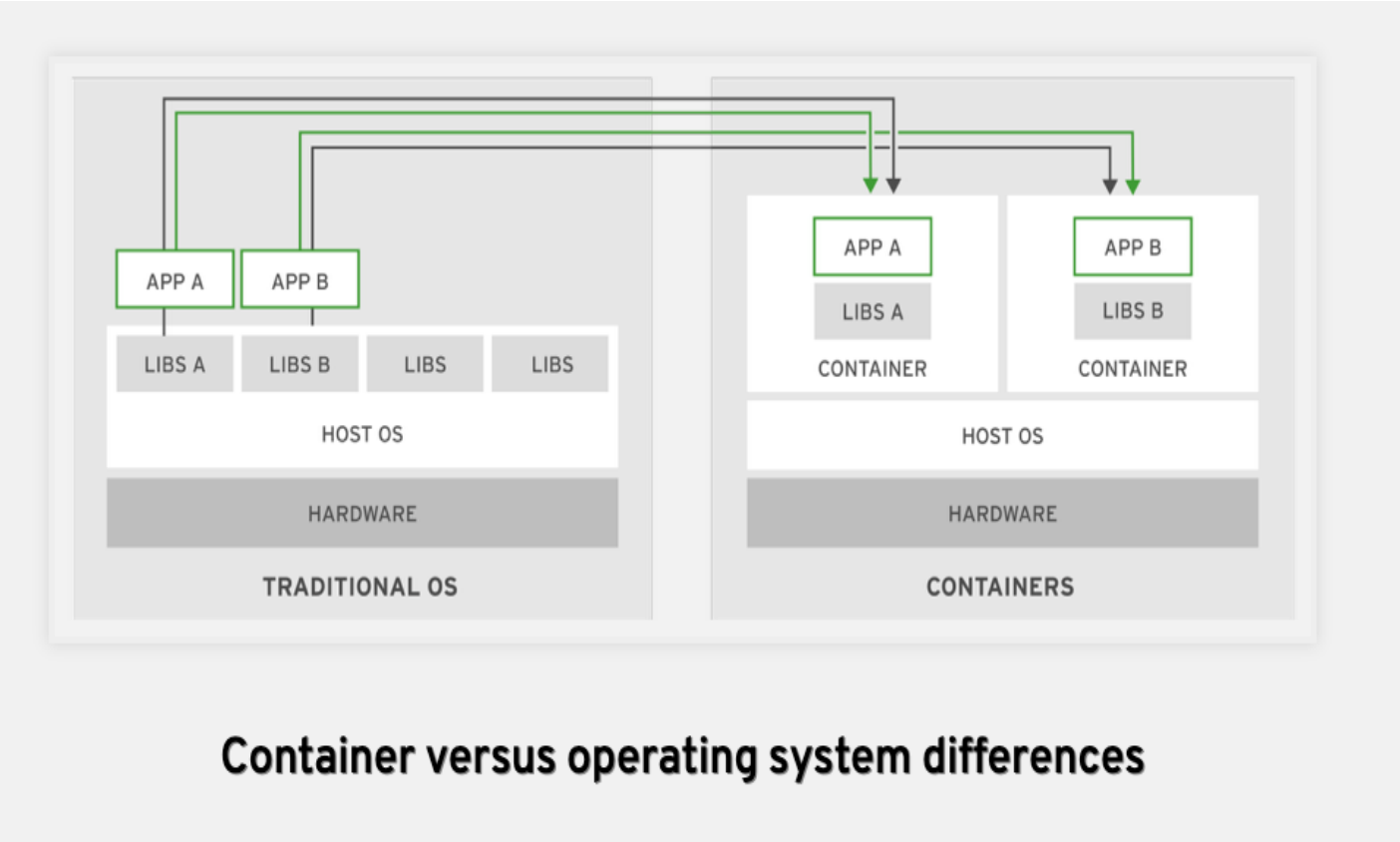
Day 1	Day 2	Day 3	Day 4	Day 5
Introduction in Kubernetes and Openshift	Kubernetes and Openshift Command-Line Interface	Deploy Managed and Networked Applications	Manage Storage	Manage Application Updates
Kubernetes and Openshift Command-Line Interface	Run Application as Containers and Pods	Manage Storage	Configure Applications for Reliability	Comprehensive Review



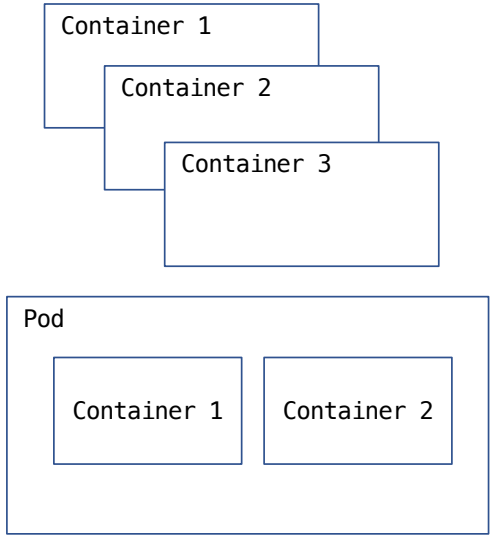
Container versus operating system differences

Container:

- niedriger Hardware-Footprint
- isolierte Umgebung
- schnelle Bereitstellung
- Bereitstellung mit mehreren Umgebungen
- Wiederverwendbar

container vs. operationg system

Podman :
großer Aufwand beim Betrieb mehrerer Container, Service-Kommunikation, Routing



Kubernetes : Orchestrierung von Container-Anwendungen

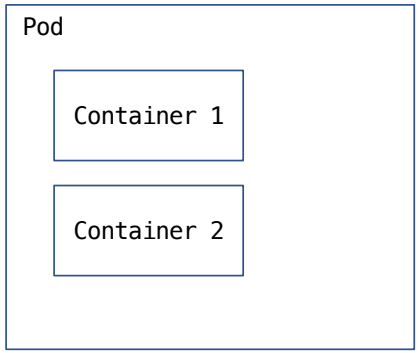
- Service Discovery, Loadbalancing
- Horizontale Skalierung
- Health Checks
- Rolling Updates
- Secret/Configmanagement
- Operatoren: native Kubernetes Anwendungen zum Cluster- und Anwendungs-Management

Openshift (RHOCP):

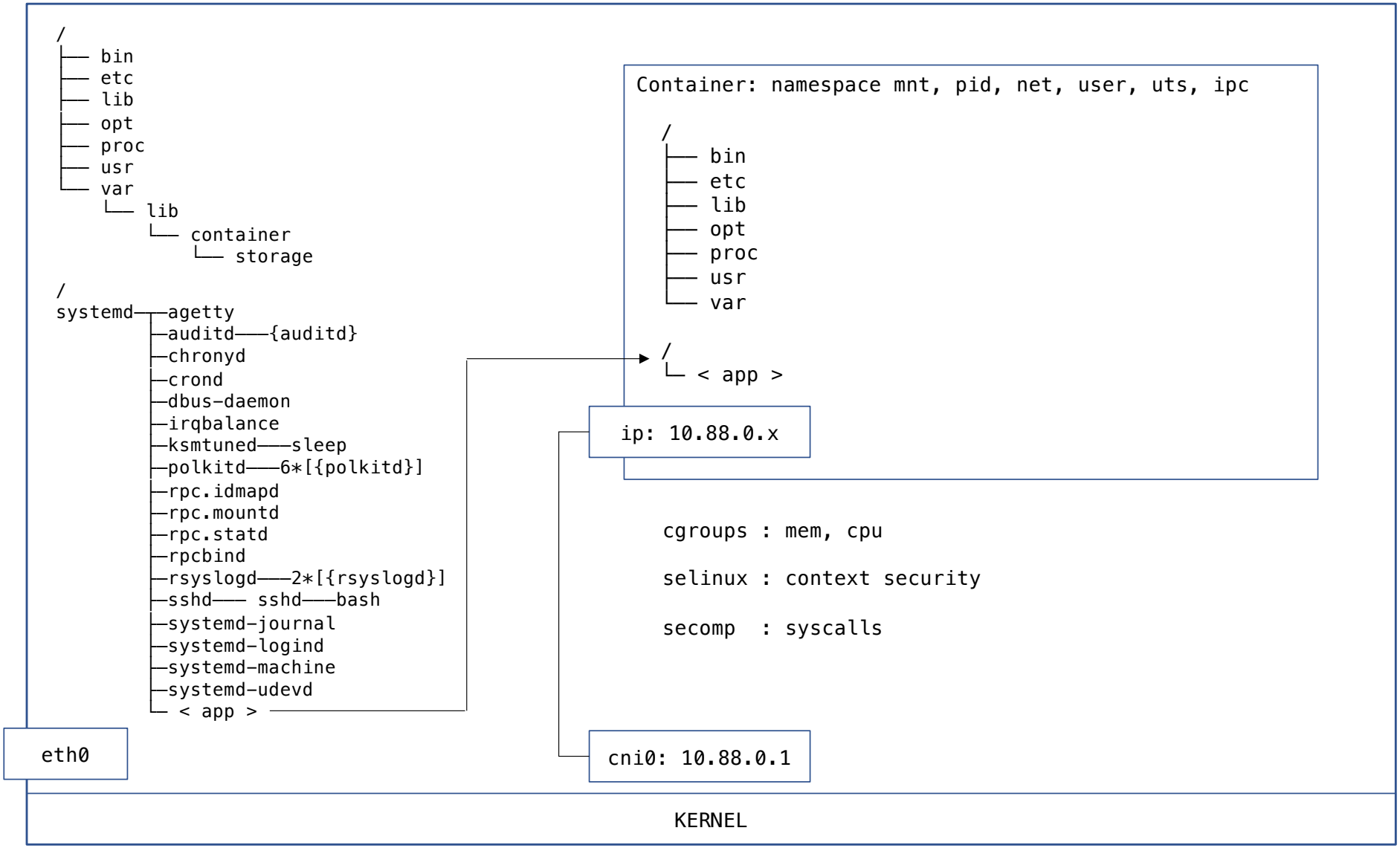
- basiert auf Kubernetes
- Entwickler-Workflow (CI/CD)
- Routing
- Metriken und Log-Management
- einheitliche Benutzeroberfläche

Podman:
- Verwalten von Images und Containern
- mehrere Container können in einen Pod zusammengefasst werden

