Container und Container Images

Was verbirgt sich dahinter?

Dan Čermák

Chemnitzer Linux-Tage
22nd and 23rd March 2025

who -u

Dan Čermák

- Software Developer @SUSE
- i3 SIG, Package maintainer
- Developer Tools, Testing and Documentation, Home Automation
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- dcermak
- @Defolos@mastodon.social
- @defolos.bsky.social

Agenda

- Containers from Scratch
- Docker & Podman
- Container Orchestration
- Should I use containers?

Software Delivery

Software Delivery

- dependencies suck → bundle everything

Software Delivery

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- Can't we just ship everything?

Software Delivery

- dependencies suck → bundle everything
- Can't we just ship everything?
- yes, but VMs suck as well 🫠

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4. `tar -czvf my-app.tar.gz /sysroot`

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2. `chroot /path/to/app /usr/local/bin/my-app`

Is that it?

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- inconvenient build process

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- no upgrade path

Is that it?

- inconvenient build process
- no upgrade path
- data sharing?

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- inconvenient build process
- no upgrade path
- data sharing?
- no security

Linux Namespaces

Linux Namespaces

- kernel level resource isolation

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  available namespaces:

Linux Namespaces

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- user

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Linux Namespaces

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  available namespaces:

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  - time

Try it:

Try it:

```
$ unshare --user --map-root-user \
      --pid --fork --mount-proc \
      /bin/bash
# whoami
root
# ps -a
    PID TTY          TIME CMD
      1 pts/8    00:00:00 bash
    104 pts/8    00:00:00 ps
```

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- 👎 standardized build process

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- 👍 great process isolation
- 👎 standardized build process
- 👎 distribution mechanism

Introducing: Docker

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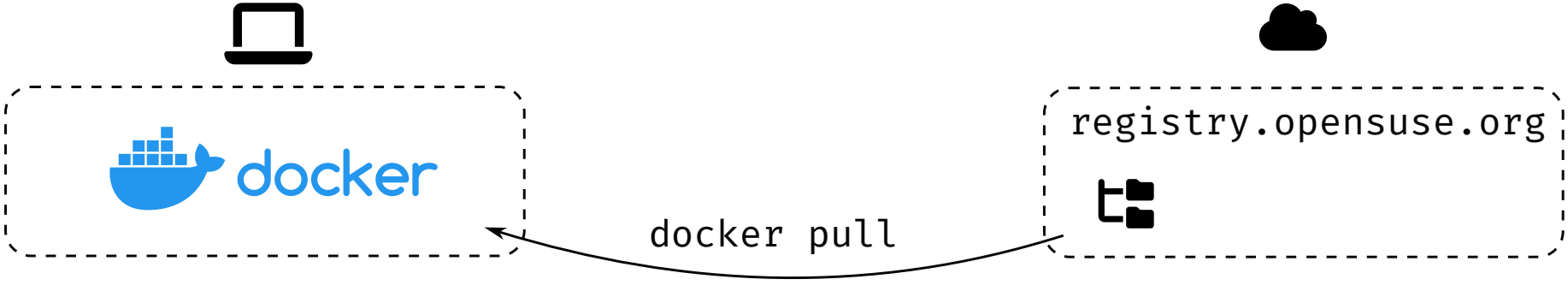
2. Docker registry

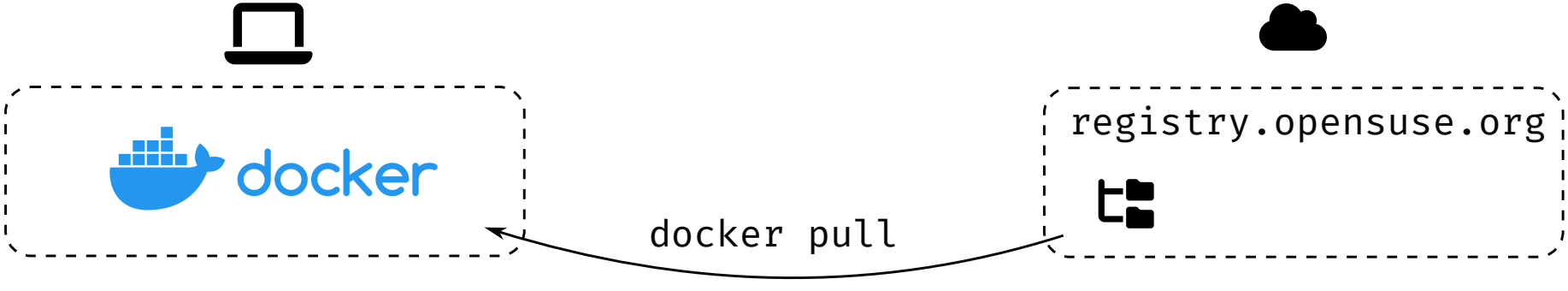
Docker Registry

Docker Registry



<registry>/<name>:<tag>@<digest>

Docker Registry



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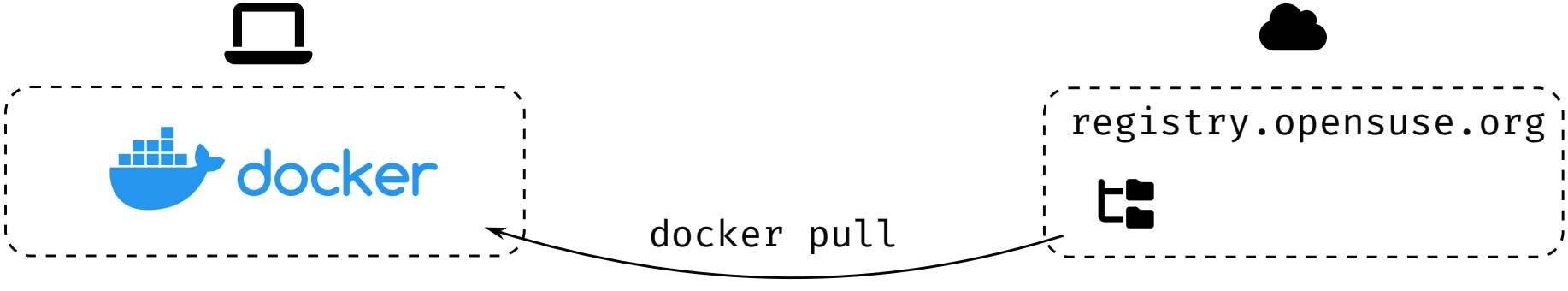
Docker Registry



