.service - Podman container.service
   Loaded: loaded (/home/user/.config/systemd/user/container.service; enabled; vendor
preset: enabled)
   Active: active (running) since Wed 2020-09-16 11:56:57 CEST; 8s ago
     Docs: man:podman-generate-systemd(1)
  Process: 80602 ExecStart=/usr/bin/podman run --conmon-pidfile
//run/user/1000/container.service-pid --cidfile //run/user/1000/container.service-cid -d ubi10-
beta-minimal:>
  Process: 80601 ExecStartPre=/usr/bin/rm -f //run/user/1000/container.service-pid
//run/user/1000/container.service-cid (code=exited, status=0/SUCCESS)
 Main PID: 80617 (conmon)
   CGroup: /user.slice/user-1000.slice/user@1000.service/container.service
           ├─ 2870 /usr/bin/podman
           ├─80612 /usr/bin/slirp4netns --disable-host-loopback --mtu 65520 --enable-sandbox -
-enable-seccomp -c -e 3 -r 4 --netns-type=path /run/user/1000/netns/cni->
           ├─80614 /usr/bin/fuse-overlayfs -o
lowerdir=/home/user/.local/share/containers/storage/overlay/l/YJSPGXM2OCDZPLMLXJOW3N
RF6Q:/home/user/.local/share/contain>
           ├─80617 /usr/bin/conmon --api-version 1 -c
cbc75d6031508dfd3d78a74a03e4ace1732b51223e72a2ce4aa3bfe10a78e4fa -u
cbc75d6031508dfd3d78a74a03e4ace1732b51223e72>
           └─cbc75d6031508dfd3d78a74a03e4ace1732b51223e72a2ce4aa3bfe10a78e4fa
             └─80626 /usr/bin/coreutils --coreutils-prog-shebang=sleep /usr/bin/sleep 1d
```

You can check if the service is enabled by using the **systemctl is-enabled container.service** command.

Verification

- List containers that are running or have exited:

```
# podman ps
CONTAINER ID  IMAGE                                  COMMAND  CREATED         STATUS
PORTS  NAMES
f20988d59920  registry.access.redhat.com/ubi10-beta-minimal:latest  top      12 seconds ago
Up 11 seconds ago         funny_zhukovsky
```



NOTE

To stop **container.service**, enter:

```
# systemctl --user stop container.service
```

Additional resources

- **systemctl(1)** man page on your system
- Enabling a system service to start at boot

8.4. ADVANTAGES OF USING QUADLETS OVER THE PODMAN GENERATE SYSTEMD COMMAND

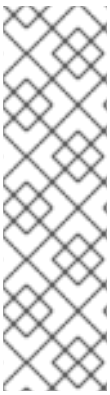
You can use the Quadlets tool, which describes how to run a container in a format similar to regular **systemd** unit files.

NOTE

Quadlet is available beginning with Podman v4.6.

Quadlets have many advantages over generating unit files by using the **podman generate systemd** command, such as:

- **Easy to maintain**: The container descriptions focus on the relevant container details and hide technical details of running containers under **systemd**.
- **Automatically updated**: Quadlets do not require manually regenerating unit files after an update. If a newer version of Podman is released, your service is automatically updated when the **systemclt daemon-reload** command is executed, for example, at boot time.
- **Simplified workflow**: Thanks to the simplified syntax, you can create Quadlet files from scratch and deploy them anywhere.
- **Support standard systemd options**: Quadlet extends the existing systemd-unit syntax with new tables, for example, a table to configure a container.



NOTE

Quadlet supports a subset of Kubernetes YAML capabilities. For more information, see the support matrix of supported YAML fields. You can generate the YAML files by using one of the following tools:

- Podman: **podman generate kube** command
- OpenShift: **oc generate** command with the **--dry-run** option
- Kubernetes: **kubectl create** command with the **--dry-run** option

Quadlet supports these unit file types:

- **Container units**: Used to manage containers by running the **podman run** command.

- File extension: **.container**
- Section name: **[Container]**
- Required fields: **Image** describing the container image the service runs

- **Kube units**: Used to manage containers defined in Kubernetes YAML files by running the **podman kube play** command.
  - File extension: **.kube**
  - Section name: **[Kube]**
  - Required fields: **Yaml** defining the path to the Kubernetes YAML file
- **Network units**: Used to create Podman networks that may be referenced in **.container** or **.kube** files.
  - File extension: **.network**
  - Section name: **[Network]**
  - Required fields: None
- **Volume units**: Used to create Podman volumes that may be referenced in **.container** files.
  - File extension: **.volume**
  - Section name: **[Volume]**
  - Required fields: None

Additional resources

- **podman-systemd.unit(5)** man page on your system

8.5. GENERATING A SYSTEMD UNIT FILE USING PODMAN

Podman allows **systemd** to control and manage container processes. You can generate a **systemd** unit file for the existing containers and pods by using **podman generate systemd** command. It is recommended to use **podman generate systemd** because the generated units files change frequently (via updates to Podman) and the **podman generate systemd** ensures that you get the latest version of unit files.

NOTE

Starting with Podman v4.6, you can use the Quadlets that describe how to run a container in a format similar to regular **systemd** unit files and hides the complexity of running containers under **systemd**.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create a container (for example **myubi**):

```
$ podman create --name myubi registry.access.redhat.com/ubi10-beta:latest sleep infinity
0280afe98bb75a5c5e713b28de4b7c5cb49f156f1cce4a208f13fee2f75cb453
```

2. Use the container name or ID to generate the **systemd** unit file and direct it into the **~/.config/systemd/user/container-myubi.service** file:

```
$ podman generate systemd --name myubi > ~/.config/systemd/user/container-myubi.service
```

Verification

- Display the content of generated **systemd** unit file:

```
$ cat ~/.config/systemd/user/container-myubi.service
# container-myubi.service
# autogenerated by Podman 3.3.1
# Wed Sep  8 20:34:46 CEST 2021

[Unit]
Description=Podman container-myubi.service
Documentation=man:podman-generate-systemd(1)
Wants=network-online.target
After=network-online.target
RequiresMountsFor=/run/user/1000/containers

[Service]
Environment=PODMAN_SYSTEMD_UNIT=%n
Restart=on-failure
TimeoutStopSec=70
ExecStart=/usr/bin/podman start myubi
ExecStop=/usr/bin/podman stop -t 10 myubi
ExecStopPost=/usr/bin/podman stop -t 10 myubi
PIDFile=/run/user/1000/containers/overlay-containers/9683103f58a32192c84801f0be93446cb33c1ee7d9cdda225b78049d7c5deea4/userdata/conmon.pid
Type=forking

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

  - The **Restart=on-failure** line sets the restart policy and instructs **systemd** to restart when the service cannot be started or stopped cleanly, or when the process exits non-zero.
  - The **ExecStart** line describes how we start the container.
  - The **ExecStop** line describes how we stop and remove the container.

Additional resources

- **podman-generate-systemd(1)** man page on your system

8.6. AUTOMATICALLY GENERATING A SYSTEMD UNIT FILE USING PODMAN

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

NOTE

Starting with Podman v4.6, you can use the Quadlets that describe how to run a container in a format similar to regular **systemd** unit files and hides the complexity of running containers under **systemd**.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Pull the image you want to use on your system. For example, to pull the **httpd-24** image:

```
# podman pull registry.access.redhat.com/ubi10-beta/httpd-24
```

2. Optional: List all images available on your system:

```
# podman images
REPOSITORY                                  TAG         IMAGE ID      CREATED       SIZE
registry.access.redhat.com/ubi10-beta/httpd-24  latest      8594be0a0b57  2 weeks ago
462 MB
```

3. Create the **httpd** container:

```
# podman create --name httpd -p 8080:8080 registry.access.redhat.com/ubi10-
beta/httpd-24
cdb9f981cf143021b1679599d860026b13a77187f75e46cc0eac85293710a4b1
```

4. Optional: Verify the container has been created:

```
# podman ps -a
CONTAINER ID  IMAGE                                       COMMAND             CREATED
STATUS      PORTS                 NAMES
cdb9f981cf14  registry.access.redhat.com/ubi10-beta/httpd-24:latest  /usr/bin/run-http...  5
minutes ago  Created     0.0.0.0:8080->8080/tcp  httpd
```

5. Generate a **systemd** unit file for the **httpd** container:

```
# podman generate systemd --new --files --name httpd
/root/container-httpd.service
```