Kubernetes:
- kleinste Einheit ist der Pod – Gruppe von (unterschiedlichen) Containern
- meistens 1:1 Beziehung (1 Pod enthält ein Container)



pod and container



rootfull container

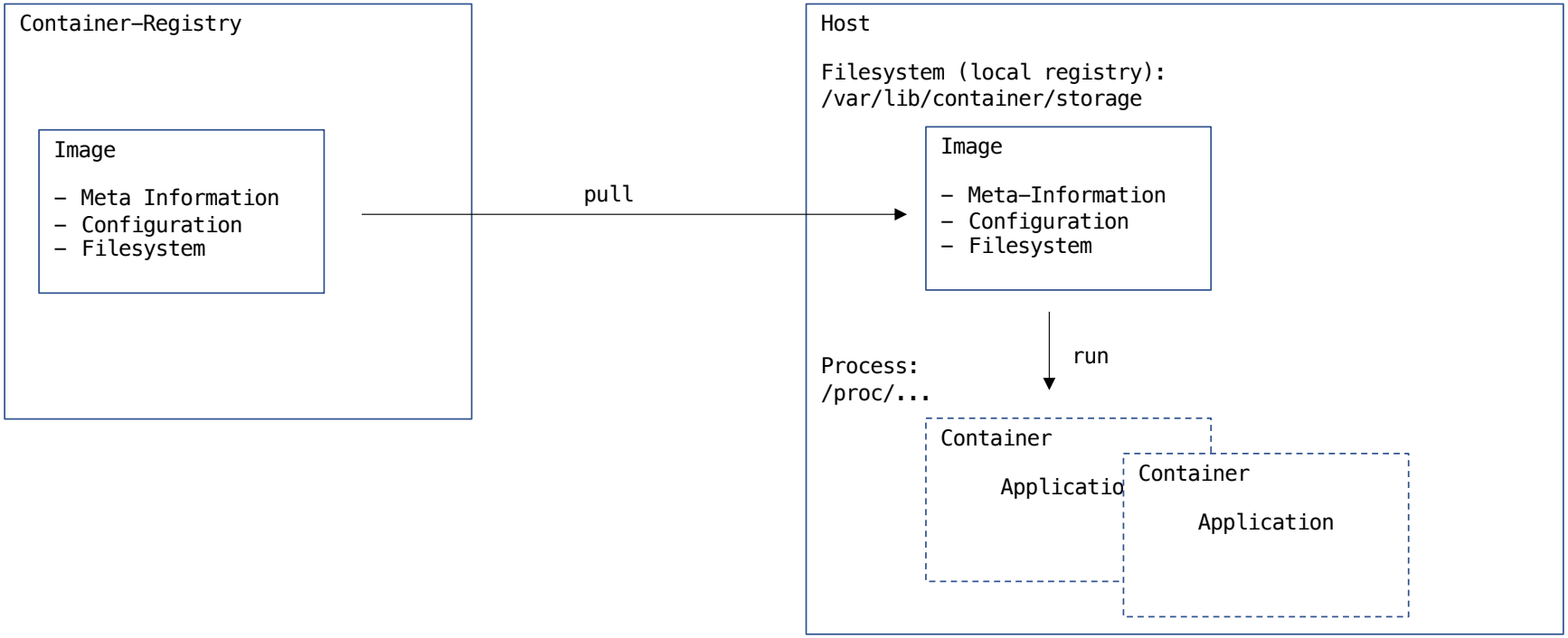
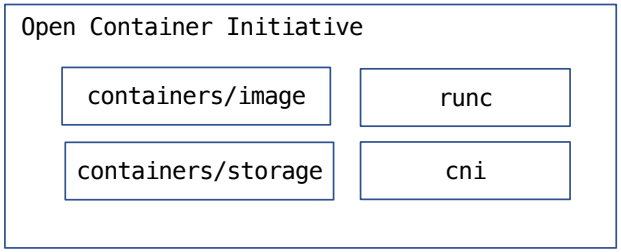


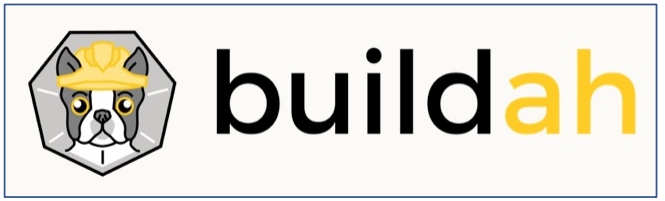
image and container

https://podman.io

- Image- und Containermanagement
- OCI: Open Container Initiative
- keine Client/Serverarchitektur
- gleiche Befehlssyntax wie do...
- Kubernetes kompatibel
- yum install podman



https://buildah.io



- Erstellen von Images
- yum install buildah

skopeo:

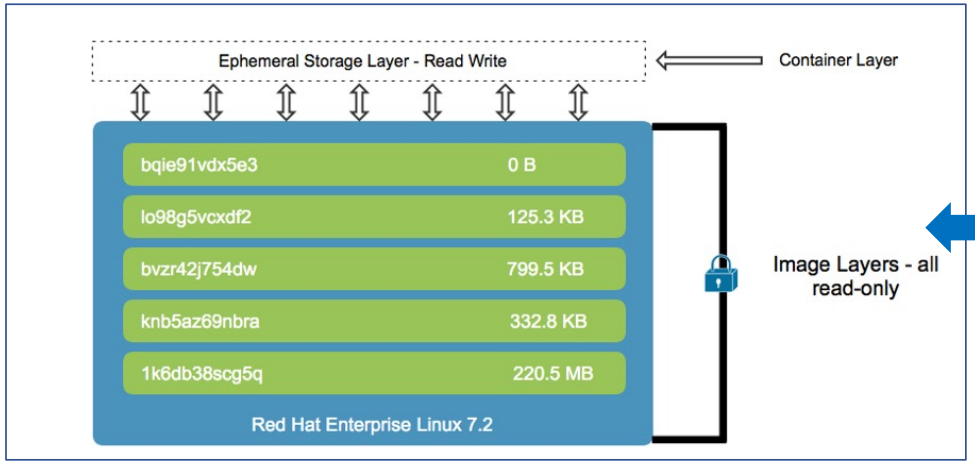
- Kopieren von Images zwischen Registries
- Auskunft über Images

podman run : Environment

```
podman run –e <KEY>=<VALUE>

podman run ––env–file=<host–file>

podman run ––env–host=true|false
```

podman run : Volumes (Files)

```
podman run –v <host–dir>:<container–dir>

podman run ––volumes–from <container–name>
```



Mapping (Mount) des Host-Filesystem in den Container:

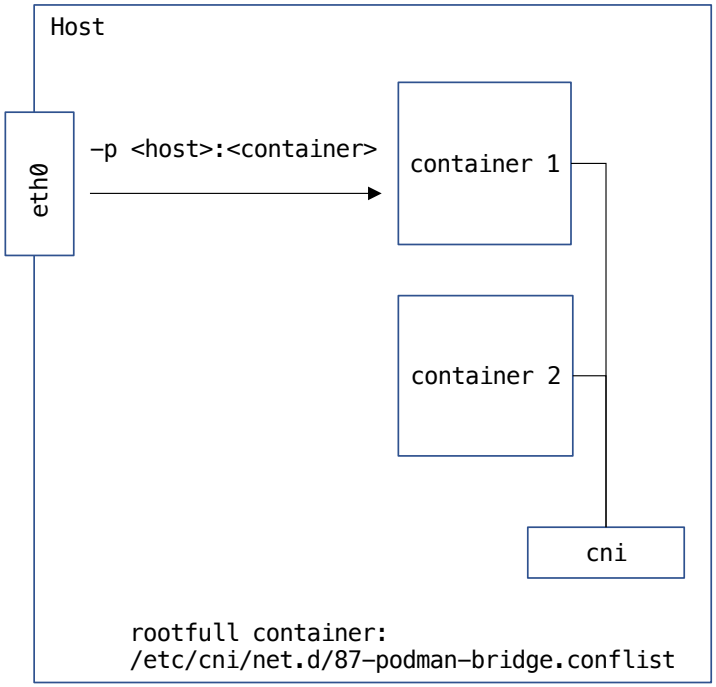
- Permissions
  `podman unshare chown –R <container–userid> <host–dir>`
  `oder chmod 0777 <host–dir>` ☺

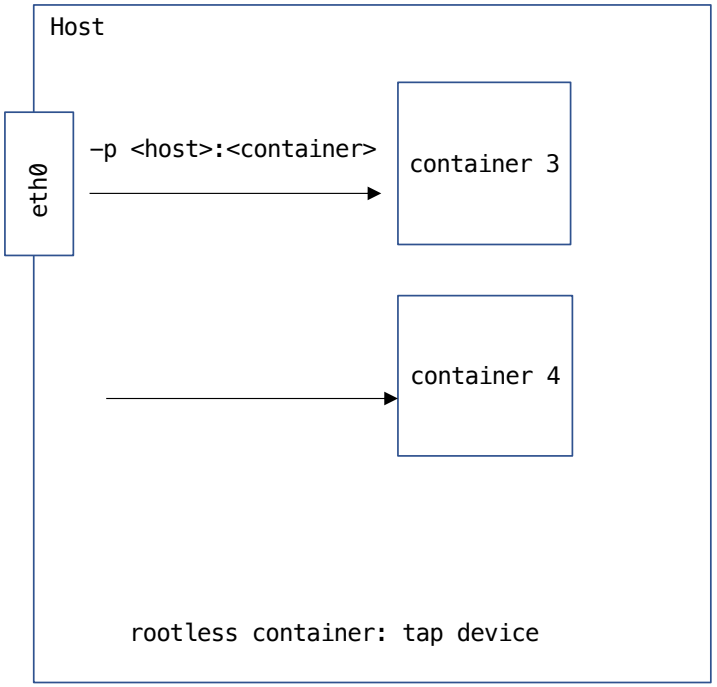
- SELinux
  `sudo semange fcontext –a –t container_file_t '<host–dir>(/.*)?'`
  `sudo restorecon –Rv <dir>`

```
podman run –v <host–dir>:<containter–dir> <image>
```

podman run - Publishing:

```
podman run -p <host-port>:<container-port> ...

podman run -P / --publish-all

podman port -l
```





```
$ podman images
REPOSITORY                                      TAG         IMAGE ID      CREATED          SIZE
localhost/nginx                                 latest      e420c54187d7  14 seconds ago   260 MB
localhost/nginx                                 1           2fd45c021c45  9 minutes ago    260 MB

$ podman tag nginx:latest nginx:1

$ podman images
REPOSITORY                                      TAG         IMAGE ID      CREATED          SIZE
localhost/nginx                                 1           e420c54187d7  27 seconds ago   260 MB
localhost/nginx                                 latest      e420c54187d7  27 seconds ago   260 MB
<none>                                          <none>      2fd45c021c45  9 minutes ago    260 MB

$ podman image prune
2fd45c021c451352e18ed2383d967fd5d510d1551837446cc0f11202c7bbae05

$ podman images
REPOSITORY                                      TAG         IMAGE ID      CREATED              SIZE
localhost/nginx                                 latest      e420c54187d7  About a minute ago   260 MB
localhost/nginx                                 1           e420c54187d7  About a minute ago   260 MB
```