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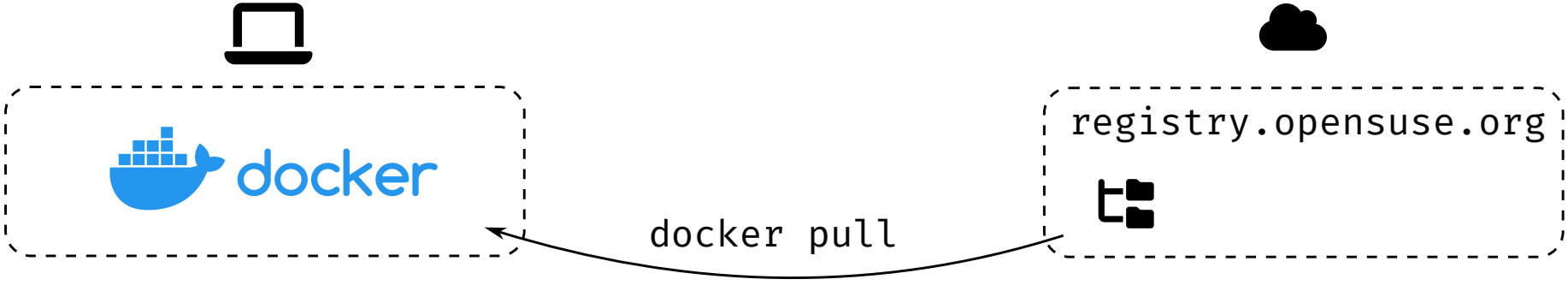

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EXPOSE 80
CMD ["/usr/bin/python", "-m", "my-app"]
