Container Security and new container technologies

Dan Walsh @rhatdan
Senior Distinguished Engineer - Red Hat

Please Stand

Please read out loud all text in RED

I Promise

To say
Make a copy
Rather than
Make a Xerox

I Promise

To say

Tissue

Rather than

Kleenex

I Promise

To say

Container Registries

Rather than

Docker registries

I Promise

To say

Container Images

Rather than

Docker images

Je promets

Dire
Les conteneurs
Plutôt que
Docker Containers

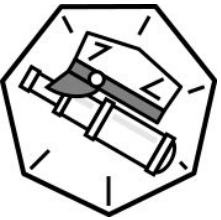
Asseyez-vous


Dan Quiote

What do you need to run a container

- Standard Definition of what makes up a container image.
  - OCI Image Bundle Definition

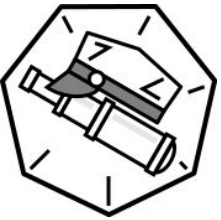

OPEN CONTAINER INITIATIVE



Introducing Skopeo

https://github.com/containers/skopeo

#nobigfatdaemons



Skopeo

- `$ skopeo inspect docker://docker.io/fedora`
- `$ skopeo copy docker://busybox:1-glibc atomic:myns/unsigned:streaming`

  `$ skopeo copy docker://busybox:latest dir:existingemptydirectory`

  `$ skopeo copy docker://busybox:latest oci:busybox_ocilayout:latest`
- `$ skopeo delete docker://localhost:5000/imagename:latest`

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What do you need to run a container`

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  - OCI Image Bundle Definition
- Mechanism to pull images from a container registry to the host
  - github.com/containers/image

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  - github.com/containers/storage

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- Mechanism to pull images from a container registry to the host
  - github.com/containers/image
- Ability to explode images onto COW file systems on disk
  - github.com/containers/storage
- Standard mechanism for running a container
  - OCI Runtime Spec (1.0)
  - runc default implementation of OCI Runtime Spec (Same tool Docker uses to run containers)

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OPENSHIFT

OPENSHIFT

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What does OpenShift/Kubernetes need run a container?

CRI - Container Runtime Interface

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Kubernetes tells CRI to run Container Image:

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What does OpenShift/Kubernetes need run a container?

CRI - Container Runtime Interface

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- CRI needs to pull image from Container Registry
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What does OpenShift/Kubernetes need run a container?

CRI - Container Runtime Interface

Kubernetes tells CRI to run Container Image:

- CRI needs to pull image from Container Registry
- CRI Needs to store image on COW File system
- CRI Needs to execute OCI Runtime

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Introducing CRI-O

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Introducing CRI-O

CRI-O - OCI-based implementation of Kubernetes Container Runtime Interface

- Scope tied to kubernetes CRI
- Only supported user is kubernetes
- Uses standard components as building blocks

“Nothing more, Nothing Less”

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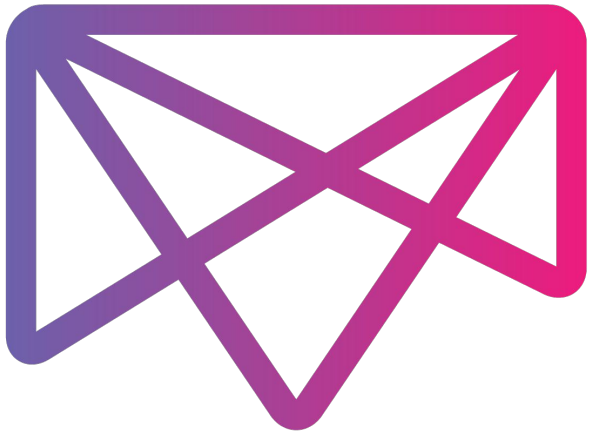

MESOSPHERE

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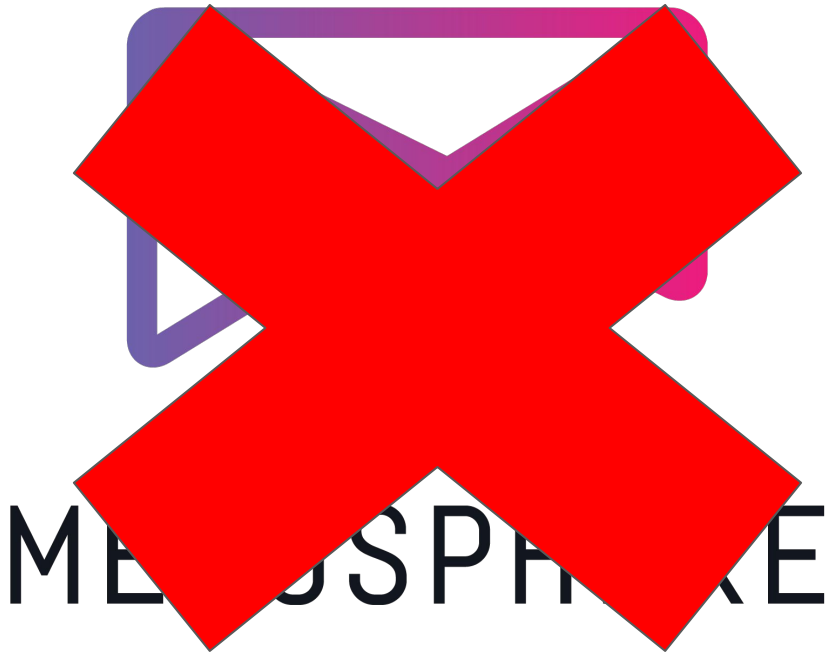