6. Display the content of the generated **container-httpd.service systemd** unit file:

```
# cat /root/container-httpd.service
# container-httpd.service
```

```
# autogenerated by Podman 3.3.1
# Wed Sep  8 20:41:44 CEST 2021

[Unit]
Description=Podman container-httpd.service
Documentation=man:podman-generate-systemd(1)
Wants=network-online.target
After=network-online.target
RequiresMountsFor=%t/containers

[Service]
Environment=PODMAN_SYSTEMD_UNIT=%n
Restart=on-failure
TimeoutStopSec=70
ExecStartPre=/bin/rm -f %t/%n.ctr-id
ExecStart=/usr/bin/podman run --cidfile=%t/%n.ctr-id --sdnotify=conmon --cgroups=no-conmon --rm -d --replace --name httpd -p 8080:8080 registry.access.redhat.com/ubi10-beta/httpd-24
ExecStop=/usr/bin/podman stop --ignore --cidfile=%t/%n.ctr-id
ExecStopPost=/usr/bin/podman rm -f --ignore --cidfile=%t/%n.ctr-id
Type=notify
NotifyAccess=all

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

NOTE

Unit files generated by using the **--new** option do not expect containers and pods to exist. Therefore, they perform the **podman run** command when starting the service (see the **ExecStart** line) instead of the **podman start** command. For example, see section Generating a systemd unit file using Podman .

- The **podman run** command uses the following command-line options:
  - The **--conmon-pidfile** option points to a path to store the process ID for the **conmon** process running on the host. The **conmon** process terminates with the same exit status as the container, which allows **systemd** to report the correct service status and restart the container if needed.
  - The **--cidfile** option points to the path that stores the container ID.
  - The **%t** is the path to the run time directory root, for example **/run/user/$UserID**.
  - The **%n** is the full name of the service.

1. Copy unit files to **/etc/systemd/system** for installing them as a root user:

```
# cp -Z container-httpd.service /etc/systemd/system
```

2. Enable and start the **container-httpd.service**:

```
# systemctl daemon-reload
# systemctl enable --now container-httpd.service
Created symlink /etc/systemd/system/multi-user.target.wants/container-httpd.service
```

```
→ /etc/systemd/system/container-httpd.service.
Created symlink /etc/systemd/system/default.target.wants/container-httpd.service →
/etc/systemd/system/container-httpd.service.
```

Verification

- Check the status of the **container-httpd.service**:

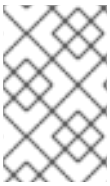
```
# systemctl status container-httpd.service
   ● container-httpd.service - Podman container-httpd.service
     Loaded: loaded (/etc/systemd/system/container-httpd.service; enabled; vendor preset:
disabled)
     Active: active (running) since Tue 2021-08-24 09:53:40 EDT; 1min 5s ago
       Docs: man:podman-generate-systemd(1)
    Process: 493317 ExecStart=/usr/bin/podman run --conmon-pidfile /run/container-
httpd.pid --cidfile /run/container-httpd.ctr-id --cgroups=no-conmon -d --repla>
    Process: 493315 ExecStartPre=/bin/rm -f /run/container-httpd.pid /run/container-httpd.ctr-
id (code=exited, status=0/SUCCESS)
   Main PID: 493435 (conmon)
   ...
```

Additional resources

- **podman-create(1)**, **podman-generate-systemd(1)**, and **systemctl(1)** man pages on your system
- Enabling a system service to start at boot

8.7. AUTOMATICALLY STARTING PODS USING SYSTEMD

You can start multiple containers as **systemd** services. Note that the **systemctl** command should only be used on the pod and you should not start or stop containers individually via **systemctl**, as they are managed by the pod service along with the internal infra-container.



NOTE

Starting with Podman v4.6, you can use the Quadlets that describe how to run a container in a format similar to regular **systemd** unit files and hides the complexity of running containers under **systemd**.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create an empty pod, for example named **systemd-pod**:

```
$ podman pod create --name systemd-pod
11d4646ba41b1fffa51c108cbdf97cfab3213f7bd9b3e1ca52fe81b90fed5577
```

2. Optional: List all pods:

```
$ podman pod ps
POD ID        NAME        STATUS   CREATED         # OF CONTAINERS  INFRA ID
11d4646ba41b  systemd-pod  Created  40 seconds ago  1                8a428b257111
11d4646ba41b1fffa51c108cbdf97cfab3213f7bd9b3e1ca52fe81b90fed5577
```

3. Create two containers in the empty pod. For example, to create **container0** and **container1** in **systemd-pod**:

```
$ *podman create --pod systemd-pod --name container0 registry.access.redhat.com/ubi*10-beta top
$ *podman create --pod systemd-pod --name container1 registry.access.redhat.com/ubi*10-beta top
```

4. Optional: List all pods and containers associated with them:

```
$ podman ps -a --pod
CONTAINER ID  IMAGE                                COMMAND  CREATED        STATUS
PORTS   NAMES              POD ID        PODNAME
24666f47d9b2  registry.access.redhat.com/ubi10-beta:latest  top      3 minutes ago  Created
container0          3130f724e229  systemd-pod
56eb1bf0cdfe  k8s.gcr.io/pause:3.2                          4 minutes ago  Created
3130f724e229-infra  3130f724e229  systemd-pod
62118d170e43  registry.access.redhat.com/ubi10-beta:latest  top      3 seconds ago  Created
container1          3130f724e229  systemd-pod
```

5. Generate the **systemd** unit file for the new pod:

```
$ podman generate systemd --files --name systemd-pod
/home/user1/pod-systemd-pod.service
/home/user1/container-container0.service
/home/user1/container-container1.service
```

Note that three **systemd** unit files are generated, one for the **systemd-pod** pod and two for the containers **container0** and **container1**.

6. Display **pod-systemd-pod.service** unit file:

```
$ cat pod-systemd-pod.service
# pod-systemd-pod.service
# autogenerated by Podman 3.3.1
# Wed Sep  8 20:49:17 CEST 2021

[Unit]
Description=Podman pod-systemd-pod.service
Documentation=man:podman-generate-systemd(1)
Wants=network-online.target
After=network-online.target
RequiresMountsFor=
Requires=container-container0.service container-container1.service
Before=container-container0.service container-container1.service

[Service]
Environment=PODMAN_SYSTEMD_UNIT=%n
Restart=on-failure
```

```
TimeoutStopSec=70
ExecStart=/usr/bin/podman start bcb128965b8e-infra
ExecStop=/usr/bin/podman stop -t 10 bcb128965b8e-infra
ExecStopPost=/usr/bin/podman stop -t 10 bcb128965b8e-infra
PIDFile=/run/user/1000/containers/overlay-
containers/1dfdcf20e35043939ea3f80f002c65c00d560e47223685dbc3230e26fe001b29/userda
ta/conmon.pid
Type=forking

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

- The **Requires** line in the **[Unit]** section defines dependencies on **container-container0.service** and **container-container1.service** unit files. Both unit files will be activated.
- The **ExecStart** and **ExecStop** lines in the **[Service]** section start and stop the infra-container, respectively.

7. Display **container-container0.service** unit file:

```
$ cat container-container0.service
# container-container0.service
# autogenerated by Podman 3.3.1
# Wed Sep  8 20:49:17 CEST 2021

[Unit]
Description=Podman container-container0.service
Documentation=man:podman-generate-systemd(1)
Wants=network-online.target
After=network-online.target
RequiresMountsFor=/run/user/1000/containers
BindsTo=pod-systemd-pod.service
After=pod-systemd-pod.service

[Service]
Environment=PODMAN_SYSTEMD_UNIT=%n
Restart=on-failure
TimeoutStopSec=70
ExecStart=/usr/bin/podman start container0
ExecStop=/usr/bin/podman stop -t 10 container0
ExecStopPost=/usr/bin/podman stop -t 10 container0
PIDFile=/run/user/1000/containers/overlay-
containers/4bccd7c8616ae5909b05317df4066fa90a64a067375af5996fdef9152f6d51f5/userdat
a/conmon.pid
Type=forking

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

- The **BindsTo** line line in the **[Unit]** section defines the dependency on the **pod-systemd-pod.service** unit file
- The **ExecStart** and **ExecStop** lines in the **[Service]** section start and stop the **container0** respectively.

8. Display **container-container1.service** unit file:

```
$ cat container-container1.service
```

9. Copy all the generated files to **$HOME/.config/systemd/user** for installing as a non-root user:

```
$ cp pod-systemd-pod.service container-container0.service container-container1.service $HOME/.config/systemd/user
```

10. Enable the service and start at user login:

```
$ systemctl enable --user pod-systemd-pod.service
Created symlink /home/user1/.config/systemd/user/multi-user.target.wants/pod-systemd-pod.service → /home/user1/.config/systemd/user/pod-systemd-pod.service.
Created symlink /home/user1/.config/systemd/user/default.target.wants/pod-systemd-pod.service → /home/user1/.config/systemd/user/pod-systemd-pod.service.
```

Note that the service stops at user logout.

Verification

- Check if the service is enabled:

```
$ systemctl is-enabled pod-systemd-pod.service
enabled
```

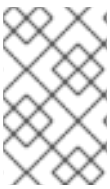
Additional resources

- **podman-create(1)**, **podman-generate-systemd(1)**, and **systemctl(1)** man pages on your system
- Enabling a system service to start at boot

8.8. AUTOMATICALLY UPDATING CONTAINERS USING PODMAN

The **podman auto-update** command allows you to automatically update containers according to their auto-update policy. The **podman auto-update** command updates services when the container image is updated on the registry. To use auto-updates, containers must be created with the **--label "io.containers.autoupdate=image"** label and run in a **systemd** unit generated by **podman generate systemd --new** command.

Podman searches for running containers with the **"io.containers.autoupdate"** label set to **"image"** and communicates to the container registry. If the image has changed, Podman restarts the corresponding **systemd** unit to stop the old container and create a new one with the new image. As a result, the container, its environment, and all dependencies, are restarted.



NOTE

Starting with Podman v4.6, you can use the Quadlets that describe how to run a container in a format similar to regular **systemd** unit files and hides the complexity of running containers under **systemd**.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Start a **myubi** container based on the **registry.access.redhat.com/ubi10-beta/ubi-init** image:

```
# podman run --label "io.containers.autoupdate=image" \
--name myubi -dt registry.access.redhat.com/ubi10-beta/ubi-init top
bc219740a210455fa27deacc96d50a9e20516492f1417507c13ce1533dbdcd9d
```

2. Optional: List containers that are running or have exited:

```
# podman ps -a
CONTAINER ID  IMAGE                                       COMMAND  CREATED         STATUS
PORTS   NAMES
76465a5e2933  registry.access.redhat.com/10-beta/ubi-init:latest  top      24 seconds ago  Up
23 seconds ago          myubi
```

3. Generate a **systemd** unit file for the **myubi** container:

```
# podman generate systemd --new --files --name myubi
/root/container-myubi.service
```

4. Copy unit files to **/usr/lib/systemd/system** for installing it as a root user:

```
# cp -Z ~/container-myubi.service /usr/lib/systemd/system
```

5. Reload **systemd** manager configuration:

```
# systemctl daemon-reload
```

6. Start and check the status of a container:

```
# systemctl start container-myubi.service
# systemctl status container-myubi.service
```

7. Auto-update the container:

```
# podman auto-update
```

Additional resources

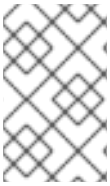
- **podman-generate-systemd(1)**, and **systemctl(1)** man pages on your system
- Enabling a system service to start at boot

8.9. AUTOMATICALLY UPDATING CONTAINERS USING SYSTEMD

As mentioned in section Automatically updating containers using Podman,

you can update the container by using the **podman auto-update** command. It integrates into custom scripts and can be invoked when needed. Another way to auto update the containers is to use the pre-

installed **podman-auto-update.timer** and **podman-auto-update.service systemd** service. The **podman-auto-update.timer** can be configured to trigger auto updates at a specific date or time. The **podman-auto-update.service** can further be started by the **systemctl** command or be used as a dependency by other **systemd** services. As a result, auto updates based on time and events can be triggered in various ways to meet individual needs and use cases.



NOTE

Starting with Podman v4.6, you can use the Quadlets that describe how to run a container in a format similar to regular **systemd** unit files and hides the complexity of running containers under **systemd**.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Display the **podman-auto-update.service** unit file:

```
# cat /usr/lib/systemd/system/podman-auto-update.service

[Unit]
Description=Podman auto-update service
Documentation=man:podman-auto-update(1)
Wants=network.target
After=network-online.target

[Service]
Type=oneshot
ExecStart=/usr/bin/podman auto-update

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

2. Display the **podman-auto-update.timer** unit file:

```
# cat /usr/lib/systemd/system/podman-auto-update.timer

[Unit]
Description=Podman auto-update timer

[Timer]
OnCalendar=daily
Persistent=true

[Install]
WantedBy=timers.target
```

   In this example, the **podman auto-update** command is launched daily at midnight.

3. Enable the **podman-auto-update.timer** service at system start:

```
# systemctl enable podman-auto-update.timer
```

4. Start the **systemd** service:

```
# systemctl start podman-auto-update.timer
```

5. Optional: List all timers:

```
# systemctl list-timers --all
NEXT                         LEFT      LAST                         PASSED       UNIT
ACTIVATES
Wed 2020-12-09 00:00:00 CET  9h left   n/a                          n/a          podman-auto-
update.timer     podman-auto-update.service
```

You can see that **podman-auto-update.timer** activates the **podman-auto-update.service**.

Additional resources

- **systemctl(1)** man page on your system
- Enabling a system service to start at boot

CHAPTER 9. PORTING CONTAINERS TO OPENSHIFT USING PODMAN

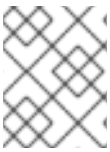
You can generate portable descriptions of containers and pods by using the YAML ("YAML Ain't Markup Language") format. The YAML is a text format used to describe the configuration data.

The YAML files are:

- Readable.
- Easy to generate.
- Portable between environments (for example between RHEL and OpenShift).
- Portable between programming languages.
- Convenient to use (no need to add all the parameters to the command line).

Reasons to use YAML files:

1. You can re-run a local orchestrated set of containers and pods with minimal input required which can be useful for iterative development.
2. You can run the same containers and pods on another machine. For example, to run an application in an OpenShift environment and to ensure that the application is working correctly. You can use **podman generate kube** command to generate a Kubernetes YAML file. Then, you can use **podman play** command to test the creation of pods and containers on your local system before you transfer the generated YAML files to the Kubernetes or OpenShift environment. With **podman play** command, you can also recreate pods and containers originally created in OpenShift or Kubernetes environments.



NOTE

The **podman kube play** command supports a subset of Kubernetes YAML capabilities. For more information, see the support matrix of supported YAML fields.

9.1. GENERATING A KUBERNETES YAML FILE USING PODMAN

You can create a pod with one container and generate the Kubernetes YAML file by using the **podman generate kube** command.

Prerequisites

- The **container-tools** meta-package is installed.
- The pod has been created. For details, see section Creating pods.

Procedure

1. List all pods and containers associated with them:

```
$ podman ps -a --pod
CONTAINER ID  IMAGE                           COMMAND    CREATED
STATUS                 PORTS  NAMES           POD
```

```
5df5c48fea87  registry.access.redhat.com/ubi10-beta/ubi:latest  /bin/bash  Less than a
second ago  Up Less than a second ago         myubi               223df6b390b4
3afdcd93de3e  k8s.gcr.io/pause:3.1                               Less than a second ago  Up Less
than a second ago         223df6b390b4-infra  223df6b390b4
```

2. Use the pod name or ID to generate the Kubernetes YAML file:

```
$ podman generate kube mypod > mypod.yaml
```

Note that the **podman generate** command does not reflect any Logical Volume Manager (LVM) logical volumes or physical volumes that might be attached to the container.

3. Display the **mypod.yaml** file:

```
$ cat mypod.yaml
# Generation of Kubernetes YAML is still under development!
#
# Save the output of this file and use kubectl create -f to import
# it into Kubernetes.
#
# Created with podman-1.6.4
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: "2020-06-09T10:31:56Z"
  labels:
app: mypod
  name: mypod
spec:
  containers:
  - command:
        - /bin/bash
        env:
        - name: PATH
            value: /usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin
        - name: TERM
            value: xterm
        - name: HOSTNAME
        - name: container
            value: oci
        image: registry.access.redhat.com/ubi10-beta/ubi:latest
        name: myubi
        resources: {}
        securityContext:
            allowPrivilegeEscalation: true
            capabilities: {}
            privileged: false
            readOnlyRootFilesystem: false
        tty: true
        workingDir: /
status: {}
```

Additional resources

- **podman-generate-kube(1)** man page on your system

9.2. GENERATING A KUBERNETES YAML FILE IN OPENSHIFT ENVIRONMENT

In the OpenShift environment, use the **oc create** command to generate the YAML files describing your application.

Procedure

- Generate the YAML file for your **myapp** application:

```
$ oc create myapp --image=me/myapp:v1 -o yaml --dry-run > myapp.yaml
```

The **oc create** command creates and run the **myapp** image. The object is printed using the **--dry-run** option and redirected into the **myapp.yaml** output file.

NOTE

In the Kubernetes environment, you can use the **kubectl create** command with the same flags.

9.3. STARTING CONTAINERS AND PODS WITH PODMAN

With the generated YAML files, you can automatically start containers and pods in any environment. The YAML files can be generated by using tools other than Podman, such as Kubernetes or Openshift. The **podman play kube** command allows you to recreate pods and containers based on the YAML input file.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create the pod and the container from the **mypod.yaml** file:

```
$ podman play kube mypod.yaml
Pod:
b8c5b99ba846ccff76c3ef257e5761c2d8a5ca4d7ffa3880531aec79c0dacb22
Container:
848179395ebd33dd91d14ffbde7ae273158d9695a081468f487af4e356888ece
```

2. List all pods:

```
$ podman pod ps
POD ID        NAME    STATUS    CREATED         # OF CONTAINERS   INFRA ID
b8c5b99ba846  mypod   Running   19 seconds ago  2                 aa4220eaf4bb
```

3. List all pods and containers associated with them:

```
$ podman ps -a --pod
CONTAINER ID  IMAGE                                  COMMAND    CREATED          STATUS
PORTS  NAMES              POD
848179395ebd  registry.access.redhat.com/ubi10-beta/ubi:latest  /bin/bash  About a minute
```

```
ago  Up About a minute ago         myubi               b8c5b99ba846
aa4220eaf4bb  k8s.gcr.io/pause:3.1                           About a minute ago  Up About a
minute ago         b8c5b99ba846-infra  b8c5b99ba846
```

The pod IDs from **podman ps** command matches the pod ID from the **podman pod ps** command.

Additional resources

- **podman-play-kube(1)** man page on your system

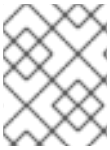
9.4. STARTING CONTAINERS AND PODS IN OPENSHIFT ENVIRONMENT

You can use the **oc create** command to create pods and containers in the OpenShift environment.

Procedure

- Create a pod from the YAML file in the OpenShift environment:

```
$ oc create -f mypod.yaml
```



NOTE

In the Kubernetes environment, you can use the **kubectl create** command with the same flags.