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UnionFS

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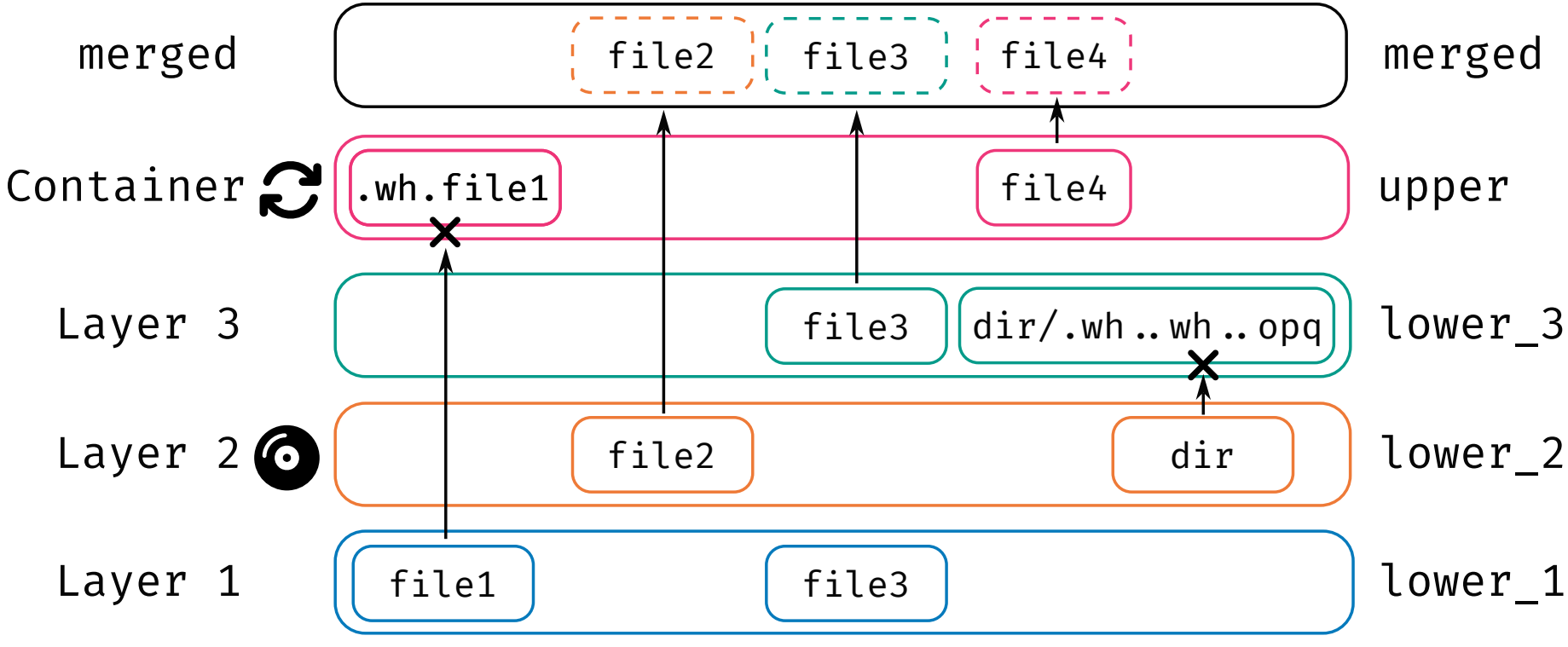
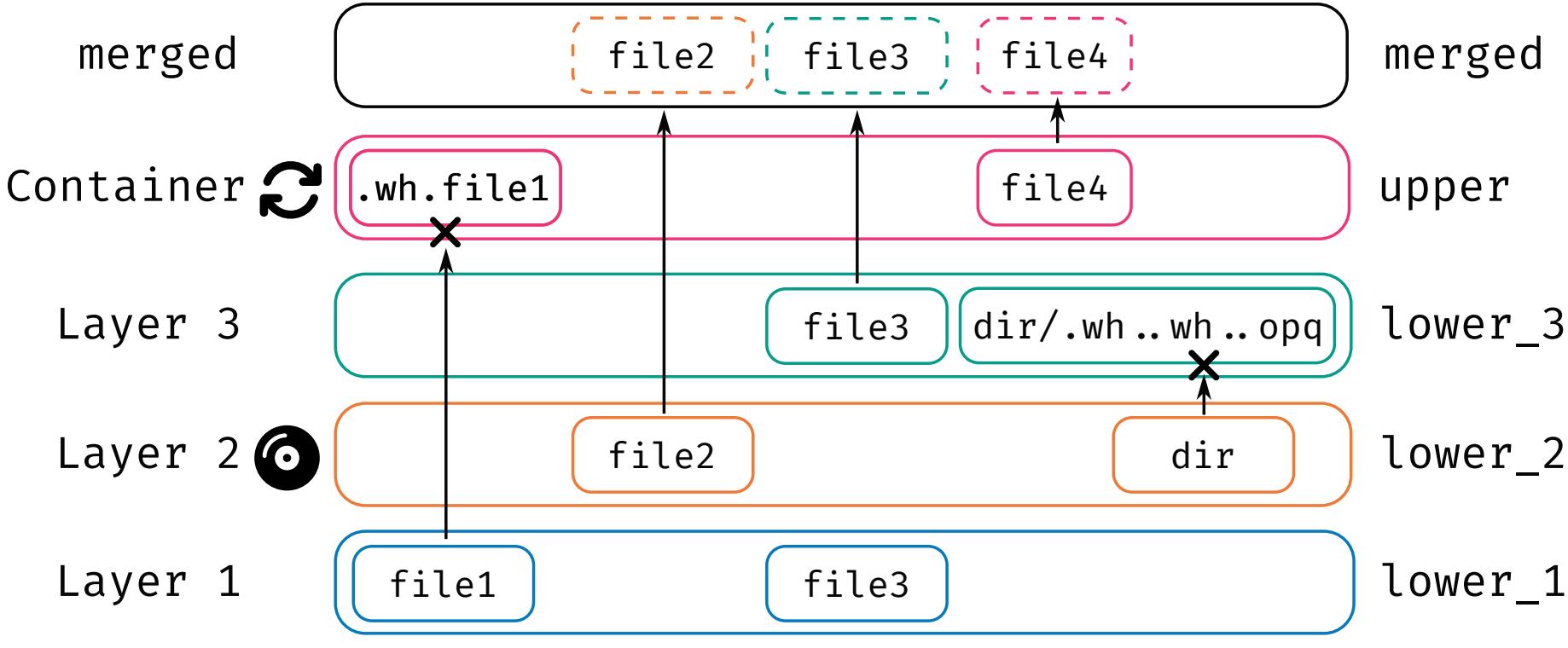