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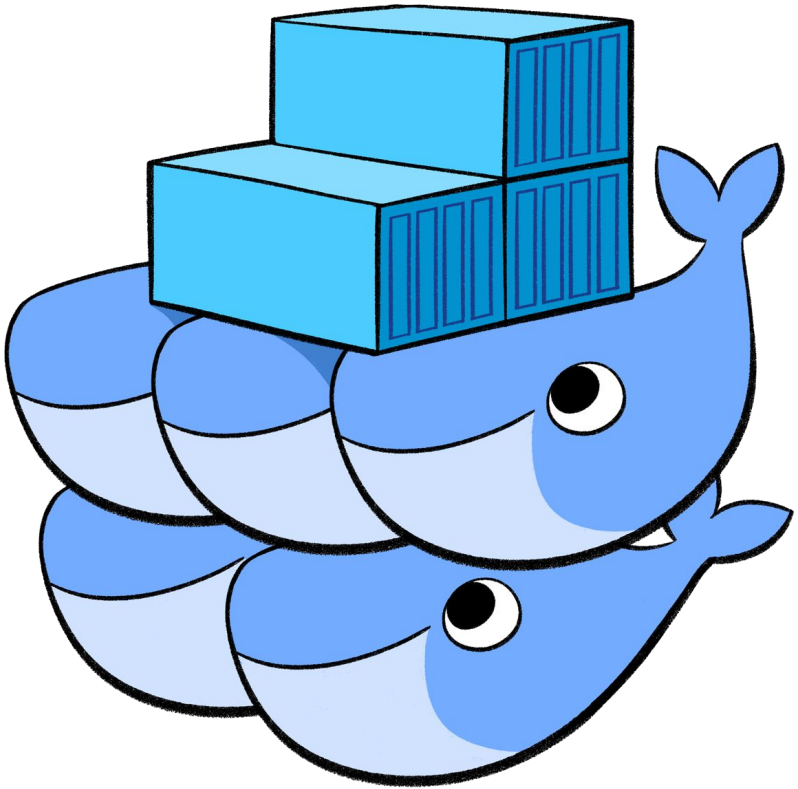
S
W
A
R
M



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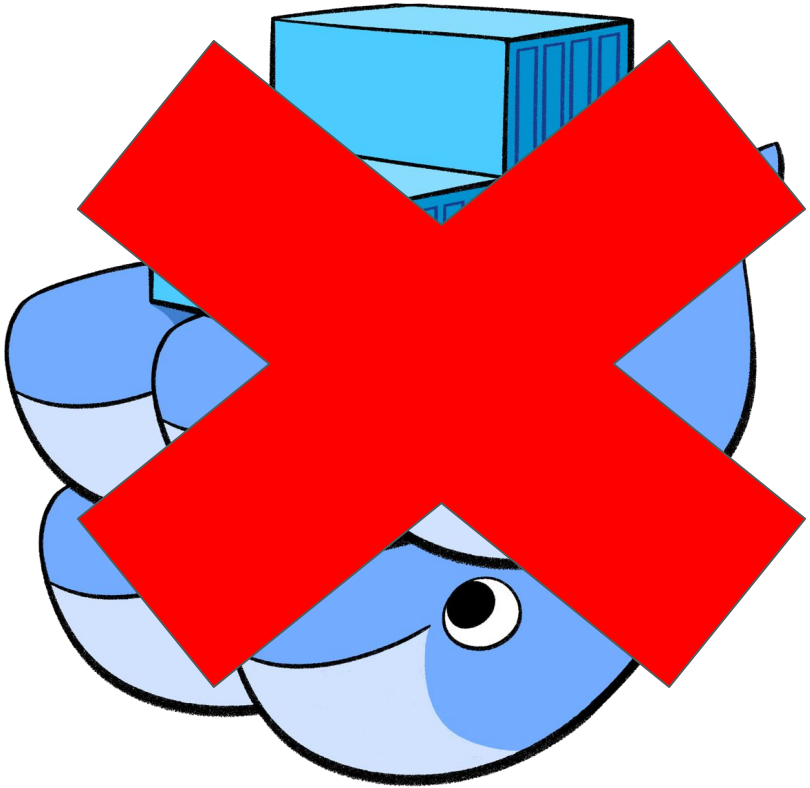
S
W
A
R
M



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vs.