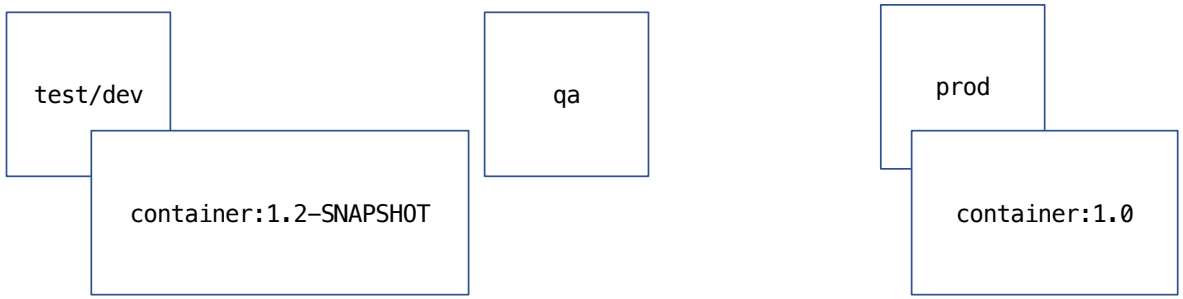


Image – Registry Push

```
Image-Name:  <registry-name>[:<registry-port]/<user|company|...>/<product>[:<tag>]
```

Default-Tag → latest

```
$ podman images
REPOSITORY                       TAG       IMAGE ID      CREATED        SIZE
localhost/do180-custom-httpd     latest    dc584a69516a  2 minutes ago  236 MB    → lokal erzeugtes Image

$ podman tag do180-custom-httpd  quay.io/danielstraub/do180-custom-httpd:v1.0
$ podman images
REPOSITORY                                TAG         IMAGE ID      CREATED         SIZE
quay.io/danielstraub/do180-custom-httpd   v1.0        dc584a69516a  2 minutes ago   236 MB
localhost/do180-custom-httpd              latest      dc584a69516a  2 minutes ago   236 MB

$ podman push quay.io/danielstraub/do180-custom-httpd:1.0
Getting image source signatures
Copying blob cc675081b281 done
Copying blob 7f9108fde4a1 skipped: already exists
...
```

alternativ ohne 'tagging':

```
$ podman push [--creds <user>:<password>] do180-custom-httpd quay.io/danielstraub/do180-custom-httpd:1.0
```

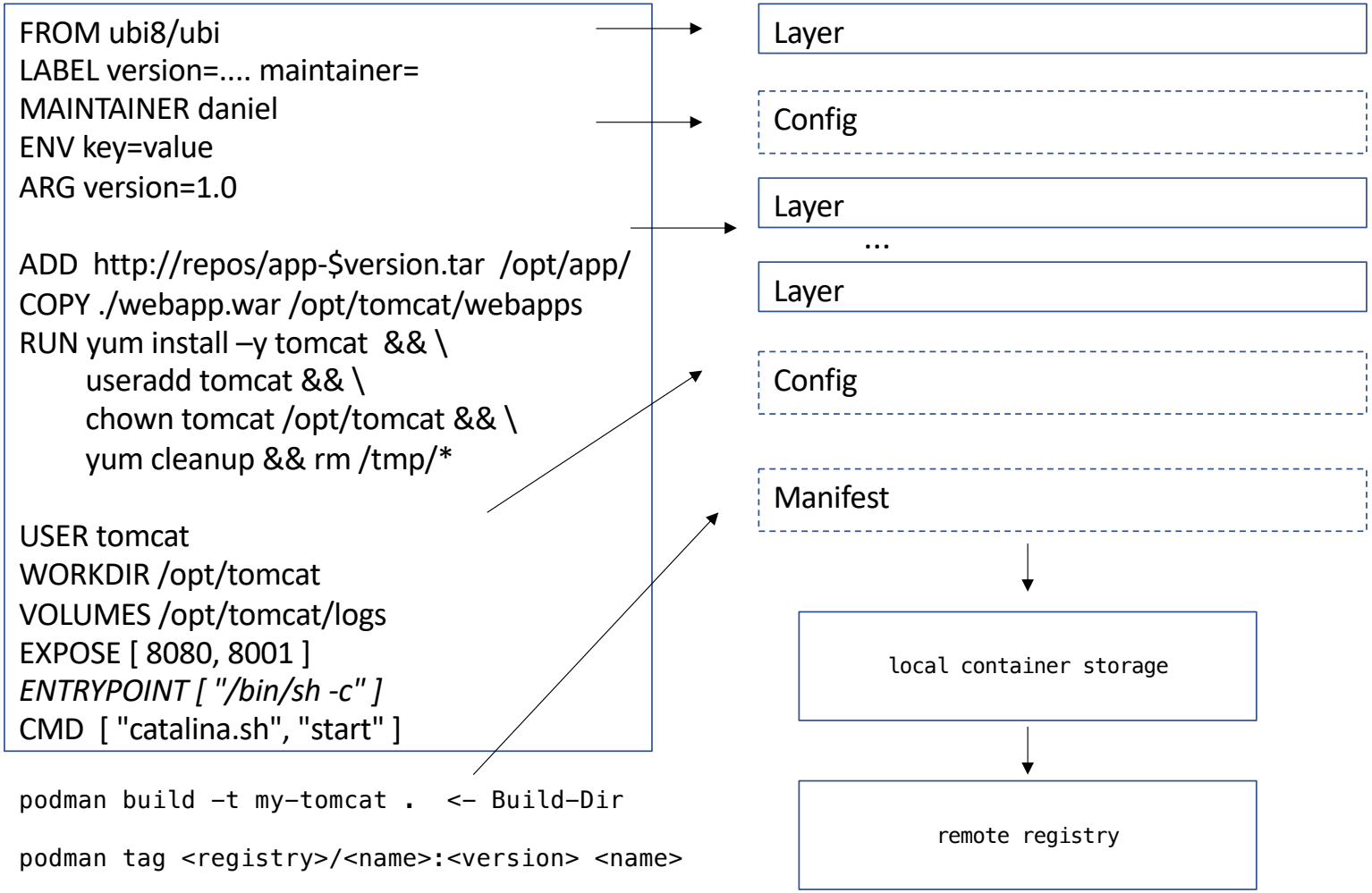
Container – Image

```
$ podman save <image> | tar -xf -
$ tree -L 1 .
.
├── 7076fcda2bf4ccbf058c10666d4c9dc2b4b643d3b6f770ed328c505387d21360
├── 7076fcda2bf4ccbf058c10666d4c9dc2b4b643d3b6f770ed328c505387d21360.tar
├── cbadeb4613603e1251cd6a24d6f2aa1d1bcd14a4fd2b85375e97d72a7a22764b.json
├── manifest.json
└── repositories
```

```
[
  {
    "Config": "cbadeb4613603e1251cd6a24d6f2aa1d1bcd14a4fd2b85375e97d72a7a22764b.json",
    "RepoTags": [
      "localhost/nginx:latest"
    ],
    "Layers": [
      "7076fcda2bf4ccbf058c10666d4c9dc2b4b643d3b6f770ed328c505387d21360.tar"
    ]
  }
]
```

podman build - Containerfile

```
FROM ubi8/ubi
LABEL version=.... maintainer=
MAINTAINER daniel
ENV key=value
ARG version=1.0

ADD  http://repos/app-$version.tar  /opt/app/
COPY ./webapp.war /opt/tomcat/webapps
RUN yum install –y tomcat  && \
      useradd tomcat && \
      chown tomcat /opt/tomcat && \
      yum cleanup && rm /tmp/*

USER tomcat
WORKDIR /opt/tomcat
VOLUMES /opt/tomcat/logs
EXPOSE [ 8080, 8001 ]
ENTRYPOINT [ "/bin/sh -c" ]
CMD  [ "catalina.sh", "start" ]
```




```
podman build –t my-tomcat .  <- Build-Dir

podman tag <registry>/<name>:<version> <name>

podman push  <registry>/<name>:<version>
```

build image

Verwenden von YUM/DNF beim Image-Build

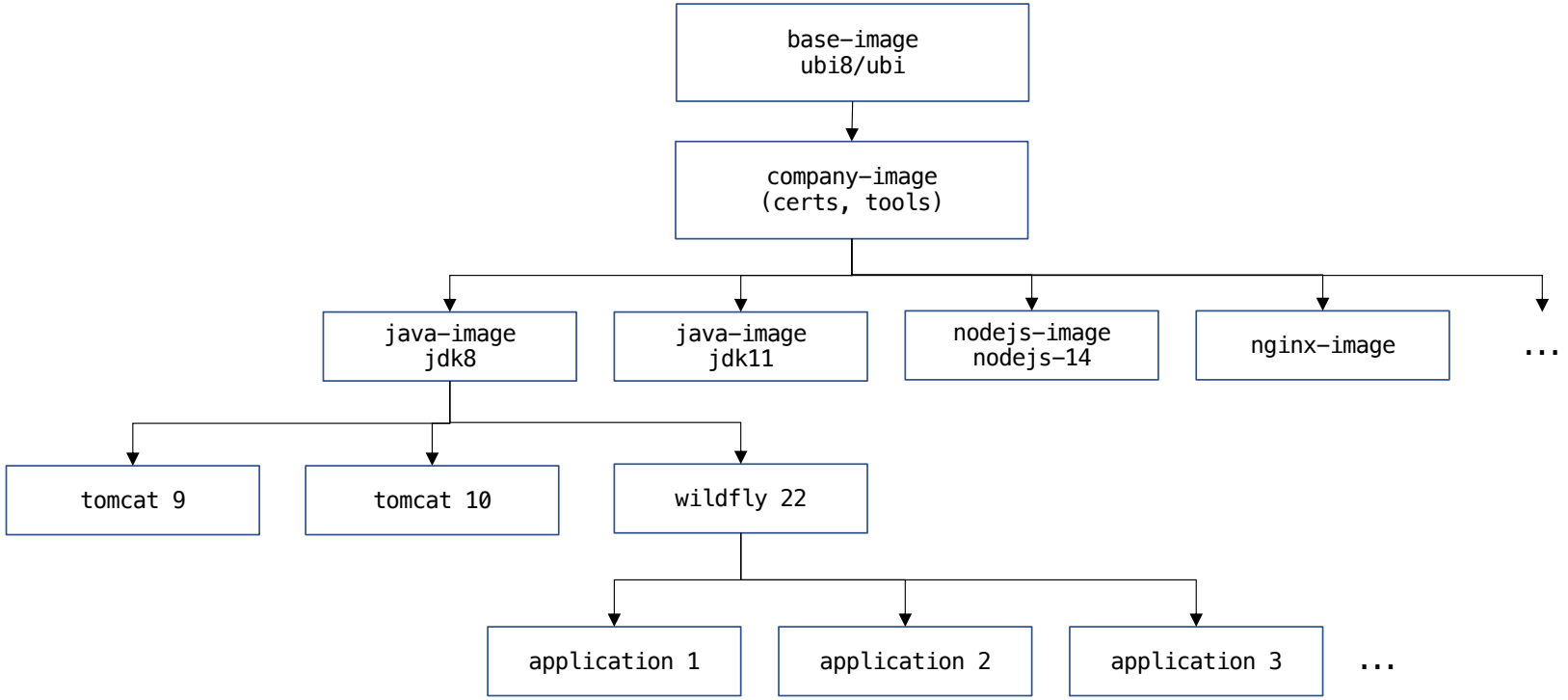
```
$ podman run --rm ubi8/ubi cat /etc/yum.repos.d/ubi.repo
[ubi-8-baseos]
name = Red Hat Universal Base Image 8 (RPMs) - BaseOS
baseurl = https://cdn-ubi.redhat.com/content/public/ubi/dist/ubi8/8/$basearch/baseos/os
enabled = 1
gpgkey = file:///etc/pki/rpm-gpg/RPM-GPG-KEY-redhat-release
gpgcheck = 1
...
```