merged
file2
file3
file4
merged
Container
.wh.file1
file4
upper
Layer 3
file3
dir/.wh..wh..opq
lower_3
Layer 2
file2
dir
lower_2
Layer 1
file1
file3
lower_1

UnionFS




```
mount -t overlay overlay \
      -o lowerdir=lower_3:lower_2:lower_1,\
         upperdir=upper,workdir=/work/ \
           merged
```

Dockerfile

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Volumes

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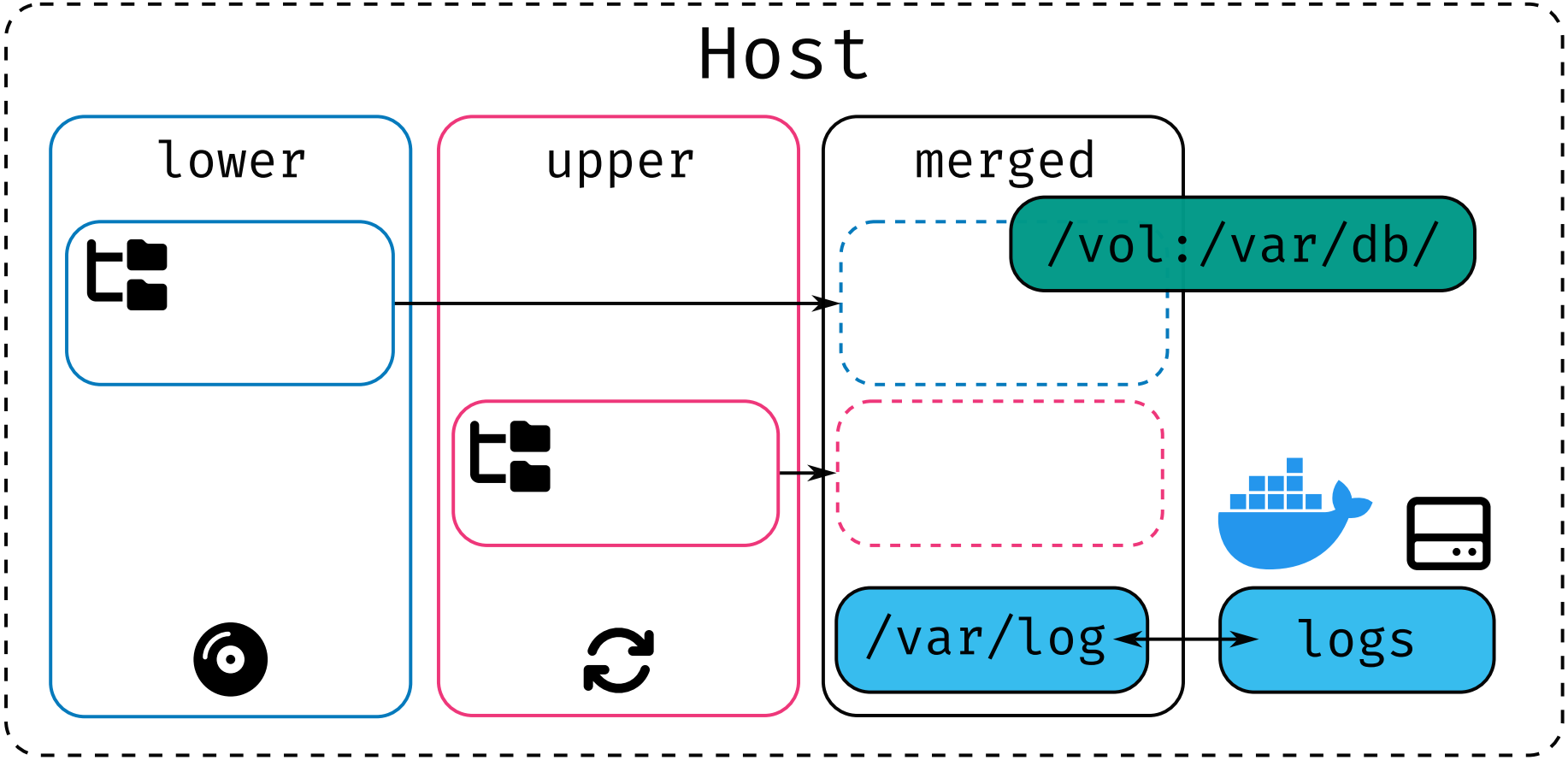