MOBY

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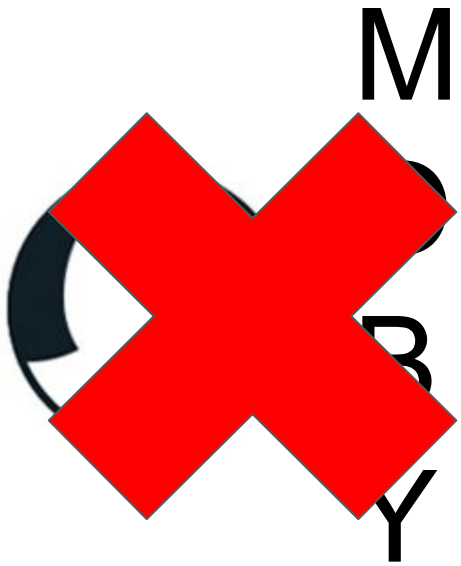
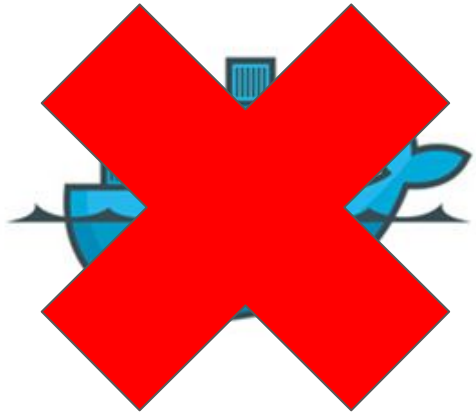
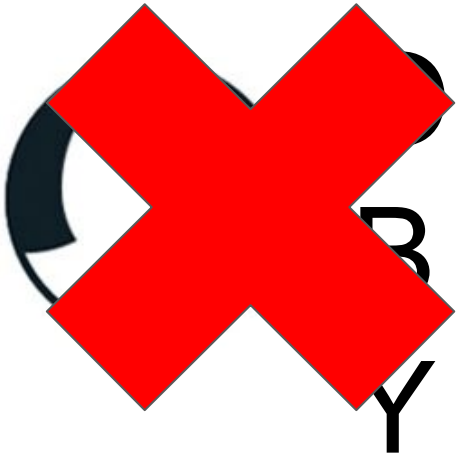
VS.



#nobigfatdaemons



VS.



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Overview of additional components

- **oci-runtime-tools** library is used to generate OCI configs for containers

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Overview of additional components

- **oci-runtime-tools** library is used to generate OCI configs for containers
- **CNI** is used for setting up networking
  - Tested with Flannel, Weave and openshift-sdn

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Overview of additional components

- **oci-runtime-tools** library is used to generate OCI configs for containers
- **CNI** is used for setting up networking
  - Tested with Flannel, Weave and openshift-sdn
- **conmon** is a utility for:
  - Monitoring
  - Logging
  - Handling tty
  - Serving attach clients
  - Detecting and reporting OOM

CoreOS

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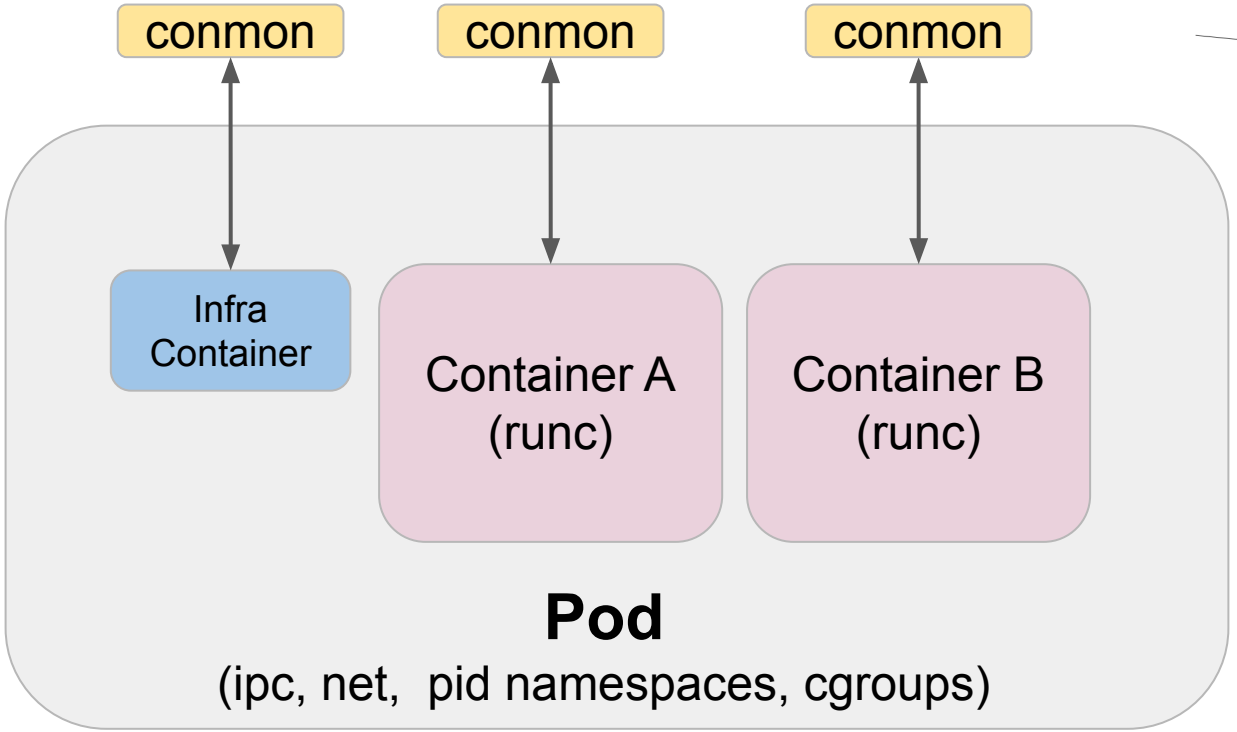
Pod architecture (runc)