yum "telefoniert" nach aussen !

Lösung: beim podman-build andere yum-Konfiguration (z.B. vom Host) mounten !
Bei Verwendung von Satellite/Subscriptions ggf. auch die notwendigen Zertifikate/GPG Schlüssel.

```
$ sudo podman build –v /etc/yum.repos.d:/etc/yum.repos.d –v /etc/pki:/etc/pki –v /etc/rhsm:/etc/rhsm .
```

Beispiel: Image – Vererbung



Änderungen an einem Basis-Image erfordern Rebuild der davon abhängigen Images !

image tree

Container in Openshift:

- beliebige User-Id RUN chmod - R 0770 ....
- Group-Id 0 (root) RUN chgrp –R 0
- Ports > 1024

```
apiVersion: project.openshift.io/v1
kind: Project
metadata:
  annotations:
    openshift.io/sa.scc.mcs: s0:c26,c15
    openshift.io/sa.scc.supplemental-groups: 1000680000/10000
    openshift.io/sa.scc.uid-range: 1000680000/10000
```

```
# oc exec pgadmin-778c479f79-tfbqn -- id
uid=1000680000(1000680000) gid=0(root) groups=0(root),1000680000
```

NFS-Mount →

```
# ls -al /mnt/nfs/apps/pgadmin
-rw-r--r-- 1 1000680000 root 124K Nov 27 01:03 access_log
-rw-r--r-- 1 1000680000 root  853 Nov 27 00:44 config_local.py
-rw-r--r-- 1 1000680000 root 1.2K Nov 27 00:46 error_log
```

https://cloud.redhat.com/blog/a-guide-to-openshift-and-uids

Lokales Testen eines Containers: podman run --user 1000680000:0 <image>

https://access.redhat.com/RegistryAuthentication

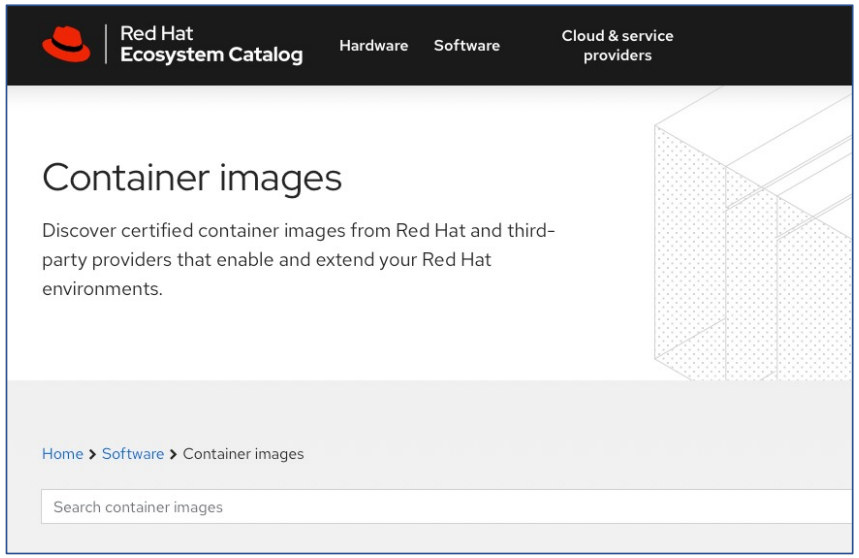
Red Hat Registries

Red Hat distributes container images through three different container registries:

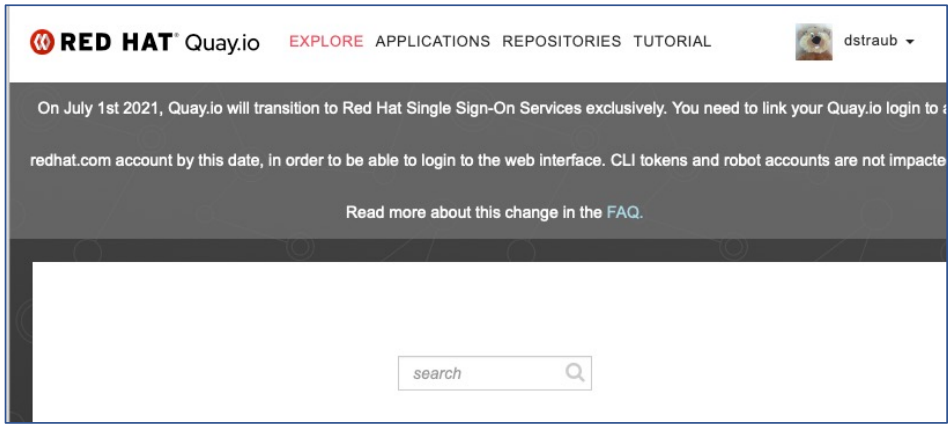
Registry	Content	Supports unauthenticated access	Supports Red Hat login	Supports registry tokens
registry.access.redhat.com	Red Hat products	Yes	No	No
registry.redhat.io	Red Hat products	No	Yes	Yes
registry.connect.redhat.com	Third-party products	No	Yes	Yes

Although both registry.access.redhat.com and registry.redhat.io hold essentially the same container images, some images that require a subscription are only available from registry.redhat.io.

https://catalog.redhat.com/software/containers/explore



https://quay.io



redhat registries

- Openshift
  Orchestrierungsservice zur Bereitstellung, Verwaltung und Skalierung von Container-Anwendungen

- Deklaratives System
  Status wird in Resourcen (YAML/JSON) definiert und durch Controller hergestellt
  IaC – Infrastructure as Code (https://blog.nelhage.com/post/declarative-configuration-management)

```
$ oc api-resources -o name --sort-by=name
alertmanagers.monitoring.coreos.com
apiservers.config.openshift.io
apiservices.apiregistration.k8s.io
appliedclusterresourcequotas.quota.openshift.io
authentications.config.openshift.io
authentications.operator.openshift.io
baremetalhosts.metal3.io
bindings
brokertemplateinstances.template.openshift.io
buildconfigs.build.openshift.io
builds.build.openshift.io
builds.config.openshift.io
catalogsources.operators.coreos.com
certificatesigningrequests.certificates.k8s.io
cloudcredentials.operator.openshift.io
clusterautoscalers.autoscaling.openshift.io
clusternetworks.network.openshift.io
clusteroperators.config.openshift.io
...
```

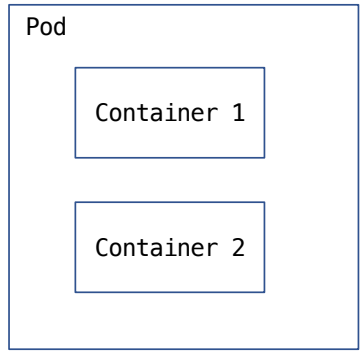
Pod
Replicatset
Deployment
Service
Route
PersistenceVolumeClaim
Secrets
Configmaps