9.5. MANUALLY RUNNING CONTAINERS AND PODS USING PODMAN

The following procedure shows how to manually create a WordPress content management system paired with a MariaDB database by using Podman.

Suppose the following directory layout:

```
├── mariadb-conf
│   ├── Containerfile
│   ├── my.cnf
```

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Display the **mariadb-conf/Containerfile** file:

```
$ cat mariadb-conf/Containerfile
FROM docker.io/library/mariadb
COPY my.cnf /etc/mysql/my.cnf
```

2. Display the **mariadb-conf/my.cnf** file:

```
[client-server]
# Port or socket location where to connect
port = 3306
socket = /run/mysqld/mysqld.sock

# Import all .cnf files from the configuration directory
[mariadbd]
skip-host-cache
skip-name-resolve
bind-address = 127.0.0.1

!includedir /etc/mysql/mariadb.conf.d/
!includedir /etc/mysql/conf.d/
```

3. Build the **docker.io/library/mariadb** image by using **mariadb-conf/Containerfile**:

```
$ cd mariadb-conf
$ podman build -t mariadb-conf .
$ cd ..
STEP 1: FROM docker.io/library/mariadb
Trying to pull docker.io/library/mariadb:latest...
Getting image source signatures
Copying blob 7b1a6ab2e44d done
...
Storing signatures
STEP 2: COPY my.cnf /etc/mysql/my.cnf
STEP 3: COMMIT mariadb-conf
--> ffae584aa6e
Successfully tagged localhost/mariadb-conf:latest
ffae584aa6e733ee1cdf89c053337502e1089d1620ff05680b6818a96eec3c17
```

4. Optional: List all images:

```
$ podman images
LIST IMAGES
REPOSITORY                                  TAG         IMAGE ID      CREATED
SIZE
localhost/mariadb-conf                      latest      b66fa0fa0ef2  57 seconds ago
416 MB
```

5. Create the pod named **wordpresspod** and configure port mappings between the container and the host system:

```
$ podman pod create --name wordpresspod -p 8080:80
```

6. Create the **mydb** container inside the **wordpresspod** pod:

```
$ podman run --detach --pod wordpresspod \
   -e MYSQL_ROOT_PASSWORD=1234 \
   -e MYSQL_DATABASE=mywpdb \
   -e MYSQL_USER=mywpuser \
   -e MYSQL_PASSWORD=1234 \
   --name mydb localhost/mariadb-conf
```

7. Create the **myweb** container inside the **wordpresspod** pod:

```
$ podman run --detach --pod wordpresspod \
  -e WORDPRESS_DB_HOST=127.0.0.1 \
  -e WORDPRESS_DB_NAME=mywpdb \
  -e WORDPRESS_DB_USER=mywpuser \
  -e WORDPRESS_DB_PASSWORD=1234 \
  --name myweb docker.io/wordpress
```

8. Optional: List all pods and containers associated with them:

```
$ podman ps --pod -a
CONTAINER ID  IMAGE                           COMMAND               CREATED
STATUS                   PORTS                 NAMES               POD ID        PODNAME
9ea56f771915  k8s.gcr.io/pause:3.5                                  Less than a second ago  Up Less
than a second ago  0.0.0.0:8080->80/tcp  4b7f054a6f01-infra  4b7f054a6f01  wordpresspod
60e8dbbabac5  localhost/mariadb-conf:latest       mariadbd              Less than a second ago
Up Less than a second ago  0.0.0.0:8080->80/tcp  mydb                4b7f054a6f01
wordpresspod
045d3d506e50  docker.io/library/wordpress:latest  apache2-foregroun...  Less than a second
ago  Up Less than a second ago  0.0.0.0:8080->80/tcp  myweb               4b7f054a6f01
wordpresspod
```

Verification

- Verify that the pod is running: Visit the http://localhost:8080/wp-admin/install.php page or use the **curl** command:

```
$ curl http://localhost:8080/wp-admin/install.php
<!DOCTYPE html>
<html lang="en-US" xml:lang="en-US">
<head>
...
</head>
<body class="wp-core-ui">
<p id="logo">WordPress</p>
    <h1>Welcome</h1>
...
```

Additional resources

- **podman-play-kube(1)** man page on your system

9.6. GENERATING A YAML FILE USING PODMAN

You can generate a Kubernetes YAML file by using the **podman generate kube** command.

Prerequisites

- The **container-tools** meta-package is installed.
- The pod named **wordpresspod** has been created. For details, see section Creating pods.

Procedure

1. List all pods and containers associated with them:

```
$ podman ps --pod -a
CONTAINER ID  IMAGE                                 COMMAND               CREATED
STATUS                   PORTS                 NAMES               POD ID        PODNAME
9ea56f771915  k8s.gcr.io/pause:3.5                                    Less than a second ago  Up Less
than a second ago  0.0.0.0:8080->80/tcp  4b7f054a6f01-infra  4b7f054a6f01  wordpresspod
60e8dbbabac5  localhost/mariadb-conf:latest       mariadbd              Less than a second ago
Up Less than a second ago  0.0.0.0:8080->80/tcp  mydb                4b7f054a6f01
wordpresspod
045d3d506e50  docker.io/library/wordpress:latest  apache2-foregroun...  Less than a second
ago  Up Less than a second ago  0.0.0.0:8080->80/tcp  myweb               4b7f054a6f01
wordpresspod
```

2. Use the pod name or ID to generate the Kubernetes YAML file:

```
$ podman generate kube wordpresspod >> wordpresspod.yaml
```

Verification

- Display the **wordpresspod.yaml** file:

```
$ cat wordpresspod.yaml
...
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: "2021-12-09T15:09:30Z"
  labels:
    app: wordpresspod
  name: wordpresspod
spec:
  containers:
  - args:
        value: podman
      - name: MYSQL_PASSWORD
        value: "1234"
      - name: MYSQL_MAJOR
        value: "8.0"
      - name: MYSQL_VERSION
        value: 8.0.27-1debian10
      - name: MYSQL_ROOT_PASSWORD
        value: "1234"
      - name: MYSQL_DATABASE
        value: mywpdb
      - name: MYSQL_USER
        value: mywpuser
        image: mariadb
            name: mydb
            ports:
            - containerPort: 80
              hostPort: 8080
              protocol: TCP
```

```
- args:
  - name: WORDPRESS_DB_NAME
    value: mywpdb
  - name: WORDPRESS_DB_PASSWORD
    value: "1234"
  - name: WORDPRESS_DB_HOST
    value: 127.0.0.1
  - name: WORDPRESS_DB_USER
    value: mywpuser
    image: docker.io/library/wordpress:latest
    name: myweb
```

Additional resources

- **podman-play-kube(1)** man page on your system

9.7. AUTOMATICALLY RUNNING CONTAINERS AND PODS USING PODMAN

You can use the **podman play kube** command to test the creation of pods and containers on your local system before you transfer the generated YAML files to the Kubernetes or OpenShift environment.

The **podman play kube** command can also automatically build and run multiple pods with multiple containers in the pod by using the YAML file similarly to the docker compose command. The images are automatically built if the following conditions are met:

1. a directory with the same name as the image used in YAML file exists
2. that directory contains a Containerfile

Prerequisites

- The **container-tools** meta-package is installed.
- The pod named **wordpresspod** has been created. For details, see section Manually running containers and pods using Podman.
- The YAML file has been generated. For details, see section Generating a YAML file using Podman.
- To repeat the whole scenario from the beginning, delete locally stored images:

```
$ podman rmi localhost/mariadb-conf
$ podman rmi docker.io/library/wordpress
$ podman rmi docker.io/library/mysql
```

Procedure

1. Create the wordpress pod by using the **wordpress.yaml** file:

```
$ podman play kube wordpress.yaml
STEP 1/2: FROM docker.io/library/mariadb
STEP 2/2: COPY my.cnf /etc/mysql/my.cnf
COMMIT localhost/mariadb-conf:latest
```

```
--> 428832c45d0
Successfully tagged localhost/mariadb-conf:latest
428832c45d07d78bb9cb34e0296a7dc205026c2fe4d636c54912c3d6bab7f399
Trying to pull docker.io/library/wordpress:latest...
Getting image source signatures
Copying blob 99c3c1c4d556 done
...
Storing signatures
Pod:
3e391d091d190756e655219a34de55583eed3ef59470aadd214c1fc48cae92ac
Containers:
6c59ebe968467d7fdb961c74a175c88cb5257fed7fb3d375c002899ea855ae1f
29717878452ff56299531f79832723d3a620a403f4a996090ea987233df0bc3d
```

The **podman play kube** command:

- Automatically build the **localhost/mariadb-conf:latest** image based on **docker.io/library/mariadb** image.
- Pull the **docker.io/library/wordpress:latest** image.
- Create a pod named **wordpresspod** with two containers named **wordpresspod-mydb** and **wordpresspod-myweb**.