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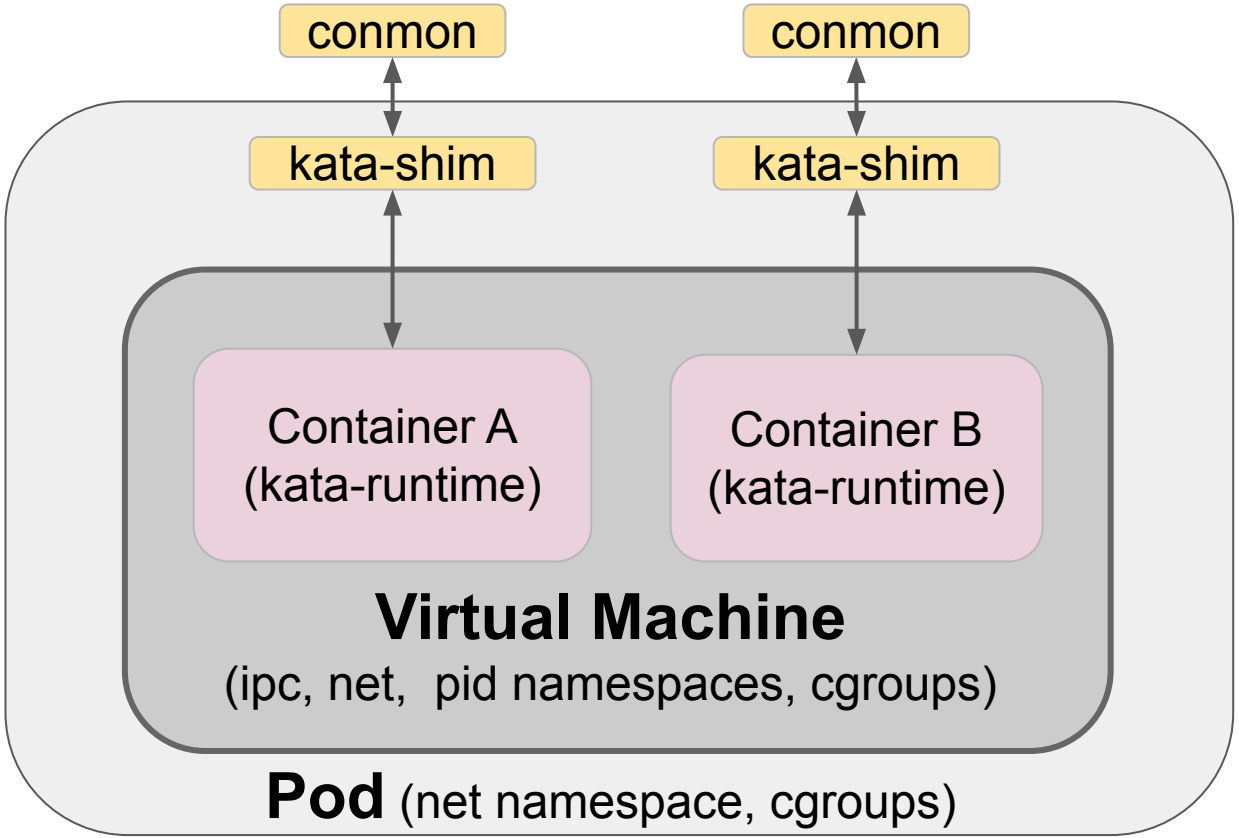
Pod architecture (Kata Containers)