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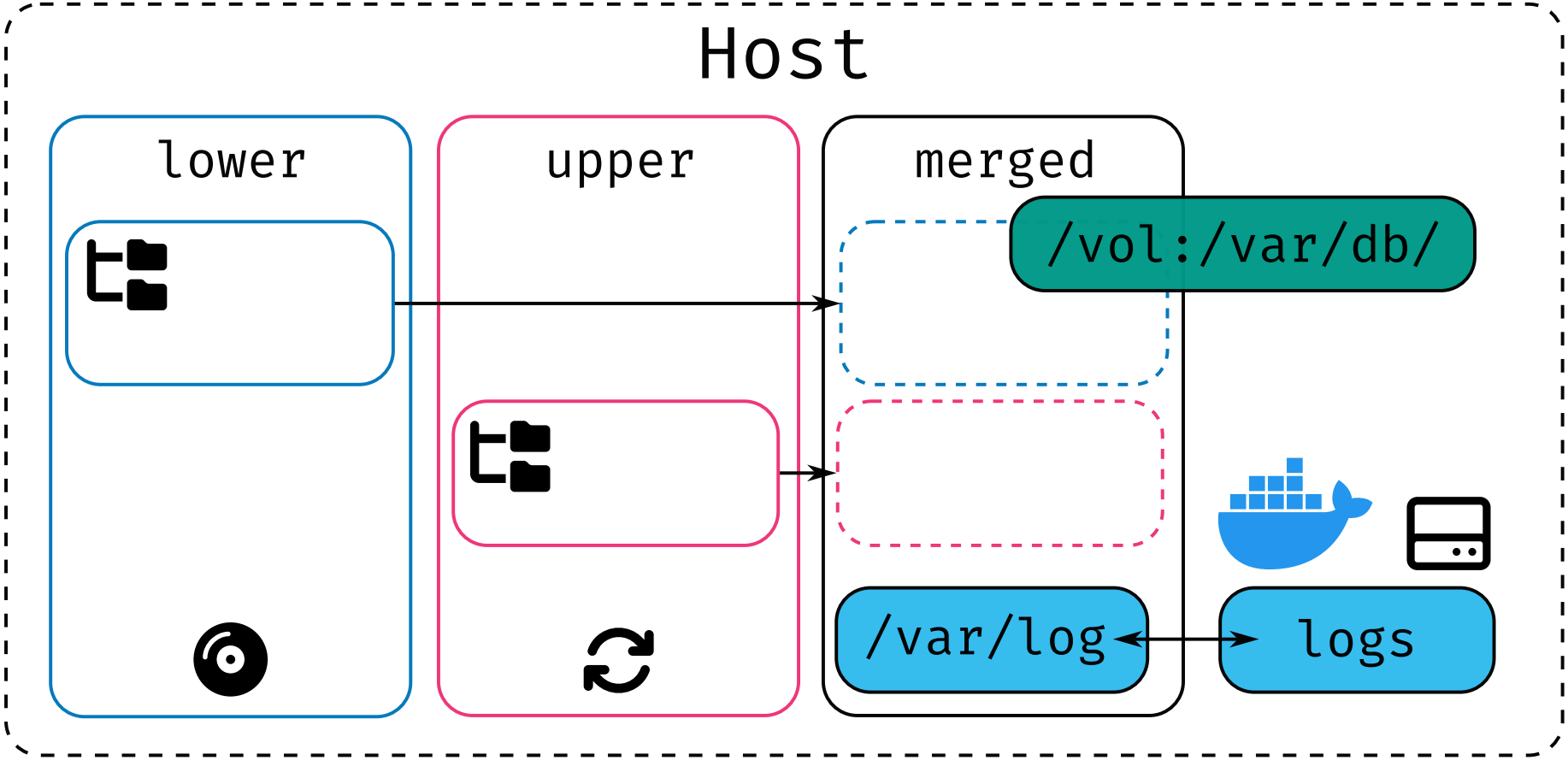
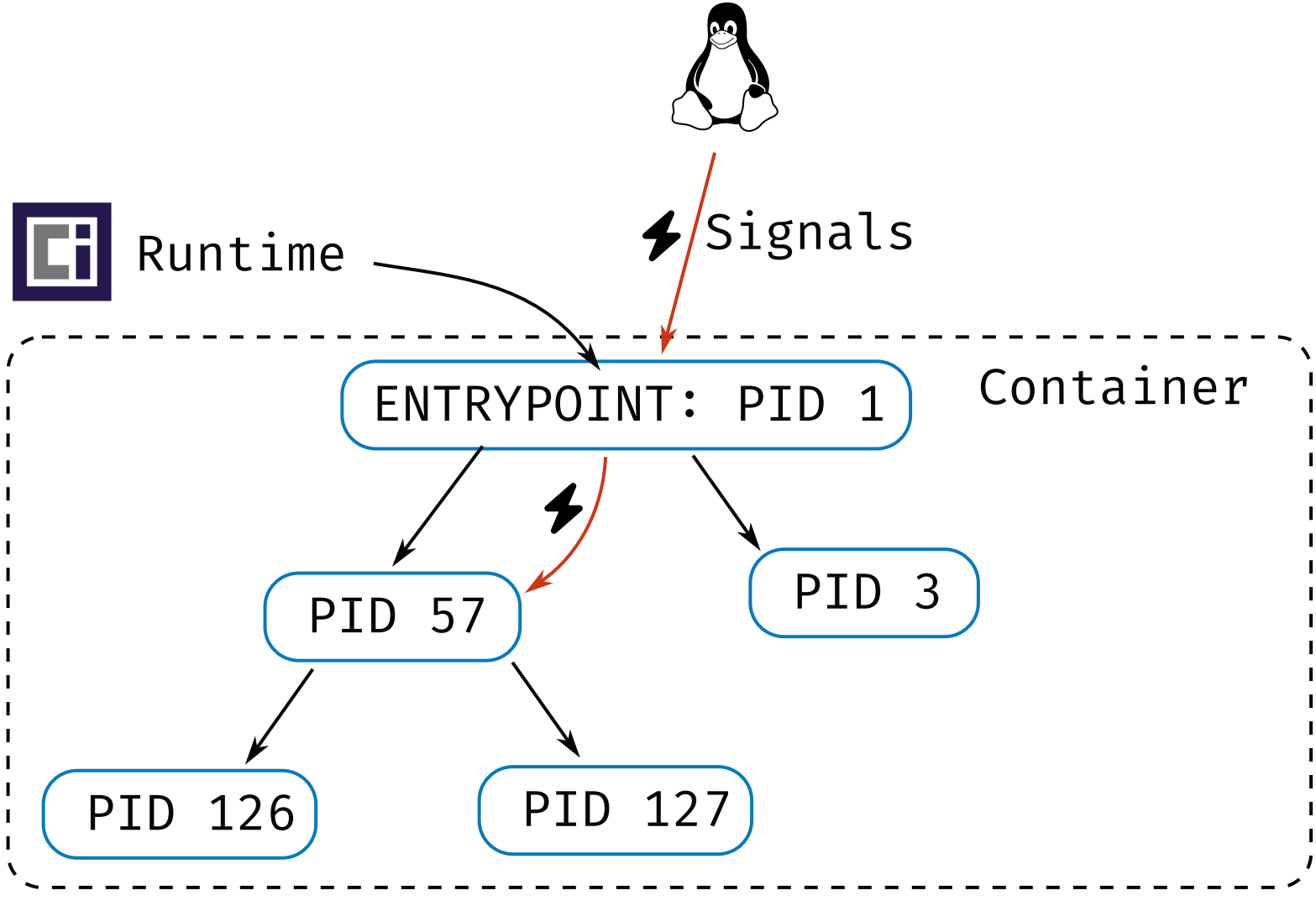



```
docker run -v /vol/:/var/db/ -v logs:/var/log $img
```