2. List all containers and pods:

```
$ podman ps --pod -a
CONTAINER ID  IMAGE                           COMMAND               CREATED        STATUS
PORTS                   NAMES               POD ID        PODNAME
a1dbf7b5606c  k8s.gcr.io/pause:3.5                                 3 minutes ago  Up 2 minutes ago
0.0.0.0:8080->80/tcp  3e391d091d19-infra  3e391d091d19  wordpresspod
6c59ebe96846  localhost/mariadb-conf:latest  mariadbd              2 minutes ago  Exited (1)
2 minutes ago  0.0.0.0:8080->80/tcp  wordpresspod-mydb   3e391d091d19  wordpresspod
29717878452f  docker.io/library/wordpress:latest  apache2-foregroun...  2 minutes ago  Up 2
minutes ago          0.0.0.0:8080->80/tcp  wordpresspod-myweb  3e391d091d19
wordpresspod
```

Verification

- Verify that the pod is running: Visit the http://localhost:8080/wp-admin/install.php page or use the **curl** command:

```
$ curl http://localhost:8080/wp-admin/install.php
<!DOCTYPE html>
<html lang="en-US" xml:lang="en-US">
<head>
...
</head>
<body class="wp-core-ui">
<p id="logo">WordPress</p>
    <h1>Welcome</h1>
...
```

Additional resources

- **podman-play-kube(1)** man page on your system

9.8. AUTOMATICALLY STOPPING AND REMOVING PODS USING PODMAN

The **podman play kube --down** command stops and removes all pods and their containers.

NOTE

If a volume is in use, it is not removed.

Prerequisites

- The **container-tools** meta-package is installed.
- The pod named **wordpresspod** has been created. For details, see section Manually running containers and pods using Podman.
- The YAML file has been generated. For details, see section Generating a YAML file using Podman.
- The pod is running. For details, see section Automatically running containers and pods using Podman.

Procedure

- Remove all pods and containers created by the **wordpresspod.yaml** file:

```
$ podman play kube --down wordpresspod.yaml
Pods stopped:
3e391d091d190756e655219a34de55583eed3ef59470aadd214c1fc48cae92ac
Pods removed:
3e391d091d190756e655219a34de55583eed3ef59470aadd214c1fc48cae92ac
```

Verification

- Verify that all pods and containers created by the **wordpresspod.yaml** file were removed:

```
$ podman ps --pod -a
CONTAINER ID  IMAGE                         COMMAND           CREATED
STATUS                  PORTS             NAMES             POD ID       PODNAME
```

Additional resources

- **podman-play-kube(1)** man page on your system

CHAPTER 10. MANAGING CONTAINERS BY USING RHEL SYSTEM ROLES

With the **podman** RHEL system role, you can manage Podman configuration, containers, and **systemd** services that run Podman containers.

10.1. CREATING A ROOTLESS CONTAINER WITH BIND MOUNT BY USING THE PODMAN RHEL SYSTEM ROLE

You can use the **podman** RHEL system role to create rootless containers with bind mount by running an Ansible playbook and with that, manage your application configuration.

The example Ansible playbook starts two Kubernetes pods: one for a database and another for a web application. The database pod configuration is specified in the playbook, while the web application pod is defined in an external YAML file.

Prerequisites

- You have prepared the control node and the managed nodes
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The user and group **webapp** exist, and must be listed in the **/etc/subuid** and **/etc/subgid** files on the host.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Configure Podman
  hosts: managed-node-01.example.com
  tasks:
    - name: Create a web application and a database
      ansible.builtin.include_role:
        name: rhel-system-roles.podman
      vars:
        podman_create_host_directories: true
        podman_firewall:
          - port: 8080-8081/tcp
            state: enabled
          - port: 12340/tcp
            state: enabled
        podman_selinux_ports:
          - ports: 8080-8081
            setype: http_port_t
        podman_kube_specs:
          - state: started
            run_as_user: dbuser
            run_as_group: dbgroup
            kube_file_content:
              apiVersion: v1
              kind: Pod
```

```
      metadata:
        name: db
      spec:
        containers:
        - name: db
          image:  quay.io/rhel-system-roles/mysql:5.6
          ports:
          - containerPort: 1234
            hostPort: 12340
          volumeMounts:
          - mountPath: /var/lib/db:Z
            name: db
        volumes:
        - name: db
          hostPath:
            path: /var/lib/db
    - state: started
      run_as_user: webapp
      run_as_group: webapp
      kube_file_src: /path/to/webapp.yml
```

The settings specified in the example playbook include the following:

run_as_user and **run_as_group**

Specify that containers are rootless.

kube_file_content

Contains a Kubernetes YAML file defining the first container named **db**. You can generate the Kubernetes YAML file by using the **podman kube generate** command.

- The **db** container is based on the **quay.io/db/db:stable** container image.
- The **db** bind mount maps the **/var/lib/db** directory on the host to the **/var/lib/db** directory in the container. The **Z** flag labels the content with a private unshared label, therefore, only the **db** container can access the content.

kube_file_src: *<path>*

Defines the second container. The content of the **/path/to/webapp.yml** file on the controller node will be copied to the **kube_file** field on the managed node.

volumes: *<list>*

A YAML list to define the source of the data to provide in one or more containers. For example, a local disk on the host (**hostPath**) or other disk device.

volumeMounts: *<list>*

A YAML list to define the destination where the individual container will mount a given volume.

podman_create_host_directories: true

Creates the directory on the host. This instructs the role to check the kube specification for **hostPath** volumes and create those directories on the host. If you need more control over the ownership and permissions, use **podman_host_directories**.

For details about all variables used in the playbook, see the **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file on the control node.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file
- **/usr/share/doc/rhel-system-roles/podman/** directory

10.2. CREATING A ROOTFUL CONTAINER WITH PODMAN VOLUME BY USING THE PODMAN RHEL SYSTEM ROLE

You can use the **podman** RHEL system role to create a rootful container with a Podman volume by running an Ansible playbook and with that, manage your application configuration.

The example Ansible playbook deploys a Kubernetes pod named **ubi8-httpd** running an HTTP server container from the **registry.access.redhat.com/ubi8/httpd-24** image. The container's web content is mounted from a persistent volume named **ubi8-html-volume**. By default, the **podman** role creates rootful containers.

Prerequisites

- You have prepared the control node and the managed nodes
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
- name: Configure Podman
  hosts: managed-node-01.example.com
  tasks:
    - name: Start Apache server on port 8080
      ansible.builtin.include_role:
        name: rhel-system-roles.podman
  vars:
    podman_firewall:
      - port: 8080/tcp
        state: enabled
    podman_kube_specs:
      - state: started
        kube_file_content:
          apiVersion: v1
          kind: Pod
          metadata:
```

```
    name: ubi8-httpd
  spec:
    containers:
      - name: ubi8-httpd
        image: registry.access.redhat.com/ubi8/httpd-24
        ports:
          - containerPort: 8080
            hostPort: 8080
        volumeMounts:
          - mountPath: /var/www/html:Z
            name: ubi8-html
    volumes:
      - name: ubi8-html
        persistentVolumeClaim:
          claimName: ubi8-html-volume
```

The settings specified in the example playbook include the following:

kube_file_content

Contains a Kubernetes YAML file defining the first container named **db**. You can generate the Kubernetes YAML file by using the **podman kube generate** command.

- The **ubi8-httpd** container is based on the **registry.access.redhat.com/ubi8/httpd-24** container image.
- The **ubi8-html-volume** maps the **/var/www/html** directory on the host to the container. The **Z** flag labels the content with a private unshared label, therefore, only the **ubi8-httpd** container can access the content.
- The pod mounts the existing persistent volume named **ubi8-html-volume** with the mount path **/var/www/html**.

For details about all variables used in the playbook, see the **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file on the control node.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file
- **/usr/share/doc/rhel-system-roles/podman/** directory

10.3. CREATING A QUADLET APPLICATION WITH SECRETS BY USING THE PODMAN RHEL SYSTEM ROLE

You can use the **podman** RHEL system role to create a Quadlet application with secrets by running an Ansible playbook.

Prerequisites

- You have prepared the control node and the managed nodes
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The certificate and the corresponding private key that the web server in the container should use are stored in the **~/certificate.pem** and **~/key.pem** files.

Procedure

1. Display the contents of the certificate and private key files:

```
$ cat ~/certificate.pem
-----BEGIN CERTIFICATE-----
...
-----END CERTIFICATE-----

$ cat ~/key.pem
-----BEGIN PRIVATE KEY-----
...
-----END PRIVATE KEY-----
```

   You require this information in a later step.

2. Store your sensitive variables in an encrypted file:

   a. Create the vault:

```
$ ansible-vault create vault.yml
New Vault password: <vault_password>
Confirm New Vault password: <vault_password>
```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

```
root_password: <root_password>
certificate: |-
  -----BEGIN CERTIFICATE-----
  ...
  -----END CERTIFICATE-----
key: |-
  -----BEGIN PRIVATE KEY-----
  ...
  -----END PRIVATE KEY-----
```

   Ensure that all lines in the **certificate** and **key** variables start with two spaces.

c. Save the changes, and close the editor. Ansible encrypts the data in the vault.

3. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Deploy a wordpress CMS with MySQL database
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  tasks:
  - name: Create and run the container
    ansible.builtin.include_role:
      name: rhel-system-roles.podman
    vars:
      podman_create_host_directories: true
      podman_activate_systemd_unit: false
      podman_quadlet_specs:
        - name: quadlet-demo
          type: network
          file_content: |
            [Network]
            Subnet=192.168.30.0/24
            Gateway=192.168.30.1
            Label=app=wordpress
        - file_src: quadlet-demo-mysql.volume
        - template_src: quadlet-demo-mysql.container.j2
        - file_src: envoy-proxy-configmap.yml
        - file_src: quadlet-demo.yml
        - file_src: quadlet-demo.kube
          activate_systemd_unit: true
      podman_firewall:
        - port: 8000/tcp
          state: enabled
        - port: 9000/tcp
          state: enabled
      podman_secrets:
        - name: mysql-root-password-container
          state: present
          skip_existing: true
          data: "{{ root_password }}"
        - name: mysql-root-password-kube
          state: present
          skip_existing: true
          data: |
            apiVersion: v1
            data:
              password: "{{ root_password | b64encode }}"
            kind: Secret
            metadata:
              name: mysql-root-password-kube
        - name: envoy-certificates
          state: present
          skip_existing: true
          data: |
            apiVersion: v1
            data:
              certificate.key: {{ key | b64encode }}
```

```
    certificate.pem: {{ certificate | b64encode }}
kind: Secret
metadata:
  name: envoy-certificates
```

The procedure creates a WordPress content management system paired with a MySQL database. The **podman_quadlet_specs role** variable defines a set of configurations for the Quadlet, which refers to a group of containers or services that work together in a certain way. It includes the following specifications:

- The Wordpress network is defined by the **quadlet-demo** network unit.
- The volume configuration for MySQL container is defined by the **file_src: quadlet-demo-mysql.volume** field.
- The **template_src: quadlet-demo-mysql.container.j2** field is used to generate a configuration for the MySQL container.
- Two YAML files follow: **file_src: envoy-proxy-configmap.yml** and **file_src: quadlet-demo.yml**. Note that .yml is not a valid Quadlet unit type, therefore these files will just be copied and not processed as a Quadlet specification.
- The Wordpress and envoy proxy containers and configuration are defined by the **file_src: quadlet-demo.kube** field. The kube unit refers to the previous YAML files in the **[Kube]** section as **Yaml=quadlet-demo.yml** and **ConfigMap=envoy-proxy-configmap.yml**.

4. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

5. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file
- **/usr/share/doc/rhel-system-roles/podman/** directory
- Ansible vault

CHAPTER 11. MONITORING CONTAINERS

Use Podman commands to manage a Podman environment. With that, you can determine the health of the container, by displaying system and pod information, and monitoring Podman events.

11.1. USING A HEALTH CHECK ON A CONTAINER

You can use the health check to determine the health or readiness of the process running inside the container.

If the health check succeeds, the container is marked as "healthy"; otherwise, it is "unhealthy". You can compare a health check with running the **podman exec** command and examining the exit code. The zero exit value means that the container is "healthy".

Health checks can be set when building an image using the **HEALTHCHECK** instruction in the **Containerfile** or when creating the container on the command line. You can display the health-check status of a container by using the **podman inspect** or **podman ps** commands.

A health check consists of six basic components:

- Command
- Retries
- Interval
- Start-period
- Timeout
- Container recovery

The description of health check components follows:

Command (--health-cmd option)

Podman executes the command inside the target container and waits for the exit code.

The other five components are related to the scheduling of the health check and they are optional.

Retries (--health-retries option)

Defines the number of consecutive failed health checks that need to occur before the container is marked as "unhealthy". A successful health check resets the retry counter.

Interval (--health-interval option)

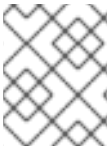
Describes the time between running the health check command. Note that small intervals cause your system to spend a lot of time running health checks. The large intervals cause struggles with catching time outs.

Start-period (--health-start-period option)

Describes the time between when the container starts and when you want to ignore health check failures.

Timeout (--health-timeout option)

Describes the period of time the health check must complete before being considered unsuccessful.



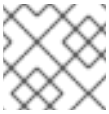
NOTE

The values of the Retries, Interval, and Start-period components are time durations, for example "30s" or "1h15m". Valid time units are "ns," "us," or "µs", "ms," "s," "m," and "h".

Container recovery (--health-on-failure option)

Determines which actions to perform when the status of a container is unhealthy. When the application fails, Podman restarts it automatically to provide robustness. The **--health-on-failure** option supports four actions:

- **none**: Take no action, this is the default action.
- **kill**: Kill the container.
- **restart**: Restart the container.
- **stop**: Stop the container.



NOTE

The **--health-on-failure** option is available in Podman version 4.2 and later.

WARNING

Do not combine the **restart** action with the **--restart** option. When running inside of a **systemd** unit, consider using the **kill** or **stop** action instead, to make use of **systemd** restart policy.

Health checks run inside the container. Health checks only make sense if you know what the health state of the service is and can differentiate between a successful and unsuccessful health check.

Additional resources

- **podman-healthcheck(1)** and **podman-run(1)** man pages on your system
- Monitoring container vitality and availability with Podman

11.2. PERFORMING A HEALTH CHECK USING THE COMMAND LINE

You can set a health check when creating the container on the command line.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Define a health check:

```
$ podman run -dt --name=hc-container -p 8080:8080 --health-cmd='curl
http://localhost:8080 || exit 1' --health-interval=0
registry.access.redhat.com/ubi8/httpd-24
```

- The **--health-cmd** option sets a health check command for the container.
- The **--health-interval=0** option with 0 value indicates that you want to run the health check manually.

2. Check the health status of the **hc-container** container:
   - Using the **podman inspect** command:

```
$ podman inspect --format='{{json .State.Health.Status}}' hc-container
healthy
```

   - Using the **podman ps** command:

```
$ podman ps
CONTAINER ID  IMAGE                            COMMAND               CREATED      STATUS
PORTS       NAMES
a680c6919fe  localhost/hc-container:latest  /usr/bin/run-http...  2 minutes ago  Up 2
minutes (healthy) hc-container
```

   - Using the **podman healthcheck run** command:

```
$ podman healthcheck run hc-container
healthy
```

Additional resources

- **podman-healthcheck(1)** and **podman-run(1)** man pages on your system
- Monitoring container vitality and availability with Podman

11.3. PERFORMING A HEALTH CHECK USING A CONTAINERFILE

You can set a health check by using the **HEALTHCHECK** instruction in the **Containerfile**.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Create a **Containerfile**:

```
$ cat Containerfile
FROM registry.access.redhat.com/ubi8/httpd-24
EXPOSE 8080
HEALTHCHECK CMD curl http://localhost:8080 || exit 1
```

NOTE

The **HEALTHCHECK** instruction is supported only for the **docker** image format. For the **oci** image format, the instruction is ignored.

2. Build the container and add an image name:

```
$ podman build --format=docker -t hc-container .
STEP 1/3: FROM registry.access.redhat.com/ubi8/httpd-24
STEP 2/3: EXPOSE 8080
--> 5aea97430fd
STEP 3/3: HEALTHCHECK CMD curl http://localhost:8080 || exit 1
COMMIT health-check
Successfully tagged localhost/health-check:latest
a680c6919fe6bf1a79219a1b3d6216550d5a8f83570c36d0dadfee1bb74b924e
```

3. Run the container:

```
$ podman run -dt --name=hc-container localhost/hc-container
```

4. Check the health status of the **hc-container** container:

- Using the **podman inspect** command:

```
$ podman inspect --format='{{json .State.Health.Status}}' hc-container
healthy
```

- Using the **podman ps** command:

```
$ podman ps
CONTAINER ID  IMAGE                COMMAND               CREATED      STATUS
PORTS       NAMES
a680c6919fe  localhost/hc-container:latest  /usr/bin/run-http...  2 minutes ago  Up 2
minutes (healthy) hc-container
```

- Using the **podman healthcheck run** command:

```
$ podman healthcheck run hc-container
healthy
```

Additional resources

- **podman-healthcheck(1)** and **podman-run(1)** man pages on your system
- Monitoring container vitality and availability with Podman

11.4. DISPLAYING PODMAN SYSTEM INFORMATION

The **podman system** command enables you to manage the Podman systems by displaying system information.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

- Display Podman system information:
  - To show Podman disk usage, enter:

```
$ podman system df
TYPE           TOTAL       ACTIVE      SIZE        RECLAIMABLE
Images         3           2           1.085GB     233.4MB (0%)
Containers     2           0           28.17kB     28.17kB (100%)
Local Volumes  3           0           0B          0B (0%)
```

  - To show detailed information about space usage, enter:

```
$ podman system df -v
Images space usage:

REPOSITORY                                  TAG         IMAGE ID      CREATED     SIZE
SHARED SIZE  UNIQUE SIZE  CONTAINERS
registry.access.redhat.com/ubi10-beta       latest      b1e63aaae5cf  13 days
233.4MB     233.4MB      0B          0
registry.access.redhat.com/ubi10-beta/httpd-24  latest      0d04740850e8  13 days
461.5MB     0B           461.5MB     1
registry.redhat.io/rhel8/podman             latest      dce10f591a2d  13 days     390.6MB
233.4MB      157.2MB      1

Containers space usage:

CONTAINER ID  IMAGE         COMMAND                   LOCAL VOLUMES  SIZE
CREATED     STATUS      NAMES
311180ab99fb  0d04740850e8  /usr/bin/run-httpd        0              28.17kB     16 hours
exited      hc1
bedb6c287ed6  dce10f591a2d  podman run ubi10-beta echo hello  0           0B          11
hours     configured  dazzling_tu