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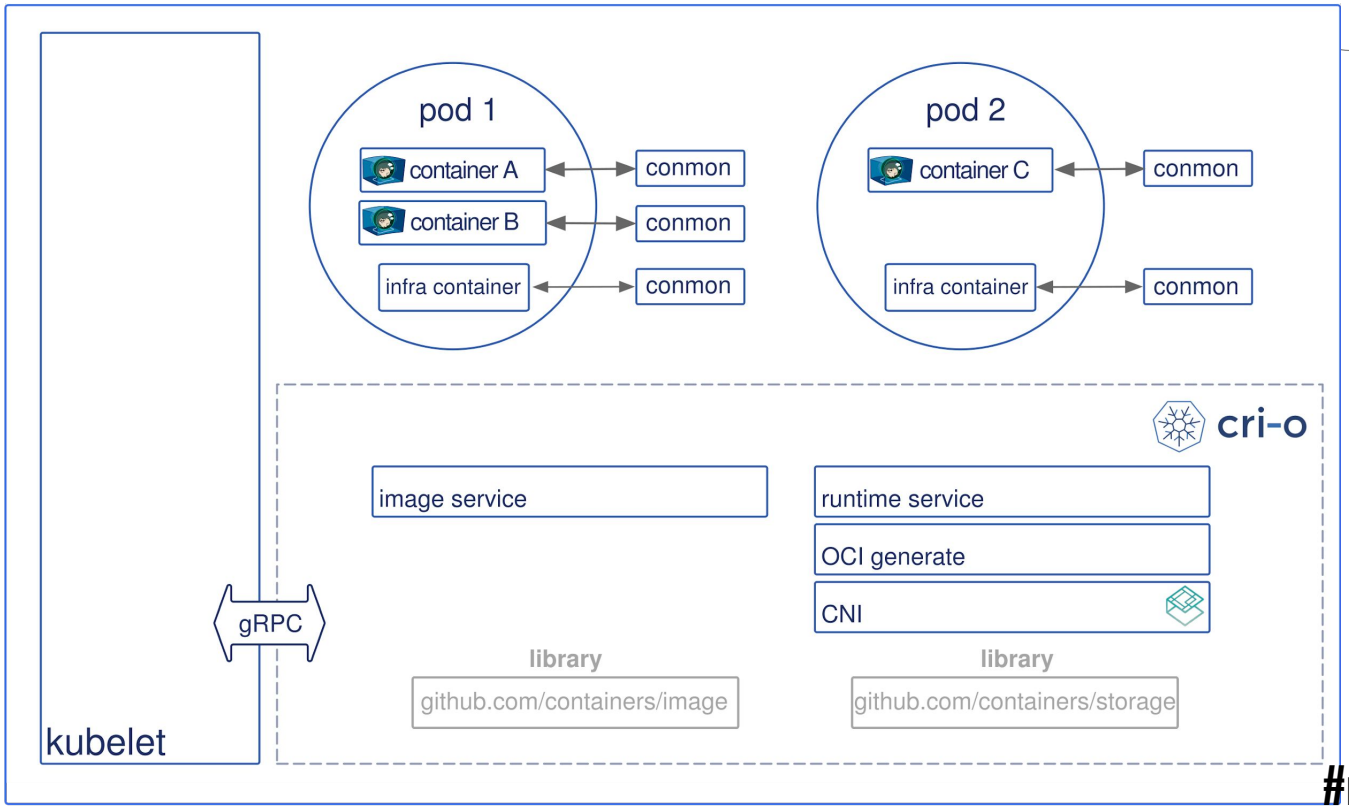
Architecture



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Status

- **All** e2e, cri-tools, integration, 11 test suites, (>2000) tests passing.
  - **No PRs merged without passing all the tests**

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Status

- **All** e2e, cri-tools, integration, 11 test suites, (>1500) tests passing.
  - **No PRs merged without passing all the tests.**
- 1.0.7 (kube 1.7.x) supported. (December 2017)

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Status

- **All** e2e, cri-tools, integration, 11 test suites, (>1500) tests passing.
  - **No PRs merged without passing all the tests.**
- 1.0.7 (kube 1.7.x) supported. (December 2017)
- 1.9.12 (kube 1.9.x) released.
  - CRI-O fully supported in OpenShift 3.9 along with docker.

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- 1.10.6 (kube 1.10.x) released.

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- 1.10.6 (kube 1.10.x) released.
- 1.11.2 (Kube 1.11.x) released

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- 1.11.2 (Kube 1.11.x) released
- 1.12.5 (Kube 1.12.x) released
- 1.13.1 (Kuber 1.13.*) released
- 1.14.1 (Kuber 1.14.*) released
- Openshift 4.0 Uses CRI-O by default No Docker

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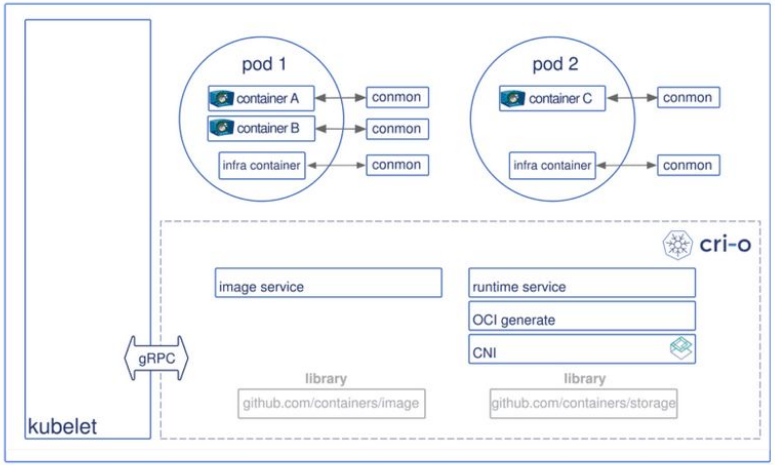
CNCF to Host CRI-O

By cncf | April 8, 2019 | Blog

0

Today, the Cloud Native Computing Foundation (CNCF) Technical Oversight Committee (TOC) voted to accept CRI-O as an incubation-level hosted project. CRI-O, created by Red Hat, is an implementation of the Kubernetes Container Runtime Interface (CRI) designed to enable the use of Open Container Initiative (OCI) compatible runtime.