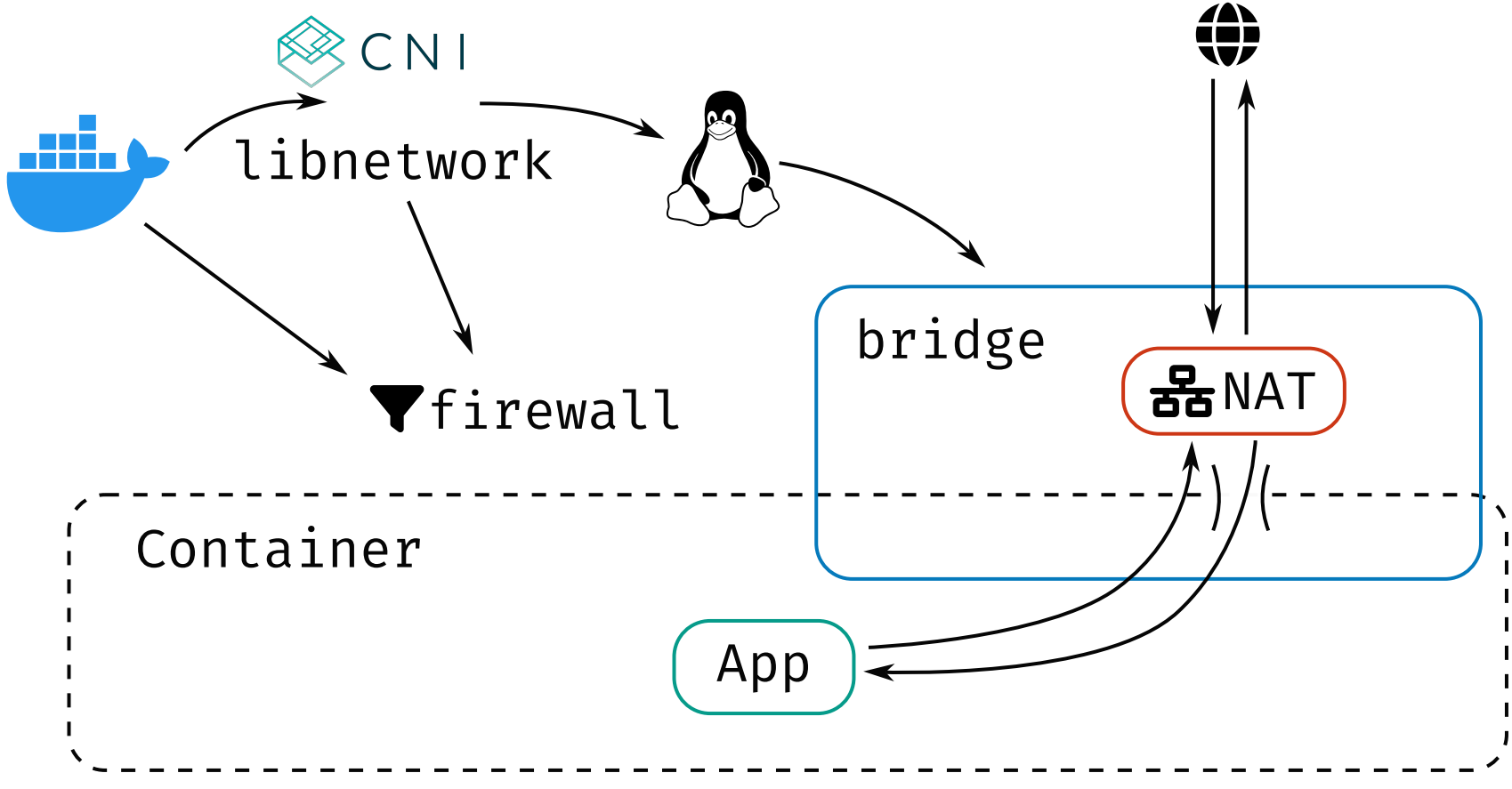
Entrypoint

Entrypoint


Runtime
Signals
ENTRYPOINT: PID 1
Container
PID 57
PID 3
PID 126
PID 127

Networking

Networking



Best Practices

Best Practices

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    pip install . ; \
    zypper -n rm --clean-deps gcc; zypper -n clean; \
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```
$ podman run -e POSTGRES_PORT=1234 \
             -e POSTGRES_USER=pg \
                 my-app
$ podman run my-app bash
#
```

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or:

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or:

```
$ podman run my-app
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Volumes are your friend:

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VOLUME ["/var/db/"]
# /var/db/ is now erased after each step!
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use the exec-form:

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use the exec-form:

```
ENTRYPOINT ["/usr/bin/my-app", "-param", "value"]
```

Podman

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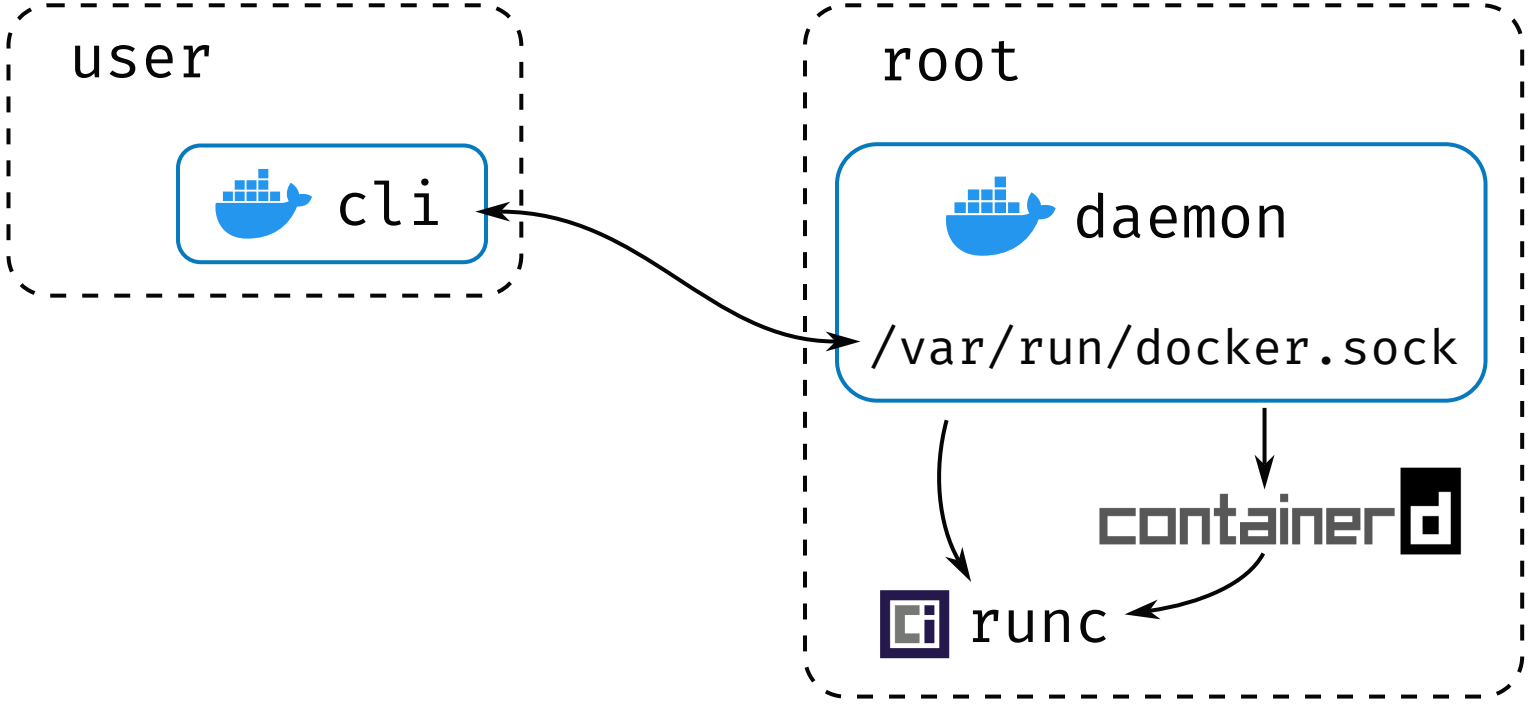
Actually Docker