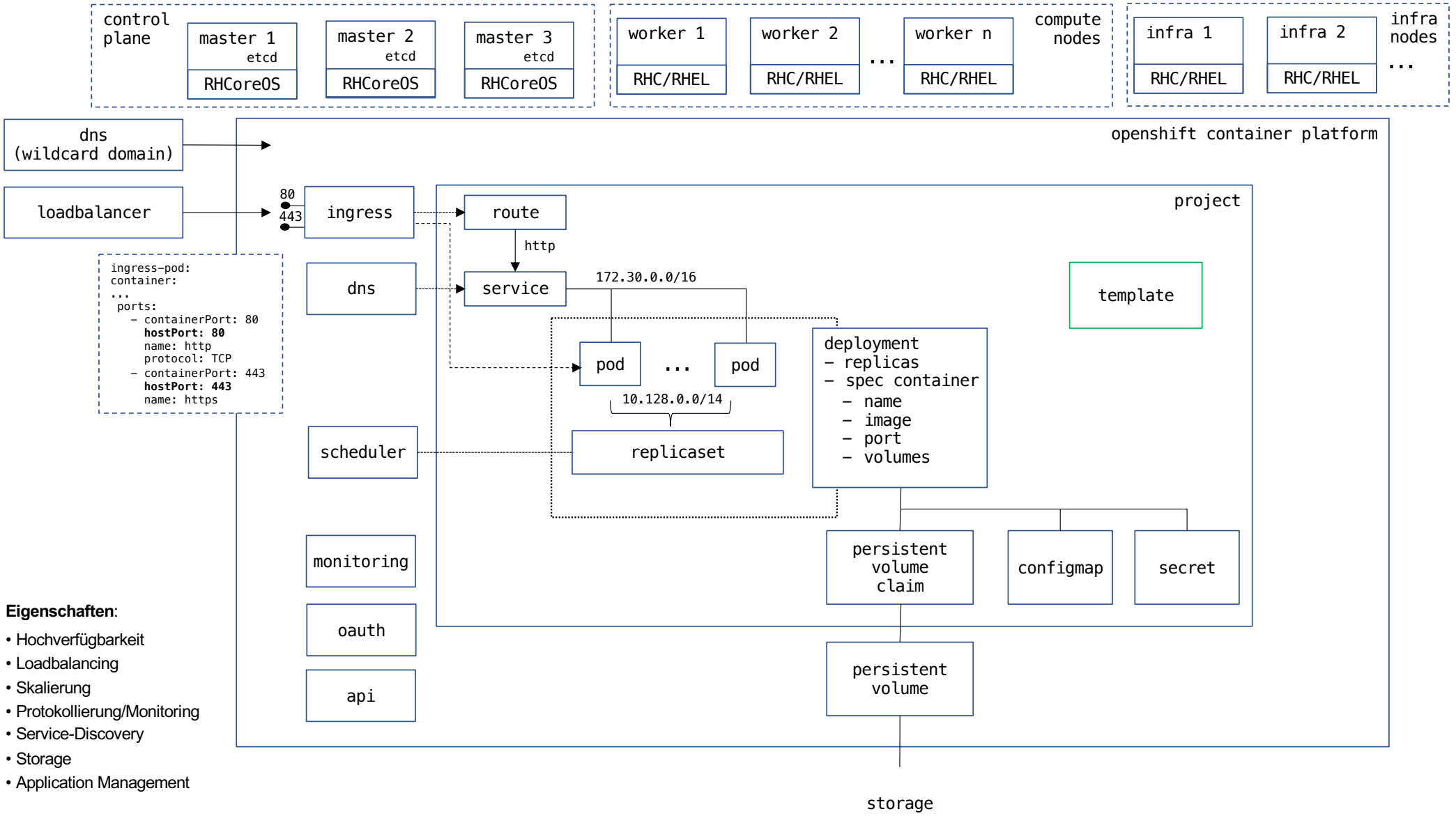
Imagestream
BuildConfig

Node
PersistenceVolume

Operator
CustomResourceDefinition

- kleinste Workload-Resource ist der Pod → Gruppe von unterschiedlichen Containern
- meistens 1:1 Beziehung
  (1 Pod enthält ein Container)





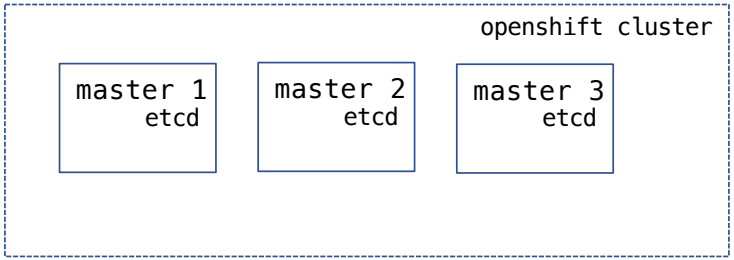
Eigenschaften:

- Hochverfügbarkeit
- Loadbalancing
- Skalierung
- Protokollierung/Monitoring
- Service-Discovery
- Storage
- Application Management

Openshift Resources (Manifest)

```
apiVersion: v1
kind: < Resource Type >
metadata:
  name: <name>
  namespace: <namespace>
  annotations:
    ...
  labels:
    app: <application-name>
    ...
spec:
  ...
  selector:
    <key>: <value>
  ...
status:
  ...
```

oc create

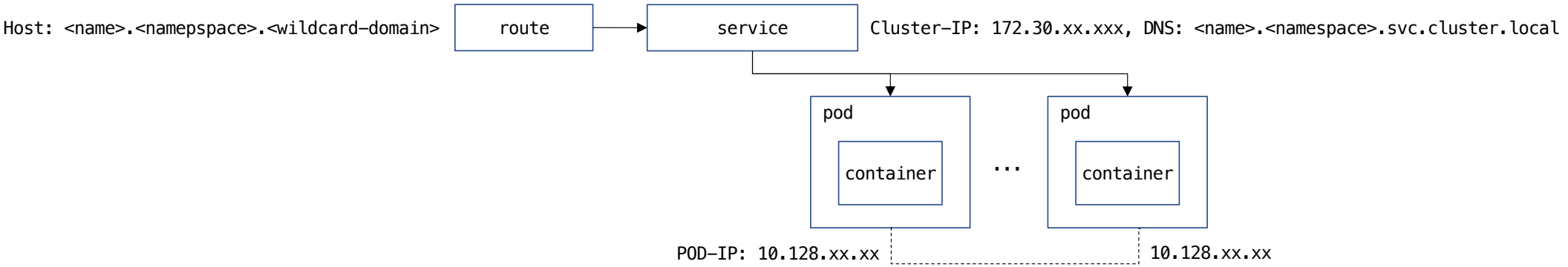



```
apiVersion: v1
kind: Pod
metadata:
  name: webserver
  namespace: do180
  labels:
    app: webserver
spec:
  containers:
  - image: quay.io/danielstraub/webserver:do180
    imagePullPolicy: Always
    ports:
    - containerPort: 8080
      protocol: TCP
  ...
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webserver
  namespace: do180
  labels:
    app: webserver
spec:
  replicas: 2
  selector:
    matchLabels:
      app: webserver
  template:
    metadata:
      labels:
        app: webserver
    spec:
      containers:
      - name: webserver
        image: quay.io/danielstraub/webserver:do180
        ports:
        - containerPort: 8080
          name: http
          protocol: TCP
```

```yaml
apiVersion: v1
kind: Service
metadata:
  name: webserver
  namespace: do180
  labels:
    app: webserver
spec:
  type: ClusterIP
  selector:
    app: webserver
  ports:
  - name: http
    port: 80
    protocol: TCP
    targetPort: http
```

```yaml
apiVersion: route.openshift.io/v1
kind: Route
metadata:
  name: webserver
  namespace: do180
  labels:
    app: webserver
  name: webserver
spec:
  host: do180.apps.eu410.prod.nextcle.com
  to:
    kind: Service
    name: webserver
  port:
    targetPort: http
```



```
$ ls
deployment.yml  route.yml  service.yml

$ oc create -f .
deployment.apps/webserver created
route.route.openshift.io/webserver created
service/webserver created

$ oc get all
NAME                             READY   STATUS    RESTARTS   AGE
pod/webserver-86bb596c54-54865   1/1     Running   0          21s

NAME                 TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)   AGE
service/webserver    ClusterIP   172.30.89.171   <none>        80/TCP    7m49s

NAME                         READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/webserver    1/1     1            1           7m49s

NAME                                    DESIRED   CURRENT   READY   AGE
replicaset.apps/webserver-86bb596c54    1         1         1       21s

NAME                                HOST/PORT                             PATH   SERVICES    PORT   TERMINATION   WILDCARD
route.route.openshift.io/webserver   do180.apps.eu410.prod.nextcle.com          webserver   http

$ curl http://do180.apps.eu410.prod.nextcle.com
Hello, DO180
```

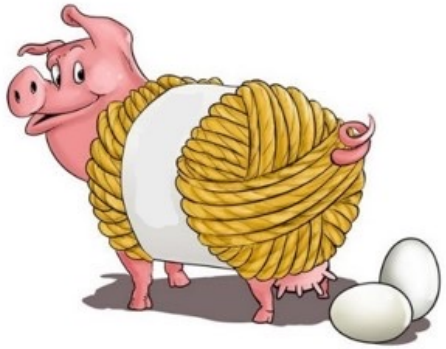
sample webserver

```
$ oc new-app --help
Create a new application by specifying source code, templates, and/or images

...

Usage:
  oc new-app (IMAGE | IMAGESTREAM | TEMPLATE | PATH | URL ...) [flags]


Beispiele:

$ oc new-app https://quay.io/dstraub/nginx --name ngnix

$ oc new-app php:7.3~https://github.com/.../php-hello
```

Container-Image

Builder-Image (s2i)

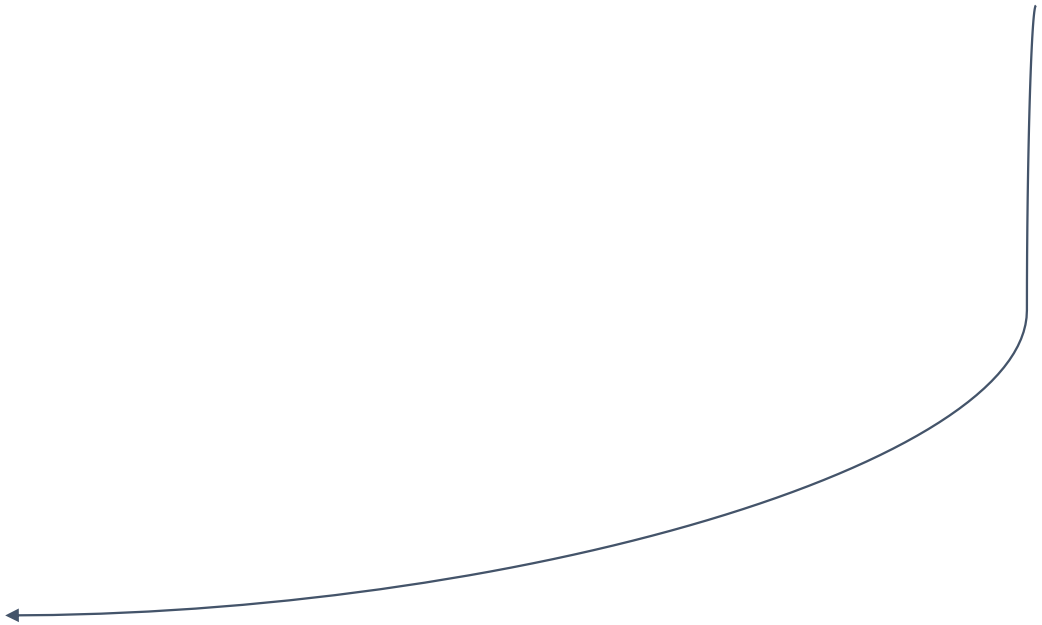
Git-Projekt (Source)



- Deployment
- Service
- Imagestream
- BuildConfig

```
$ oc create --help
Usage:
  oc create -f FILENAME [flags]
...
Available Commands:
  ...
  configmap           Create a config map from a local file, directory or literal value
  deployment          Create a deployment with the specified name
  route               Expose containers externally via secured routes
  secret              Create a secret using specified subcommand
  service             Create a service using a specified subcommand

$ oc create deployment --image=quay.io/danielstraub/webserver --port=8080 -o yaml webserver
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webserver
  labels:
    app: webserver
spec:
  replicas: 1
  selector:
    matchLabels:
      app: webserver
  template:
    metadata:
      labels:
        app: webserver
    spec:
      containers:
      - image: quay.io/danielstraub/webserver
        ports:
        - containerPort: 8080
```

```
$ oc create deployment --image=quay.io/danielstraub/toolbox -o yaml toolbox -- bash -c 'sleep infitity'
apiVersion: apps/v1
kind: Deployment
metadata:
  name: toolbox
  labels:
    app: toolbox
spec:
  replicas: 1
  selector:
    matchLabels:
      app: toolbox
  template:
    metadata:
    labels:
        app: toolbox
    spec:
      containers:
      - command:
        - bash
        - -c
        - sleep infitity
        image: quay.io/danielstraub/toolbox
        name: toolbox
```