"A founding principal of CRI-O was to 'not reinvent the wheel' but to use shared components and refine approaches tested in production,

Status

CRI-O is now powering nodes on OpenShift Online.

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" CRI-O just works for them,

so they haven’t had much to say"

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Making running containers in production

boring

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Security in CRI-O

- No Hard-Coded Capabilities list
  - Since CRI-O does not do builds, containers by default have less capabilities

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  - In production containers should not be allowed to modify images

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- Kata Containers support

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Security in CRI-O

- No Hard-Coded Capabilities list
  - Since CRI-O does not do builds, containers by default have less capabilities
- Read Only Containers
  - In production containers should not be allowed to modify images
- Kata Containers support
- Better User Namespace support

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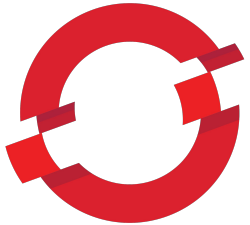
What else does OpenShift need?

- Ability to build container images
- Ability to push container images to container registries



OPENSHIFT

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Introducing Buildah

buildah

https://github.com/containers/buildah

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buildah

https://github.com/containers/buildah

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buildah

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buildah

Coreutils for building containers. Simple interface

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buildah

Coreutils for building containers. Simple interface
ctr=$(buildah from fedora)

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buildah

Coreutils for building containers. Simple interface
ctr=$(buildah from fedora)
mnt=$(buildah mount $ctr)

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File formats
Command-Line Interfaces (CLIs)
Docker CLI (docker)
Stable
Docker run reference
Use the Docker command line
docker (base command)
docker attach
docker build
docker checkpoint *
docker commit
docker config *
docker container *
docker cp
docker create
docker deploy
docker diff
docker events
docker exec
docker export
docker history
docker image *
docker images

docker cp

Estimated reading time: 5 minutes

Description

Copy files/folders between a container and the local filesystem

Usage

```
docker cp [OPTIONS] CONTAINER:SRC_PATH DEST_PATH|-
docker cp [OPTIONS] SRC_PATH|- CONTAINER:DEST_PATH
```

Options

Name, shorthand	Default	Description
`--archive , -a`		Archive mode (copy all uid/gid information)
`--follow-link , -L`		Always follow symbol link in SRC_PATH

Parent command

Command	Description
docker	The base command for the Docker CLI.

Extended description

The `docker cp` utility copies the contents of `SRC_PATH` to the `DEST_PATH`. You can copy from the container's file system to the local machine or the reverse, from the local filesystem to the container. If `-` is specified for either the `SRC_PATH` or `DEST_PATH`, you can also stream a tar archive from `STDIN` or to `STDOUT`. The `CONTAINER` can be a running or stopped container. The `SRC_PATH` or `DEST_PATH` can be a file or directory.

Edit this page
Request docs changes
Get support
On this page:
Description
Usage
Options
Parent command
Extended description

buildah

Coreutils for building containers. Simple interface

```
# ctr=$(buildah from fedora)
# mnt=$(buildah mount $ctr)
# cp -R src $mnt
```

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buildah

Coreutils for building containers. Simple interface

```
# ctr=$(buildah from fedora)
# mnt=$(buildah mount $ctr)
# cp -R src $mnt
# dnf install --installroot=$mnt httpd
```

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buildah

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# ctr=$(buildah from fedora)
# mnt=$(buildah mount $ctr)
# cp -R src $mnt
# dnf install --installroot=$mnt httpd
# make install DESTDIR=$mnt
```

#nobigfatdaemons

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```
# ctr=$(buildah from fedora)
# mnt=$(buildah mount $ctr)
# cp -R src $mnt
# dnf install --installroot=$mnt httpd
# make install DESTDIR=$mnt
# buildah config --entrypoint=/usr/sbin/test.sh --env foo=bar $ctr
```

#nobigfatdaemons

buildah

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# ctr=$(buildah from fedora)
# mnt=$(buildah mount $ctr)
# cp -R src $mnt
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# buildah commit $ctr myhttpd
```

#nobigfatdaemons

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# ctr=$(buildah from fedora)
# mnt=$(buildah mount $ctr)
# cp -R src $mnt
# dnf install --installroot=$mnt httpd
# make install DESTDIR=$mnt
# buildah config --entrypoint=/usr/sbin/test.sh --env foo=bar $ctr
# buildah commit $ctr myhttpd
# buildah push myhttpd docker://rhatdan/myhttpd
```

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buildah

Dan Wait!

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buildah

Dan Wait!
What about Dockerfile?????

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buildah

Buildah also supports Dockerfile
buildah build-using-dockerfile -f Dockerfile .

#nobigfatdaemons

buildah

Buildah also supports Dockerfile
buildah build-using-dockerfile -f Dockerfile .
Or for those lazy ones:
buildah **bud** -f Dockerfile .

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buildah

Does Buildah have a scripting language? Perhaps Buildahfile?

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buildah

BASH

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buildah

BASH

We want others to build higher level tools on Buildah.

#nobigfatdaemons

buildah

BASH

We want others to build higher level tools on Buildah.
Working to make OpenShift use Buildah for S2I containers rather then use Docker.