Local Volumes space usage:

VOLUME NAME                                                 LINKS       SIZE
76de0efa83a3dae1a388b9e9e67161d28187e093955df185ea228ad0b3e435d0  0
0B
8a1b4658aecc9ff38711a2c7f2da6de192c5b1e753bb7e3b25e9bf3bb7da8b13  0
0B
d9cab4f6ccbcf2ac3cd750d2efff9d2b0f29411d430a119210dd242e8be20e26  0           0B
```

  - To display information about the host, current storage stats, and build of Podman, enter:

```
$ podman system info
host:
  arch: amd64
  buildahVersion: 1.22.3
  cgroupControllers: []
  cgroupManager: cgroupfs
  cgroupVersion: v1
```

```
  conmon:
    package: conmon-2.0.29-1.module+el8.5.0+12381+e822eb26.x86_64
    path: /usr/bin/conmon
    version: 'conmon version 2.0.29, commit:
7d0fa63455025991c2fc641da85922fde889c91b'
  cpus: 2
  distribution:
    distribution: '"rhel"'
    version: "8.5"
  eventLogger: file
  hostname: localhost.localdomain
  idMappings:
    gidmap:
    - container_id: 0
      host_id: 1000
      size: 1
    - container_id: 1
      host_id: 100000
      size: 65536
    uidmap:
    - container_id: 0
      host_id: 1000
      size: 1
    - container_id: 1
      host_id: 100000
      size: 65536
  kernel: 4.18.0-323.el8.x86_64
  linkmode: dynamic
  memFree: 352288768
  memTotal: 2819129344
  ociRuntime:
    name: runc
    package: runc-1.0.2-1.module+el8.5.0+12381+e822eb26.x86_64
    path: /usr/bin/runc
    version: |-
      runc version 1.0.2
      spec: 1.0.2-dev
      go: go1.16.7
      libseccomp: 2.5.1
  os: linux
  remoteSocket:
    path: /run/user/1000/podman/podman.sock
  security:
    apparmorEnabled: false
    capabilities:
CAP_NET_RAW,CAP_CHOWN,CAP_DAC_OVERRIDE,CAP_FOWNER,CAP_FSETID,C
AP_KILL,CAP_NET_BIND_SERVICE,CAP_SETFCAP,CAP_SETGID,CAP_SETPCAP,CA
P_SETUID,CAP_SYS_CHROOT
    rootless: true
    seccompEnabled: true
    seccompProfilePath: /usr/share/containers/seccomp.json
    selinuxEnabled: true
  serviceIsRemote: false
  slirp4netns:
    executable: /usr/bin/slirp4netns
    package: slirp4netns-1.1.8-1.module+el8.5.0+12381+e822eb26.x86_64
```

```
    version: |-
      slirp4netns version 1.1.8
      commit: d361001f495417b880f20329121e3aa431a8f90f
      libslirp: 4.4.0
      SLIRP_CONFIG_VERSION_MAX: 3
      libseccomp: 2.5.1
  swapFree: 3113668608
  swapTotal: 3124752384
  uptime: 11h 24m 12.52s (Approximately 0.46 days)
registries:
  search:
  - registry.fedoraproject.org
  - registry.access.redhat.com
  - registry.centos.org
  - docker.io
store:
  configFile: /home/user/.config/containers/storage.conf
  containerStore:
    number: 2
    paused: 0
    running: 0
    stopped: 2
  graphDriverName: overlay
  graphOptions:
    overlay.mount_program:
      Executable: /usr/bin/fuse-overlayfs
      Package: fuse-overlayfs-1.7.1-1.module+el8.5.0+12381+e822eb26.x86_64
      Version: |-
        fusermount3 version: 3.2.1
        fuse-overlayfs: version 1.7.1
        FUSE library version 3.2.1
        using FUSE kernel interface version 7.26
  graphRoot: /home/user/.local/share/containers/storage
  graphStatus:
    Backing Filesystem: xfs
    Native Overlay Diff: "false"
    Supports d_type: "true"
    Using metacopy: "false"
  imageStore:
    number: 3
  runRoot: /run/user/1000/containers
  volumePath: /home/user/.local/share/containers/storage/volumes
version:
  APIVersion: 3.3.1
  Built: 1630360721
  BuiltTime: Mon Aug 30 23:58:41 2021
  GitCommit: ""
  GoVersion: go1.16.7
  OsArch: linux/amd64
  Version: 3.3.1
```

- To remove all unused containers, images and volume data, enter:

```
$ podman system prune
WARNING! This will remove:
        - all stopped containers
```

```
        - all stopped pods
        - all dangling images
        - all build cache
Are you sure you want to continue? [y/N] y
```

- The **podman system prune** command removes all unused containers (both dangling and unreferenced), pods and optionally, volumes from local storage.
- Use the **--all** option to delete all unused images. Unused images are dangling images and any image that does not have any containers based on it.
- Use the **--volume** option to prune volumes. By default, volumes are not removed to prevent important data from being deleted if there is currently no container using the volume.

Additional resources

- **podman-system-df**, **podman-system-info**, and **podman-system-prune** man pages on your system

11.5. PODMAN EVENT TYPES

You can monitor events that occur in Podman. Several event types exist and each event type reports different statuses.

The *container* event type reports the following statuses:

- attach
- checkpoint
- cleanup
- commit
- create
- exec
- export
- import
- init
- kill
- mount
- pause
- prune
- remove
- restart

- restore
- start
- stop
- sync
- unmount
- unpause

The *pod* event type reports the following statuses:

- create
- kill
- pause
- remove
- start
- stop
- unpause

The *image* event type reports the following statuses:

- prune
- push
- pull
- save
- remove
- tag
- untag

The *system* type reports the following statuses:

- refresh
- renumber

The *volume* type reports the following statuses:

- create
- prune
- remove

Additional resources

- **podman-events(1)** man page on your system

11.6. MONITORING PODMAN EVENTS

You can monitor and print events that occur in Podman by using the **podman events** command. Each event will include a timestamp, a type, a status, name, if applicable, and image, if applicable.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Run the **myubi** container:

```
$ podman run -q --rm --name=myubi registry.access.redhat.com/ubi8/ubi:latest
```

2. Display the Podman events:
   - To display all Podman events, enter:

```
$ now=$(date --iso-8601=seconds)
$ podman events --since=now --stream=false
2023-03-08 14:27:20.696167362 +0100 CET container create
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi,...)
2023-03-08 14:27:20.652325082 +0100 CET image pull
registry.access.redhat.com/ubi8/ubi:latest
2023-03-08 14:27:20.795695396 +0100 CET container init
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi...)
2023-03-08 14:27:20.809205161 +0100 CET container start
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi...)
2023-03-08 14:27:20.809903022 +0100 CET container attach
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi...)
2023-03-08 14:27:20.831710446 +0100 CET container died
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi...)
2023-03-08 14:27:20.913786892 +0100 CET container remove
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi...)
```

     The **--stream=false** option ensures that the **podman events** command exits when reading the last known event.

     You can see several events that happened when you enter the **podman run** command:

     - **container create** when creating a new container.
     - **image pull** when pulling an image if the container image is not present in the local storage.

- **container init** when initializing the container in the runtime and setting a network.
- **container start** when starting the container.
- **container attach** when attaching to the terminal of a container. That is because the container runs in the foreground.
- **container died** is emitted when the container exits.
- **container remove** because the **--rm** flag was used to remove the container after it exits.

- You can also use the **journalctl** command to display Podman events:

```
$ journalctl --user -r SYSLOG_IDENTIFIER=podman
Mar 08 14:27:20 fedora podman[129324]: 2023-03-08 14:27:20.913786892 +0100 CET
m=+0.066920979 container remove
...
Mar 08 14:27:20 fedora podman[129289]: 2023-03-08 14:27:20.696167362 +0100 CET
m=+0.079089208 container create
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72f>
```

- To show only Podman create events, enter:

```
$ podman events --filter event=create
2023-03-08 14:27:20.696167362 +0100 CET container create
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72fe09
(image=registry.access.redhat.com/ubi8/ubi:latest, name=myubi,...)
```

- You can also use the **journalctl** command to display Podman create events:

```
$ journalctl --user -r PODMAN_EVENT=create
Mar 08 14:27:20 fedora podman[129289]: 2023-03-08 14:27:20.696167362 +0100 CET
m=+0.079089208 container create
d4748226a2bcd271b1bc4b9f88b54e8271c13ffea9b30529968291c62d72f>
```

Additional resources

- **podman-events(1)** man page on your system
- Container Events and Auditing

11.7. USING PODMAN EVENTS FOR AUDITING

Previously, the events had to be connected to an event to interpret them correctly. For example, the **container-create** event had to be linked with an **image-pull** event to know which image had been used. The **container-create** event also did not include all data, for example, the security settings, volumes, mounts, and so on.

Beginning with Podman v4.4, you can gather all relevant information about a container directly from a single event and **journald** entry. The data is in JSON format, the same as from the **podman container inspect** command and includes all configuration and security settings of a container. You can configure Podman to attach the container-inspect data for auditing purposes.

Prerequisites

- The **container-tools** meta-package is installed.

Procedure

1. Modify the **~/.config/containers/containers.conf** file and add the **events_container_create_inspect_data=true** option to the `` section:

```
$ cat ~/.config/containers/containers.conf
[engine]
events_container_create_inspect_data=true
```

   For the system-wide configuration, modify the **/etc/containers/containers.conf** or **/usr/share/container/containers.conf** file.

2. Create the container:

```
$ podman create registry.access.redhat.com/ubi8/ubi:latest
19524fe3c145df32d4f0c9af83e7964e4fb79fc4c397c514192d9d7620a36cd3
```

3. Display the Podman events:

   - Using the **podman events** command:

```
$ now=$(date --iso-8601=seconds)
$ podman events --since $now --stream=false --format "{{.ContainerInspectData}}"
| jq ".Config.CreateCommand"
[
  "/usr/bin/podman",
  "create",
  "registry.access.redhat.com/ubi8"
]
```

     - The **--format "{{.ContainerInspectData}}"** option displays the inspect data.
     - The **jq ".Config.CreateCommand"** transforms the JSON data into a more readable format and displays the parameters for the **podman create** command.

   - Using the **journalctl** command:

```
$ journalctl --user -r PODMAN_EVENT=create --all -o json | jq
".PODMAN_CONTAINER_INSPECT_DATA | fromjson" | jq
".Config.CreateCommand"
[
  "/usr/bin/podman",
  "create",
  "registry.access.redhat.com/ubi8"
]
```

     The output data for the **podman events** and **journalctl** commands are the same.

Additional resources

- **podman-events(1)** and **containers.conf(5)** man pages on your system

- Container Events and Auditing

CHAPTER 12. USING THE CONTAINER-TOOLS API

The new REST based Podman 2.0 API replaces the old remote API for Podman that used the varlink library. The new API works in both a rootful and a rootless environment.

The Podman v2.0 RESTful API consists of the Libpod API providing support for Podman, and Docker-compatible API. With this new REST API, you can call Podman from platforms such as cURL, Postman, Google's Advanced REST client, and many others.

NOTE

As the podman service supports socket activation, unless connections on the socket are active, podman service will not run. Hence, to enable socket activation functionality, you need to manually start the **podman.socket** service. When a connection becomes active on the socket, it starts the podman service and runs the requested API action. Once the action is completed, the podman process ends, and the podman service returns to an inactive state.

12.1. ENABLING THE PODMAN API USING SYSTEMD IN ROOT MODE

You can do the following:

1. Use **systemd** to activate the Podman API socket.
2. Use a Podman client to perform basic commands.

Prerequisities

- The **podman-remote** package is installed.

```
# dnf install podman-remote
```

Procedure

1. Start the service immediately:

```
# systemctl enable --now podman.socket
```

2. To enable the link to **var/lib/docker.sock** by using the **docker-podman** package:

```
# dnf install podman-docker
```

Verification

1. Display system information of Podman:

```
# podman-remote info
```

2. Verify the link:

```
# ls -al /var/run/docker.sock
lrwxrwxrwx. 1 root root 23 Nov  4 10:19 /var/run/docker.sock -> /run/podman/podman.sock
```

Additional resources

- Podman v2.0 RESTful API

12.2. ENABLING THE PODMAN API USING SYSTEMD IN ROOTLESS MODE

You can use **systemd** to activate the Podman API socket and podman API service.

Prerequisites

- The **podman-remote** package is installed.

```
# dnf install podman-remote
```

Procedure

1. Enable and start the service immediately:

```
$ systemctl --user enable --now podman.socket
```

2. Optional: To enable programs by using Docker to interact with the rootless Podman socket:

```
$ export DOCKER_HOST=unix:///run/user/<uid>/podman//podman.sock
```

Verification

1. Check the status of the socket:

```
$ systemctl --user status podman.socket
● podman.socket - Podman API Socket
 Loaded: loaded (/usr/lib/systemd/user/podman.socket; enabled; vendor preset: enabled)
Active: active (listening) since Mon 2021-08-23 10:37:25 CEST; 9min ago
Docs: man:podman-system-service(1)
Listen: /run/user/1000/podman/podman.sock (Stream)
CGroup: /user.slice/user-1000.slice/user@1000.service/podman.socket
```

   The **podman.socket** is active and is listening at **/run/user/*<uid>*/podman.podman.sock**, where ***<uid>*** is the user's ID.

2. Display system information of Podman:

```
$ podman-remote info
```

Additional resources

- Podman v2.0 RESTful API

12.3. RUNNING THE PODMAN API MANUALLY

You can run the Podman API. This is useful for debugging API calls, especially when using the Docker compatibility layer.

Prerequisities

- The **podman-remote** package is installed.

```
# dnf install podman-remote
```

Procedure

1. Run the service for the REST API:

```
# podman system service -t 0 --log-level=debug
```

   - The value of 0 means no timeout. The default endpoint for a rootful service is **unix:/run/podman/podman.sock**.
   - The **--log-level <level>** option sets the logging level. The standard logging levels are **debug**, **info**, **warn**, **error**, **fatal**, and **panic**.

2. In another terminal, display system information of Podman. The **podman-remote** command, unlike the regular **podman** command, communicates through the Podman socket:

```
# podman-remote info
```

3. To troubleshoot the Podman API and display request and responses, use the **curl** comman. To get the information about the Podman installation on the Linux server in JSON format:

```
# curl -s --unix-socket /run/podman/podman.sock http://d/v1.0.0/libpod/info | jq
    {
  "host": {
    "arch": "amd64",
    "buildahVersion": "1.15.0",
    "cgroupVersion": "v1",
    "conmon": {
      "package": "conmon-2.0.18-1.module+el8.3.0+7084+c16098dd.x86_64",
      "path": "/usr/bin/conmon",
      "version": "conmon version 2.0.18, commit:
7fd3f71a218f8d3a7202e464252aeb1e942d17eb"
    },
    …
  "version": {
    "APIVersion": 1,
    "Version": "2.0.0",
    "GoVersion": "go1.14.2",
    "GitCommit": "",
    "BuiltTime": "Thu Jan  1 01:00:00 1970",
    "Built": 0,
    "OsArch": "linux/amd64"
  }
}
```

   A **jq** utility is a command-line JSON processor.

4. Pull the **registry.access.redhat.com/ubi8/ubi** container image:

```
# curl -XPOST --unix-socket /run/podman/podman.sock -v
```

```
'http://d/v1.0.0/images/create?fromImage=registry.access.redhat.com%2Fubi8%2Fubi'
*   Trying /run/podman/podman.sock...
* Connected to d (/run/podman/podman.sock) port 80 (#0)
> POST /v1.0.0/images/create?fromImage=registry.access.redhat.com%2Fubi8%2Fubi
HTTP/1.1
> Host: d
> User-Agent: curl/7.61.1
> Accept: /
>
< HTTP/1.1 200 OK
< Content-Type: application/json
< Date: Tue, 20 Oct 2020 13:58:37 GMT
< Content-Length: 231
<
{"status":"pulling image () from registry.access.redhat.com/ubi8/ubi:latest,
registry.redhat.io/ubi8/ubi:latest","error":"","progress":"","progressDetail":
{},"id":"ecbc6f53bba0d1923ca9e92b3f747da8353a070fccbae93625bd8b47dbee772e"}
* Connection #0 to host d left intact
```

5. Display the pulled image:

```
# curl --unix-socket /run/podman/podman.sock -v 'http://d/v1.0.0/libpod/images/json' |
jq
*   Trying /run/podman/podman.sock...
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0     0    0     0    0     0      0      0 --:--:-- --:--:-- --:--:--     0* Connected to d
(/run/podman/podman.sock) port 80 (0) > GET /v1.0.0/libpod/images/json HTTP/1.1 > Host: d
> User-Agent: curl/7.61.1 > Accept: / > < HTTP/1.1 200 OK < Content-Type: application/json
< Date: Tue, 20 Oct 2020 13:59:55 GMT < Transfer-Encoding: chunked < { [12498 bytes
data] 100 12485 0 12485 0 0 2032k 0 --:--:-- --:--:-- --:--:-- 2438k * Connection #0 to host d
left intact [ { "Id":
"ecbc6f53bba0d1923ca9e92b3f747da8353a070fccbae93625bd8b47dbee772e",
"RepoTags": [ "registry.access.redhat.com/ubi8/ubi:latest", "registry.redhat.io/ubi8/ubi:latest"
], "Created": "2020-09-01T19:44:12.470032Z", "Size": 210838671, "Labels": { "architecture":
"x86_64", "build-date": "2020-09-01T19:43:46.041620", "com.redhat.build-host": "cpt-
1008.osbs.prod.upshift.rdu2.redhat.com", ... "maintainer": "Red Hat, Inc.", "name": "ubi8", ...
"summary": "Provides the latest release of Red Hat Universal Base Image 8.", "url":
"https://access.redhat.com/containers//registry.access.redhat.com/ubi8/images/8.2-347",
      ...
    },
    "Names": [
      "registry.access.redhat.com/ubi8/ubi:latest",
      "registry.redhat.io/ubi8/ubi:latest"
    ],
    ...
    ]
  }
]
```

Additional resources

- **podman-system-service(1)** man page on your system