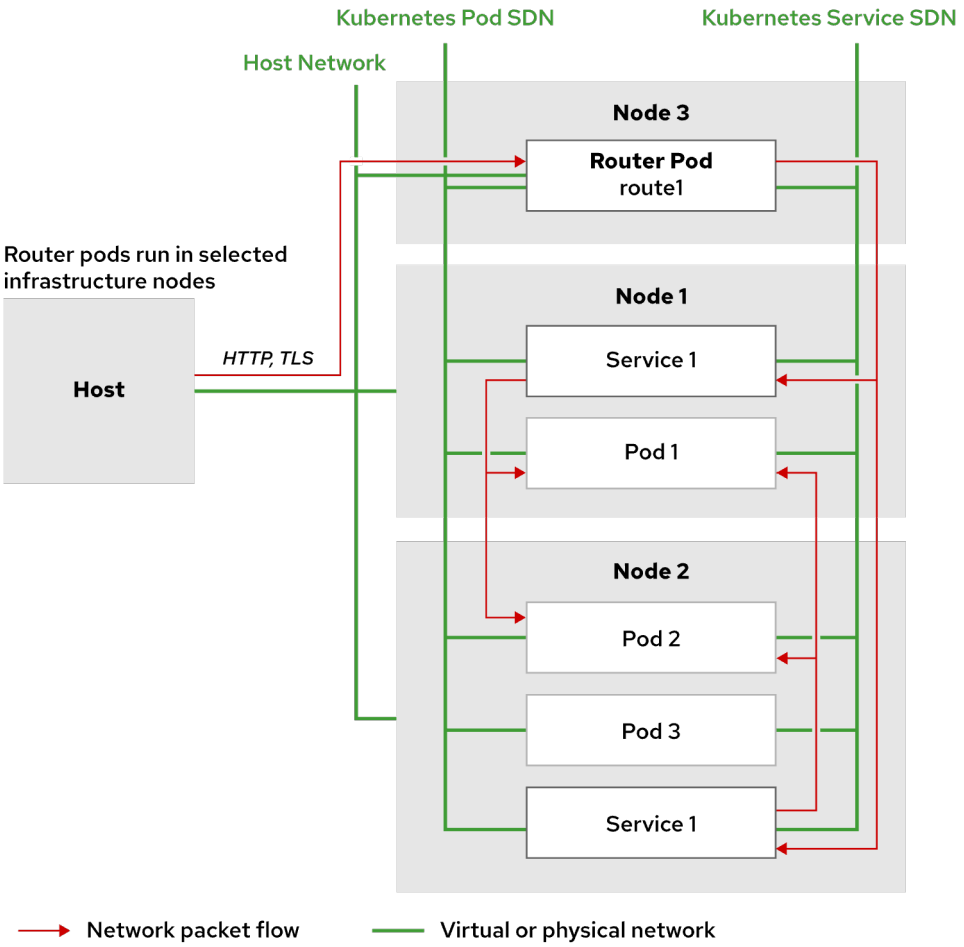


```
$ oc create service clusterip webserver --tcp=80:8080 -o yaml
apiVersion: v1
kind: Service
metadata:
  name: webserver
  labels:
    app: webserver
spec:
  ports:
  - name: 80-8080
    port: 80
    protocol: TCP
    targetPort: 8080
  selector:
    app: webserver
  type: ClusterIP

$ oc create route edge --hostname do180.<wildcard-doamin> --service webserver --insecure-policy=Redirect webserver -o yaml
apiVersion: route.openshift.io/v1
kind: Route
metadata:
  name: webserver
  labels:
    app: webserver
spec:
  host: do180.apps.eu410.prod.nextcle.com
  port:
    targetPort: http
  tls:
    insecureEdgeTerminationPolicy: Redirect
    termination: edge
  to:
    name: webserver
```

```
oc create route -help

Available Commands:
  edge        Create a route that uses edge TLS termination
  passthrough Create a route that uses passthrough TLS termination
  reencrypt   Create a route that uses reencrypt TLS termination
```

- `oc login –u <user> –p <password> <api-server-url>`
- `oc new-project <name>`
- `oc create –f <resource-yml>`
- `oc status`
- `oc get <resource-type> [ <resource-name> ]`
  - `oc get pods`
  - `oc get deployment`
  - `oc get svc <service>`
  - `oc get events`
- `oc describe <resource-type> <resource-name>`
- `oc expose svc <service-name>`
- `oc logs <podname>`
- `oc exec –it <podname> -- <program>`
- `oc rsh <podname>`
- `oc port-forward <podname> <local-port>:<remote-port>`
- `oc new-app <☺anything☺>`
- `oc delete <resource-type> <resource-name>`
- `oc rollout latest deployment <deployment-name>`

https://docs.openshift.com/container-platform/4.12/cli_reference/openshift_cli/developer-cli-commands.html



route and service

```
$ oc expose service <service>
```

console-openshift-console.apps.eu46.prod.nextcle.com

```
Route:  <service>-<project>.<wildcard-domain>
```

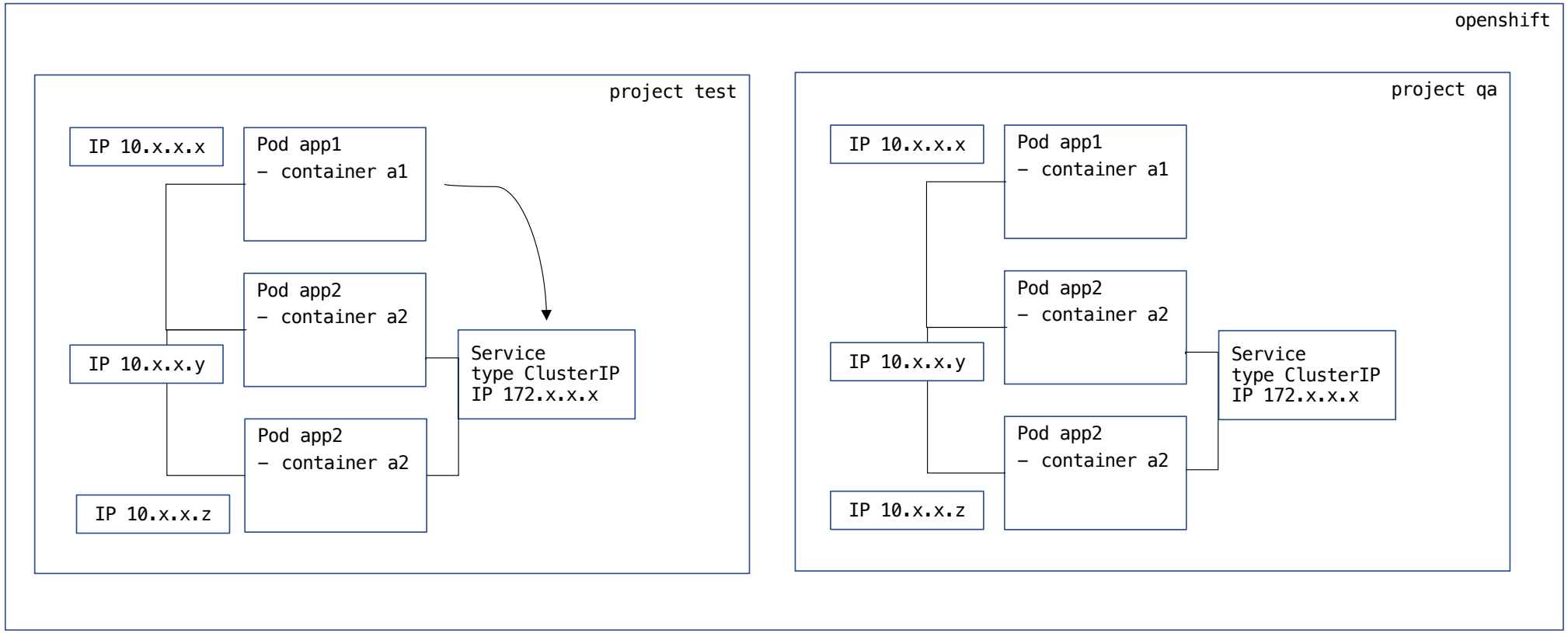
← Wildcard-Domain im DNS

```
$ oc expose service <service> --hostname=<domain>
```

```
$ nslookup dummy.apps.eu45.prod.nextcle.com
Name:      dummy.apps.eu45.prod.nextcle.com
Address: 161.156.16.195

$ nslookup do180.ctrlaltdel.de
Name:      do180.ctrlaltdel.de
Address: 161.156.16.195
```

← weiterer A-Record auf Wildcard-Domain ...

```
$ curl -H 'Host: do180.ctrlaltdel.de' 161.156.16.195
<html>
<head><title>Index of /</title></head>
...

$ oc expose service nginx --name do180 --hostname=do180.ctrlaltdel.de
$ curl do180.ctrlaltdel.de
<html>
<head><title>Index of /</title></head>
...
```



DNS:
A: person.test.svc.cluster.local
SVC: _443._tcp.https.<service>.test.svc.cluster.local

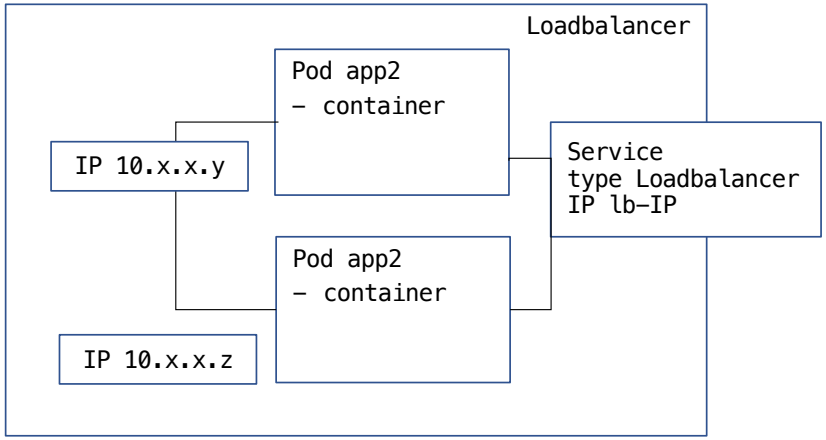
/etc/resolv.conf:
search test.svc.cluster.local svc.cluster.local ...