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buildah

BASH

We want others to build higher level tools on Buildah.
Working to make OpenShift use Buildah for S2I containers rather then use Docker.
Want to work with Ansible-containers to use buildah for containers as well.

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buildah

Security

- No Big Fat Container Daemon
  - Run your container builds inside of locked down containers under Kubernetes
  - No need to leak in the docker.sock

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buildah

Security

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  - Run your container builds inside of locked down containers under Kubernetes
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- Buildah can be run as non root on the desktop

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buildah

Security

- No Big Fat Container Daemon
  - Run your container builds inside of locked down containers under Kubernetes
  - No need to leak in the docker.sock
- Buildah can be run as non root on the desktop
- Building Minimal Images
  - Only include content in the image required to run the image
  - Does not require you to use Dockerfile and therefore include Yum/Python in image

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What else does OpenShift need?

- Ability to diagnose problems on the host
- If you don't use Docker to run the containers, how does an admin discover what is going on in his Container runtime, without the docker CLI?

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Introducing podman
part of the libpod effort

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Replacing Docker With Podman

By Dan Walsh @rhatdan

dnf install -y podman

```
dnf install -y podman

alias docker=podman
```

Questions

Blog: https://medium.com/cri-o
Github:

- https://github.com/kubernetes-sigs/cri-o
- https://github.com/containers/buildah
- https://github.com/containers/skopeo
- https://github.com/containers/libpod (podman)
- https://github.com/containers/storage
- https://github.com/containers/image

Site: https://cri-o.io IRC: freenode: #cri-o
Site: https://podman.io IRC: freenode: #podman
Site: https://buildah.io IRC: freenode: #buildah

Alan Moran on Twitter: "I completely forgot that ~2 months ago I set up "alias docker='podman'" and it has been a dream. #nobigfatdaemons @projectatomic" - Mozilla Firefox

Alan Moran on Twitter: "I

Twitter, Inc. (US) https://twitter.com/ialanmoran/status/1001671953571303425

Home Moments Notifications Messages docker=podman Tweet

docker=podman

Top Latest People Photos

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Who to follow · Refresh · View all

Joe Beda @jbeda Follow

RDO @RDOcommunity Follow

Alex Polvi @polvi Follow

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Trends for you · Change

#FlagDay
Why Americans celebrate Flag Day on June 14

#WorldCupRussia2018
89.9K Tweets

#ThursdayThoughts
51.9K Tweets

Degrassi
Drake reunites with Degrassi cast in new music video

Spieth
1,924 Tweets

Clinton
159K Tweets

#USOpen2018
1,749 Tweets

katacoda.com

Alan Moran
@ialanmoran

Follow

I completely forgot that ~2 months ago I set up "alias docker='podman'" and it has been a dream. #nobigfatdaemons @projectatomic

11:49 PM - 29 May 2018

7 Retweets **15** Likes

2 7 15

Tweet your reply

Alan Moran @ialanmoran · May 30
Only downside is no Mac OS support (Main dev machine)

Joe Thompson @caffeinepresent · May 30
Replying to @ialanmoran @projectatomic
So, what reminded you?

1

Alan Moran @ialanmoran · May 30
docker help 🙃

Introducing podman

podman is tool for managing POD/Containers based on the Docker CLI

https://github.com/projectatomic/libpod

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Introducing podman

podman is tool for managing POD/Containers based on the Docker CLI

podman ps -a

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podman ps -a

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podman is tool for managing POD/Containers based on the Docker CLI

podman ps -a

podman run -ti fedora sleep 2000

podman exec -ti fedora sh

podman images

...

https://github.com/projectatomic/libpod

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DEMO

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Security

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  - Run Manage/Containers without being root.
  - No need for access to the /var/run/docker.sock

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Security

- No Big Fat Container Daemon
  - No need to leak in the docker.sock
  - Run Manage/Containers without being root.
  - No need for access to the /var/run/docker.sock
- Containers run as child of the process that ran it
  - Better Auditing
  - Support for socket activation

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Proper Integration with Systemd

- Can run systemd as PID 1 in container, with no modifications

Proper Integration with Systemd

- Can run systemd as PID 1 in container, with no modifications
- Support sd_notify

Proper Integration with Systemd

- Can run systemd as PID 1 in container, with no modifications
- Support sd_notify
- Socket Activation

Remote API for Podman

- Added Varlink support
- Socket activation of podman system service with varlink

```
[Unit]
Description=Podman Remote API Service
Requires=io.podman.socket
After=io.podman.socket
Documentation=man:podman-varlink(1)

[Service]
Type=simple
ExecStart=/usr/bin/podman varlink unix:/run/podman/io.podman

[Install]
WantedBy=multi-user.target
Also=io.podman.socket
```

Python Bindings

```
python3 -c "import podman; import json; c=podman.Client();print(json.dumps(c.system.info(), indent=4))"
[
  {
    "mem_free": 5796605952,
    "mem_total": 16679206912,
    "swap_free": 0,
    "swap_total": 0,
    "arch": "amd64",
    "cpus": 4,
    "hostname": "localhost.localdomain",
    "kernel": "4.18.9-200.fc28.x86_64",
    "os": "linux",
    "uptime": "11h 2m 32.25s (Approximately 0.46 days)"
  },
...
```