Podman

Actually Docker



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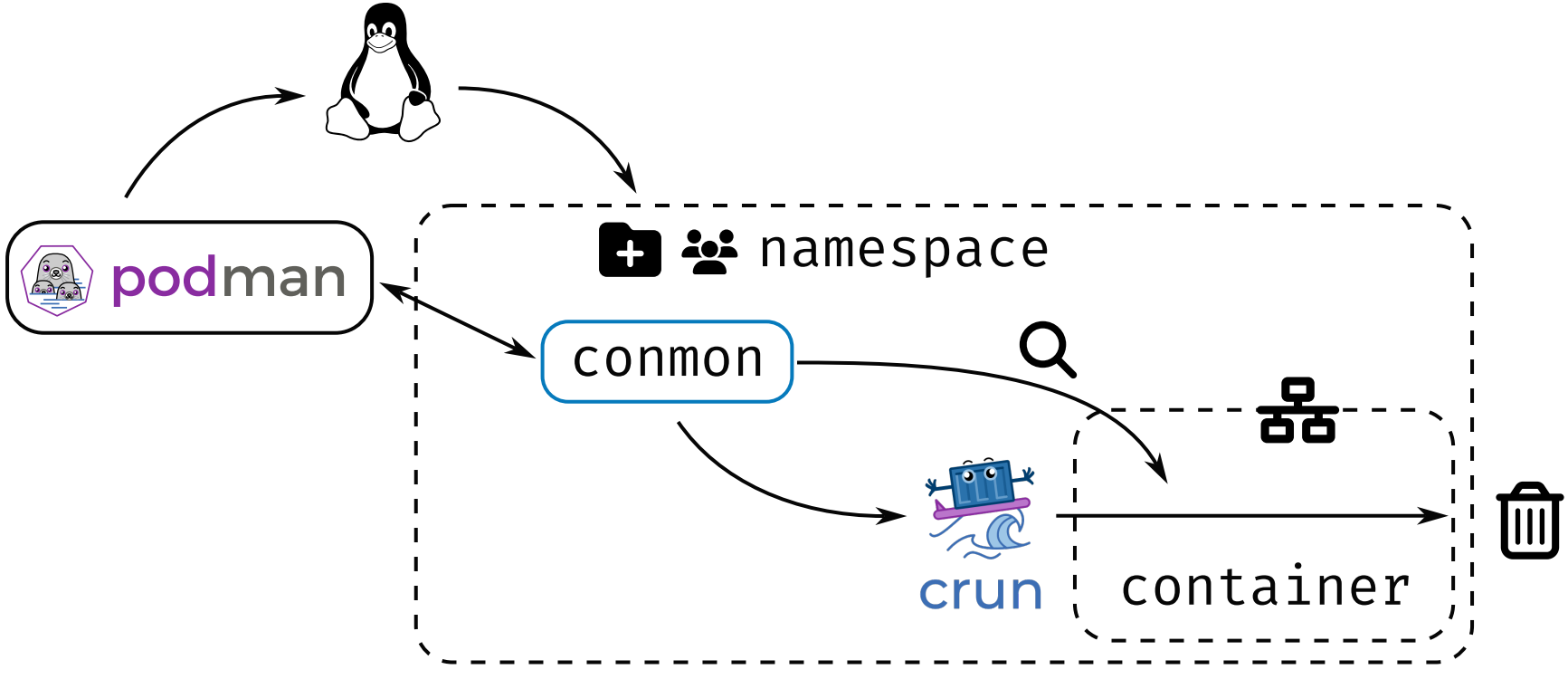

Rootless Containers

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- rootless networking runs in userspace

Security

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- container breakout attacks exist

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- container potentially as privileged as the user running it
- container breakout attacks exist
- SELinux is your friend

When to use

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- Single binary

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- Testing other Distributions

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- Single binary
- Cloud Native Deployment
- Testing other Distributions
- Reproducible Dev/Test/Build Environment

When to use

- Single binary
- Cloud Native Deployment
- Testing other Distributions
- Reproducible Dev/Test/Build Environment
- Base OS doesn't matter

When not to use

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- Complex multi binary legacy code

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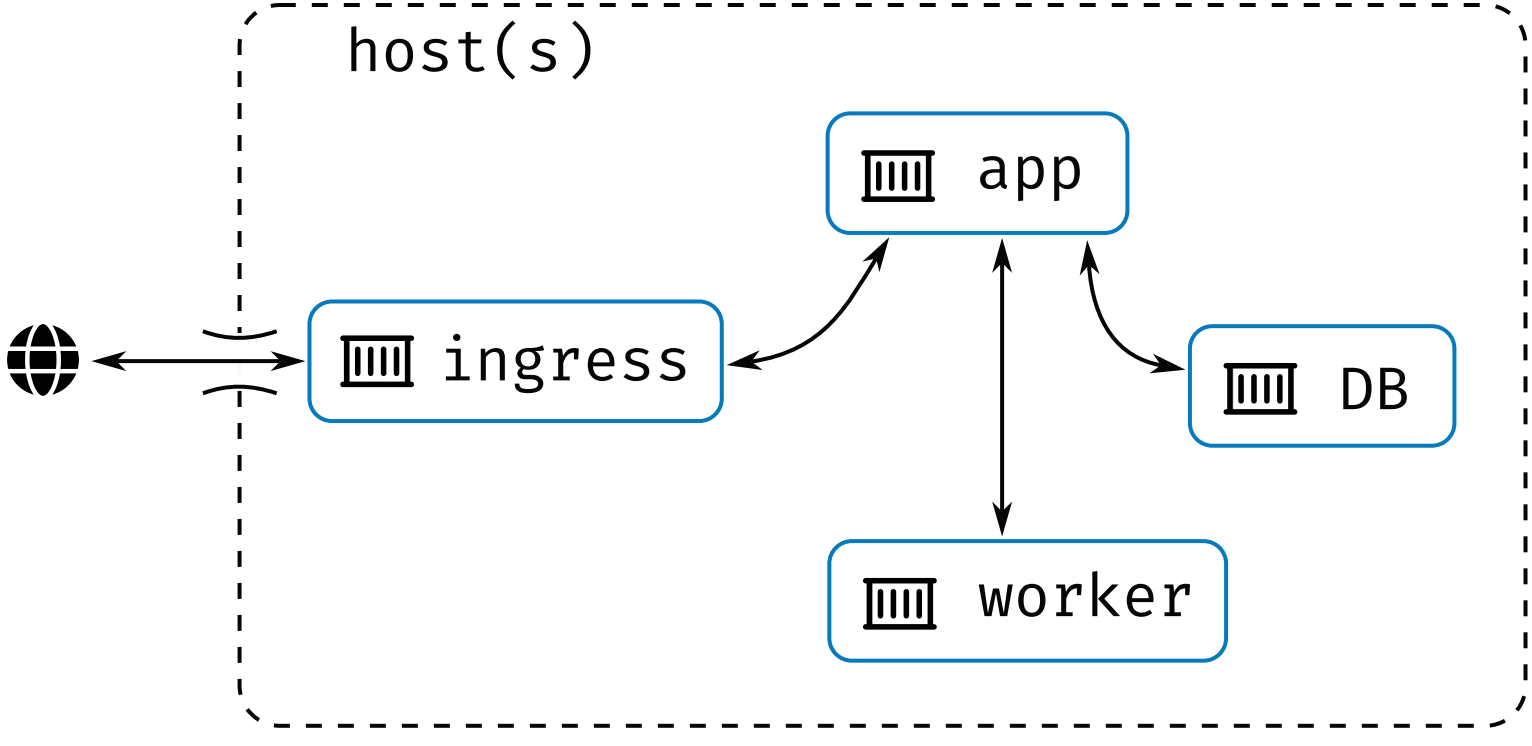
- High-Performance Code