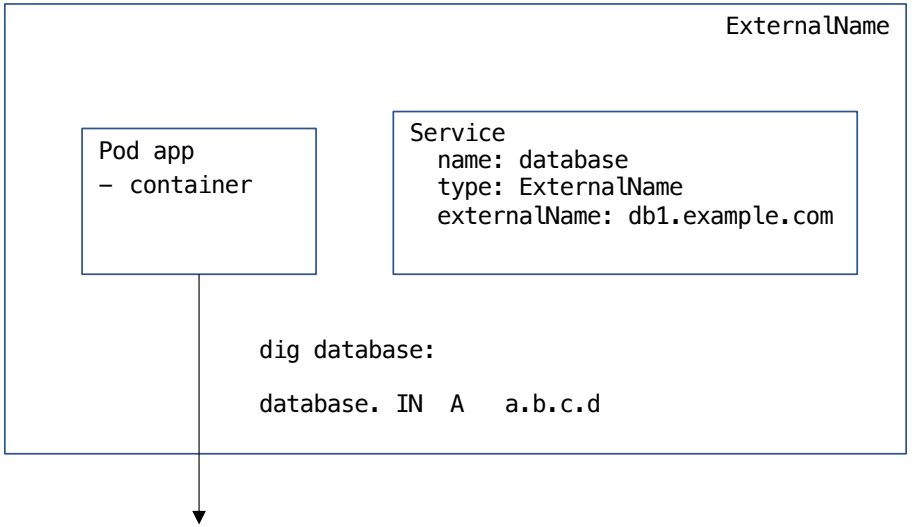
DNS:
A: person.qa.svc.cluster.local
SVC: _443._tcp.https.<service>.qa.svc.cluster.local

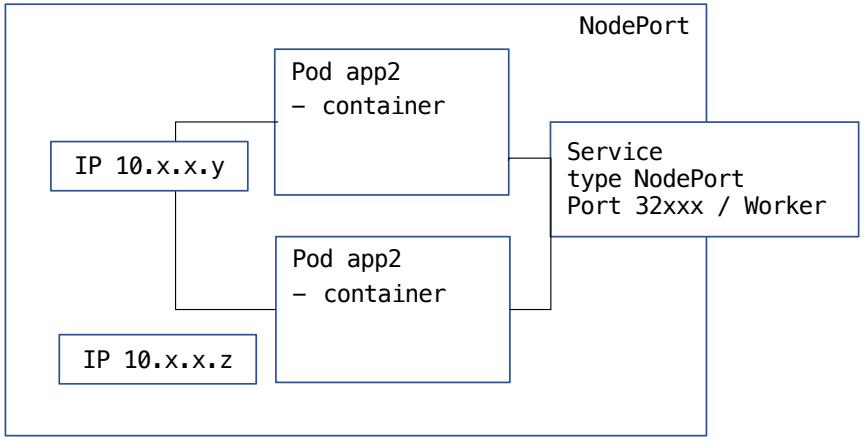
/etc/resolv.conf:
search qa.svc.cluster.local svc.cluster.local ...

→ einfacher DNS-Lookup nach <service> in jedem Projekt

nur Cloud-Provider ! (oder MetalLB-Operator)







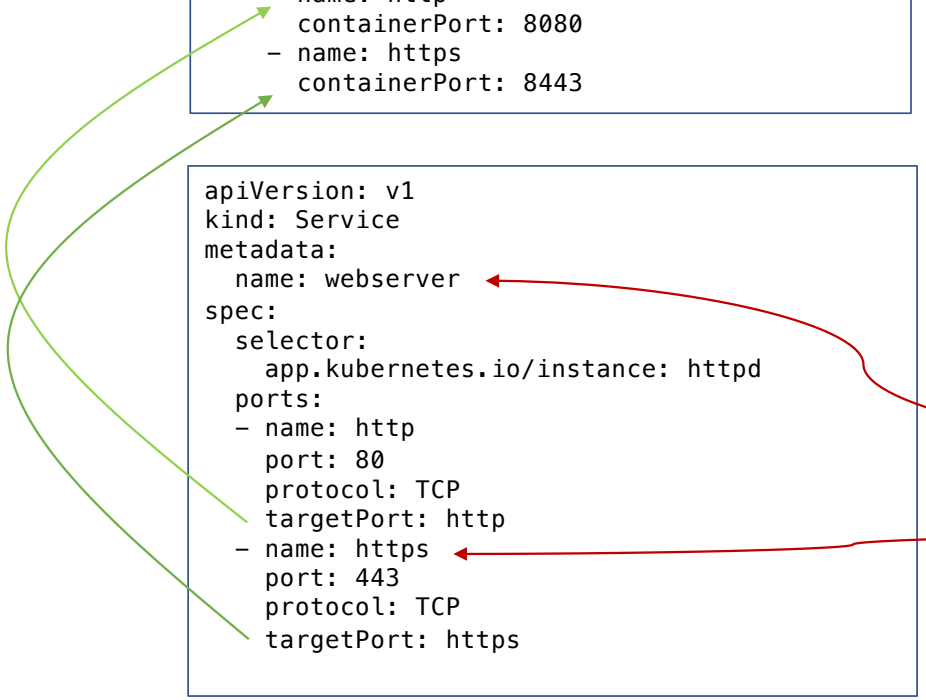
db1.example.com
a.b.c.d

Pod | Service | Route

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: webserver
  labels:
    app.kubernetes.io/instance: httpd
spec:
  containers:
  - name: httpd
    image: ...
    ports:
    - name: http
      containerPort: 8080
    - name: https
      containerPort: 8443
```

```yaml
apiVersion: v1
kind: Service
metadata:
  name: webserver
spec:
  selector:
    app.kubernetes.io/instance: httpd
  ports:
  - name: http
    port: 80
    protocol: TCP
    targetPort: http
  - name: https
    port: 443
    protocol: TCP
    targetPort: https
```

```yaml
apiVersion: route.openshift.io/v1
kind: Route
metadata:
  name: webserver-secure
spec:
   host: webserver.apps....
   to:
     kind: Service
     name: webserver
   port:
     target-port: https
```



route / service

Container in Openshift:

- beliebige User-Id RUN chmod - R 0770 ....
- Group-Id 0 (root) RUN chgrp –R 0
- Ports > 1024

```
apiVersion: project.openshift.io/v1
kind: Project
metadata:
  annotations:
    openshift.io/sa.scc.mcs: s0:c26,c15
    openshift.io/sa.scc.supplemental-groups: 1000680000/10000
    openshift.io/sa.scc.uid-range: 1000680000/10000
```

```
# oc exec pgadmin-778c479f79-tfbqn -- id
uid=1000680000(1000680000) gid=0(root) groups=0(root),1000680000
```

NFS-Mount →

```
# ls -al /mnt/nfs/apps/pgadmin
-rw-r--r-- 1 1000680000 root 124K Nov 27 01:03 access_log
-rw-r--r-- 1 1000680000 root  853 Nov 27 00:44 config_local.py
-rw-r--r-- 1 1000680000 root 1.2K Nov 27 00:46 error_log
```

https://cloud.redhat.com/blog/a-guide-to-openshift-and-uids

Lokales Testen eines Containers: podman run --user 1000680000:0 <image>

Abweichende User-Id : Serviceaccount mit Security Context Constraint 'anyuid' notwendig :

```
apiVersion:
rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: scc-anyuid
rules:
- apiGroups:
  - security.openshift.io
  resourceNames:
  - anyuid
  resources:
  - securitycontextconstraints
  verbs:
  - use
```

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: gitea:anyuid
  namespace: apps
roleRef:
  kind: ClusterRole
  name: scc-anyuid
  apiGroup: rbac.authorization.k8s.io
subjects:
- kind: ServiceAccount
  name: gitea
  namespace: apps
```

```
apiVersion: v1
kind: ServiceAccount
metadata:
  name: gitea
  namespace: apps
```

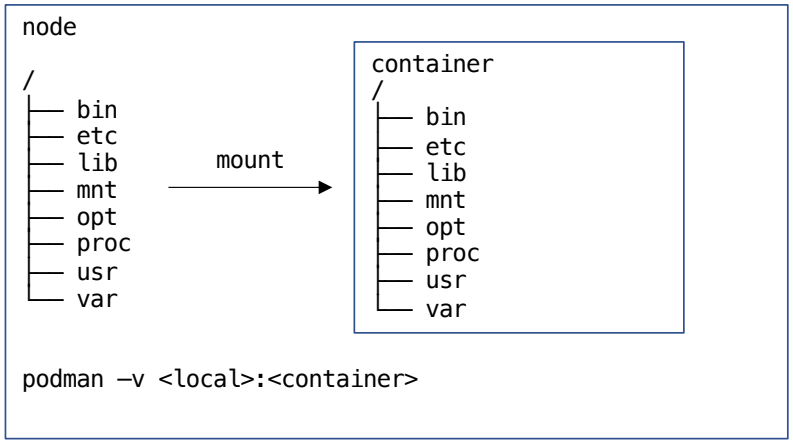
erstellt von Cluster-Administrator !

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: gitea
  namespace: apps
  ...
spec:
  template:
    spec:
      serviceAccountName: gitea
  ...
```

```
# oc exec gitea-7dcdc5c445-w9qmv -- id
uid=65534(nobody) gid=65534(nobody) groups=65534(nobody),0(root)

# ll /mnt/nfs/repos/ds
drwxr-xr-x 7 nobody nobody 119 Nov 26 16:57 admin.git/
drwxr-xr-x 7 nobody nobody 119 Nov 26 16:12 calibre.git/
drwxr-xr-x 7 nobody nobody 119 Nov 17 16:02 gitea.git/
...
```

UserId aus Container-Config !

Volumes




```
kind: Pod
...
spec:
  containers:
     ...
     volumeMounts:
       – mountPath: <path_container_fs>
         name: <name>
      ...
  volumes:
     – name: <volume>
       <volume–type>:
          <volume–attributes>
```

→ https://kubernetes.io/docs/concepts/storage/volumes/

Volume=Types
- emptyDir
- hostPath (system:openshift:scc:hostmount–anyuid !)
- configMap
- secret
- peristentVolumeClaim

...

Secrets:

- Passwörter, Token, Zertifikate ...
- typisiert: basic-auth, dockercfg, tls, opaque
- Inhalte sind base64-encodiert, nicht verschlüsselt

ConfigMap:

- generische Key-Value Daten

→ max. Größe 1 MB
→ nur innerhalb eines Project (NS) sichtbar

```
apiVersion: v1
kind: Secret
metadata:
  name: ...
  namespace: ...
data:
  password: MTIzNDU2
type: Opaque
```