Remote API Support

pypodman - Python program used for running remote podman commands.

https://asciinema.org/a/203590

Cockpit support

https://github.com/cockpit-project/cockpit-podman

What we don’t do

- Autostart
  - Systemd should be handling this
  - We now support AutoRestart
- Swarm
  - We support Kubernetes container orchestrator
- Notary
  - We do support simple signing, but would look at PRs for Notary support
- Docker API - We have no plans to support this, but we do have Varlink
- Docker volumes Plugins
  - It is on the roadmap

Red Hat
Enterprise Linux 8

Does not included supported version of Docker!

English

Single-page HTML

8.0 release notes

Providing feedback on Red Hat documentation

1. Overview

2. Architectures

3. Distribution of content in RHEL 8

3.1. Installation

3.2. Repositories

3.3. Application Streams

4. New features

4.1. The web console

4.2. Installer and image creation

4.3. Kernel

4.4. Software management

4.5. Infrastructure services

Chapter 9. Notable changes to containers

A set of container images is available for Red Hat Enterprise Linux (RHEL) 8.0. Notable changes include:

- Docker is not included in RHEL 8.0. For working with containers, use the **podman**, **buildah**, **skopeo**, and **runc** tools.

  For information on these tools and on using containers in RHEL 8, see Building, running, and managing containers.

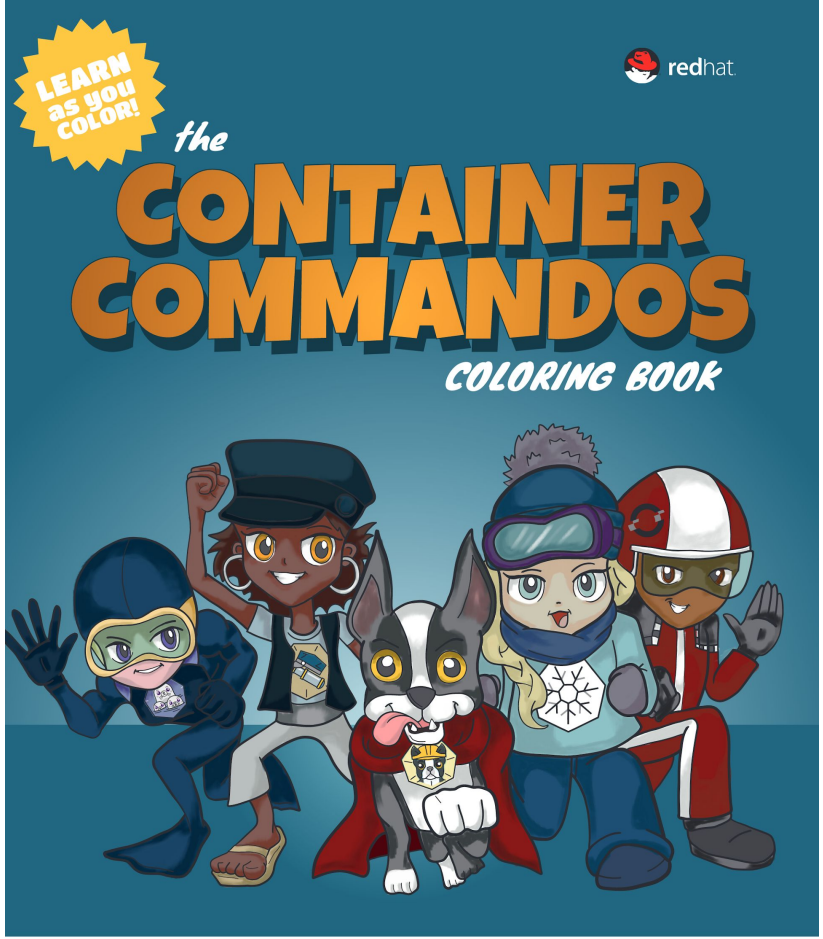
- The **podman** tool has been released as a fully supported feature.

  The **podman** tool manages pods, container images, and containers on a single node. It is built on the **libpod** library, which enables management of containers and groups of containers, called pods.

  To learn how to use **podman**, see Building, running, and managing containers.

- In RHEL 8 GA, Red Hat Universal Base Images (UBI) are newly available. UBIs replace some of the images Red Hat previously provided, such as the standard and the minimal RHEL base images.

  Unlike older Red Hat images, UBIs are freely redistributable. This means they can be



https://github.com/mairin/coloringbook-container-commandos/blob/master/Web.pdf

Questions

Blog: https://medium.com/cri-o
Github:

- https://github.com/kubernetes-sigs/cri-o
- https://github.com/containers/buildah
- https://github.com/containers/skopeo
- https://github.com/containers/libpod (podman)
- https://github.com/containers/storage
- https://github.com/containers/image

Site: https://cri-o.io IRC: freenode: #cri-o
Site: https://podman.io IRC: freenode: #podman
Site: https://buildah.io IRC: freenode: #buildah