When not to use

- Complex multi binary legacy code
- High-Performance Code
- Base OS matters

Container Orchestration

Container Orchestration



docker-compose

docker-compose

```
services:
  app:
    build: .
    ports:
      - "8080:8080"
    volumes:
      - .:/src
    depends_on:
      db:
        condition: service_healthy
  db:
    image: registry.opensuse.org/opensuse/mariadb
    environment:
      - MARIADB_ALLOW_EMPTY_ROOT_PASSWORD=1
```

docker-compose

```
services:
  app:
    build: .
    ports:
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      - .:/src
    depends_on:
      db:
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  db:
    image: registry.opensuse.org/opensuse/mariadb
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      - MARIADB_ALLOW_EMPTY_ROOT_PASSWORD=1
```

```
docker compose up
```

Quadlet / `podman generate systemd`

Quadlet / `podman generate systemd`

```
[Unit]
Description=TW container

[Container]
Image=registry.opensuse.org/opensuse/tumbleweed

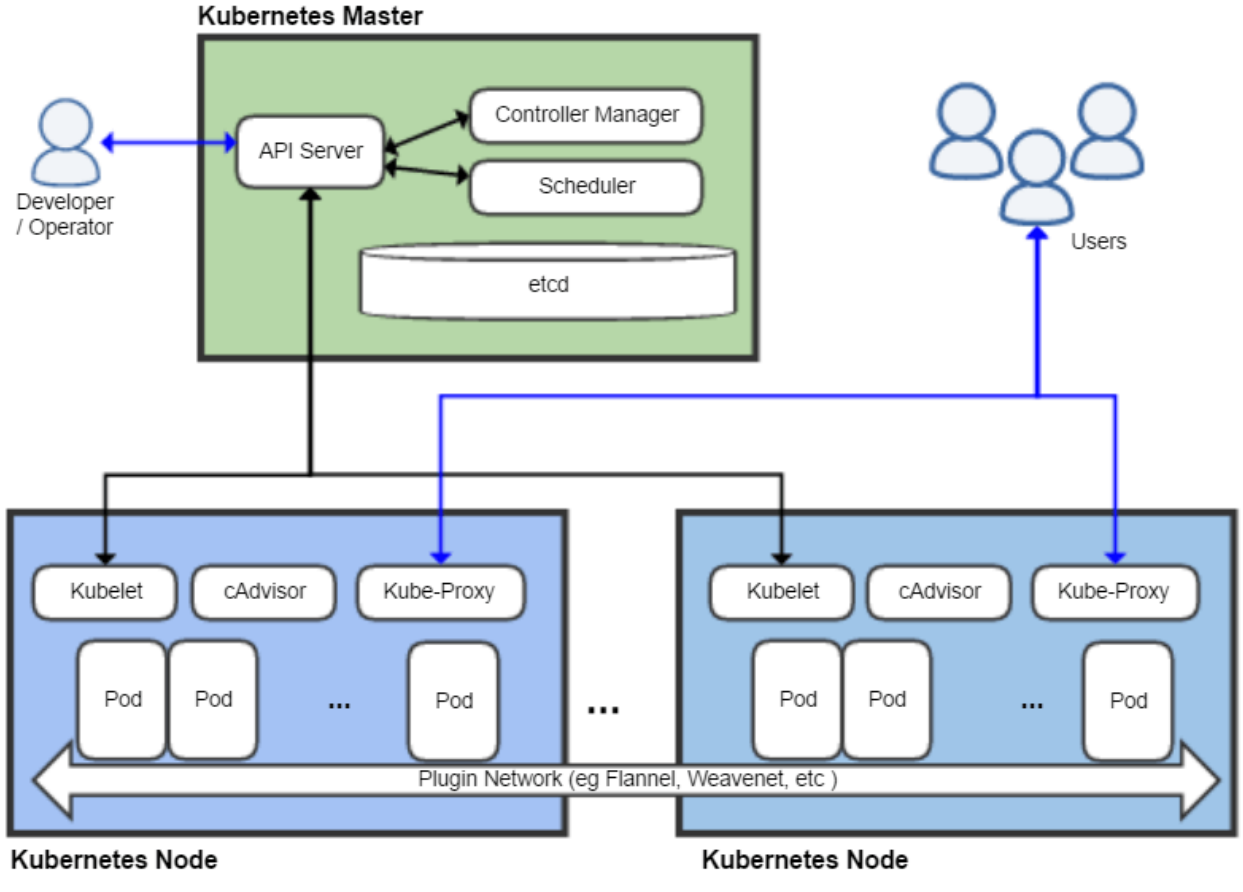
# volume and network defined below in other configs
Volume=test.volume:/data
Network=test.network

Exec=sleep infinity

[Service]
Restart=always
TimeoutStartSec=900
```

Kubernetes

Kubernetes


Kubernetes Master
Developer
/ Operator
API Server
Controller Manager
Scheduler
etcd
Users
Kubelet
cAdvisor
Kube-Proxy
Pod
Pod
...
Pod
...
Kubelet
cAdvisor
Kube-Proxy
Pod
Pod
...
Pod
Plugin Network (eg Flannel, Weavenet, etc)
Kubernetes Node
Kubernetes Node

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web-application
  labels:
    app: web
spec:
  replicas: 3
  selector:
    matchLabels:
      app: web
  template:
    metadata:
      labels:
        app: web
```

Should I use containers?

Should I use containers?

It depends

Questions?

dcermak.github.io/container-images