```
# echo MTIzNDU2 | base64 –d
123456
```

beim Anlegen im Manifest:

```
stringData:
  password: 123456
```

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ...
  namespace: …
  annotion:
binaryData:
  keystore: |
    7oAMCAQICCF7Dt6ZDf6TgMA0GCSqGSIb3DQEBBQUAMEI1ZSQUla
    MTEQMA4GA1UECwwHU ...
data:
  HOME: /usr/share/nginx
  default.conf: |
    server {
      listen 8080 default_server;
      server_name _;
      location / {
         root   /usr/share/nginx/html;
         index  index.html index.htm;
      }
    }
```

```
$ oc create configmap <cm-name> --from-literal FOO=BAR

$ oc create configmap <cm-name> --from-file <path>

$ oc create secret docker-registry quayio --docker-server quay.io --docker-username <user> --docker-password <password>
$ oc create –f cm.yml  | oc apply –f cm.yml
```

Secrets: Verwendung als Umgebungs-Variable

```
apiVersion: v1
kind: Pod
metadata:
  name: secret-env-pod
spec:
  containers:
  - name: mycontainer
    image: redis
    envFrom:
      configMapRef:
        name: < cm >
    env:
    - name: SECRET_USERNAME
      valueFrom:
        secretKeyRef:
           name: mysecret
           key: username
    - name: SECRET_PASSWORD
      valueFrom:
        secretKeyRef:
           name: mysecret
           key: password
```

ConfigMap: Verwendung als Konfigurations-Dateien

```
apiVersion: apps/v1
kind: Pod
metadata:
  name: nginx
spec:
  containers:
  - name: nginx
    container: nginx
    volumeMounts:
    - mountPath: /etc/nginx/conf.d
      name: config
  volumes:
   - name: config
     configMap:
       name: nginx-config
```

```
apiVersion: apps/v1
kind: Pod
metadata:
  name: wildfly-standalone-xml
spec:
  containers:
  - name: wildfly
    container: nginx
    volumeMounts:
    - mountPath: /opt/wildfly/standalone/configuation
      name: standalone-xml
      subPath: standalone.xml
  volumes:
   - name: standalone-xml
     configMap:
       name: standalone-xml
```

```
$ oc set env deployment/<deployment-name> --from cm/<cm-name>

$ oc set volume deployment/<deployment-name> -add -t configmap -m /etc/nginx/conf.d --name config --configmap-name <cm-name>
```

Persistence

Administrator erzeugt PersistentVolume

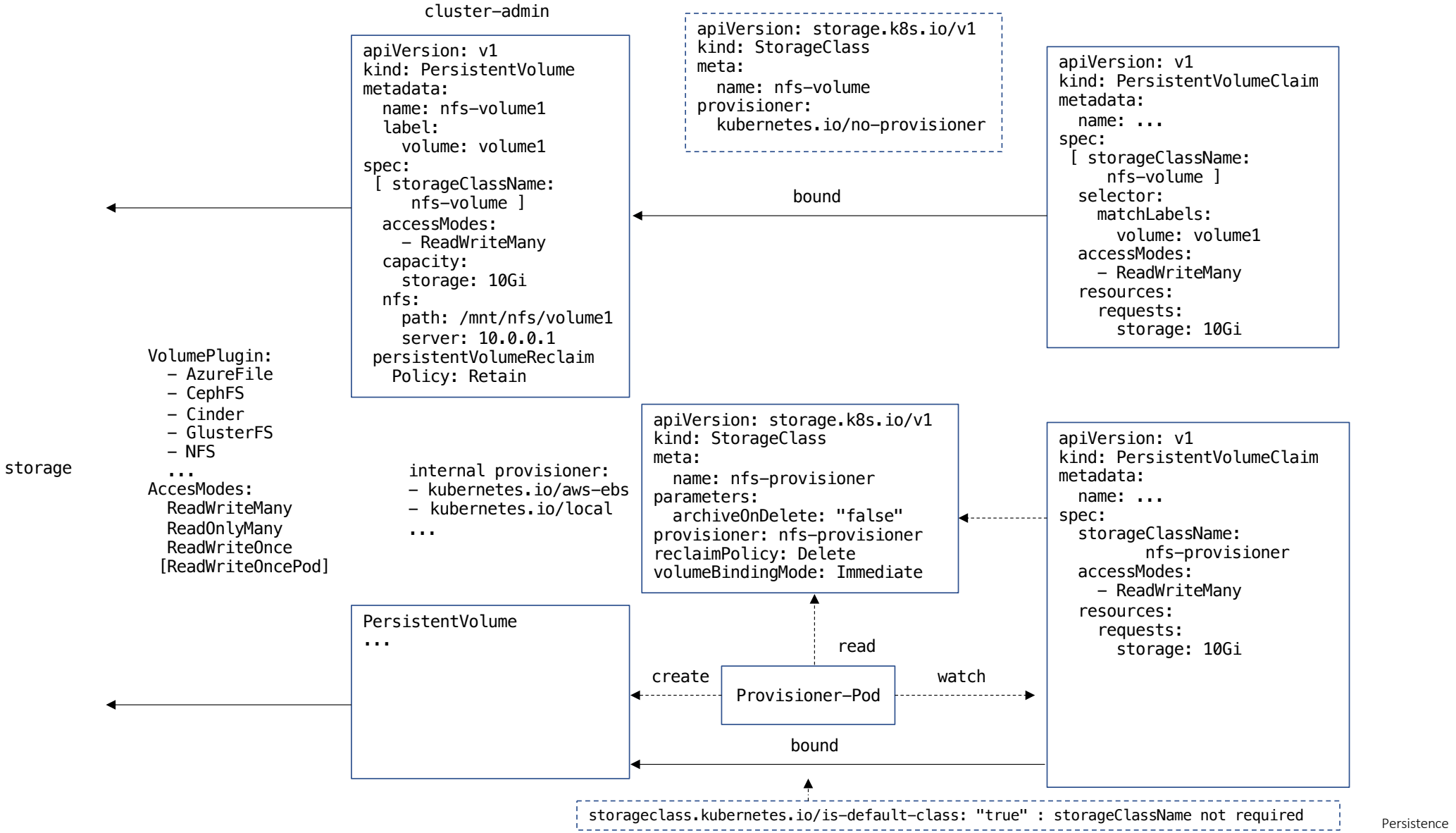
```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: nfs-data
  labels:
    volume: nfs-data
spec:
  accessModes:
    - ReadWriteMany
  capacity:
    storage: 10Gi
  nfs:
    path: /mnt/nfs/data
    server: 10.0.0.1
  persistentVolumeReclaimPolicy: Retain
```

Anwendung erstellt Anforderung

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: html-data
spec:
  accessModes:
    - ReadWriteMany
  selector:
    matchLabels:
      volume: nfs-data
  resources:
    requests:
      storage: 10Gi
```

und verwendet dieses im Deployment / Pod

```
kind: Deployment
...
    containers:
      - name: webserver
        ...
        volumeMounts:
         - mountPath: /usr/share/ngnix/html
           name: html
    volumes:
      - name: html
        persistentVolumeClaim:
          claimName: html-data
```


cluster-admin
apiVersion: v1
kind: PersistentVolume
metadata:
name: nfs-volume1
label:
volume: volume1
spec:
[storageClassName:
nfs-volume]
accessModes:
- ReadWriteMany
capacity:
storage: 10Gi
nfs:
path: /mnt/nfs/volume1
server: 10.0.0.1
persistentVolumeReclaim
Policy: Retain
apiVersion: storage.k8s.io/v1
kind: StorageClass
meta:
name: nfs-volume
provisioner:
kubernetes.io/no-provisioner
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
name: ...
spec:
[storageClassName:
nfs-volume]
selector:
matchLabels:
volume: volume1
accessModes:
- ReadWriteMany
resources:
requests:
storage: 10Gi
bound
storage
VolumePlugin:
- AzureFile
- CephFS
- Cinder
- GlusterFS
- NFS
...
AccesModes:
ReadWriteMany
ReadOnlyMany
ReadWriteOnce
[ReadWriteOncePod]
internal provisioner:
- kubernetes.io/aws-ebs
- kubernetes.io/local
...
apiVersion: storage.k8s.io/v1
kind: StorageClass
meta:
name: nfs-provisioner
parameters:
archiveOnDelete: "false"
provisioner: nfs-provisioner
reclaimPolicy: Delete
volumeBindingMode: Immediate
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
name: ...
spec:
storageClassName:
nfs-provisioner
accessModes:
- ReadWriteMany
resources:
requests:
storage: 10Gi
PersistentVolume
...
read
create
Provisioner-Pod
watch
bound
storageclass.kubernetes.io/is-default-class: "true" : storageClassName not required
Persistence

Liveness / Readiness / Startup Probes

- liveness : Container wird bei negativen Ergebnis neu gestartet `.spec.containers.livenessProbe`
- readiness: Route/Service wird aktiviert/deaktiviert `.spec.containers.readinessProbe`
- startup: liveness/readiness sind deaktiviert bis startup positiv ist `.spec.containers.startupProbe`
  Container wird bei neg. Startup-Probe sofort beendet

Probes:

```
exec:
  command:
  - cat
  - /tmp/ready
initialDelaySeconds: 5
periodSeconds: 5
```

```
httpGet:
  path: /healthz
  port: healthz-port
  scheme: https
  httpHeaders: ...
failureThreshold: 1
periodSeconds: 10

200 <= status < 400
```

```
tcpSocket:
  port: 5432
initialDelaySeconds: 15
periodSeconds: 20
```

- initialDelaySeconds: Zeitdauer bis zur ersten liviness/readiness Probe
- periodSeconds: Intervall zur Ausführung der Proben (default 10 sec)
- timeoutSeconds: max. Timeout bei einer Probe (default 1 sec)
- successThreshold: Schwellwert ab wann aufeinderfolgende positive Proben als Erfolg gewertet werden (default 1)
- failureThreshold: Schwellwert ab wann aufeinderfolgende negative Proben als Ausfall gewertet werden (default 3)

```yaml
kind: Deployment
apiVersion: apps/v1
metadata:
  name: webserver
spec:
  ...
  template:
    spec:
      containers:
      - name: webserver
        image: webserver
        imagePullPolicy: Always
        ports:
        - name: http
          containerPort: 8080
          protocol: TCP
        readinessProbe:
          failureThreshold: 3
          httpGet:
            path: /healthz
            port: http
            scheme: HTTP
          periodSeconds: 10
          successThreshold: 1
          timeoutSeconds: 1
        ...
```

nginx.conf

```
server {
  listen 8080 default_server;
  server_name _;
  location / {
    root   /usr/share/nginx/html;
    index  index.html index.htm;
  }

  location /healthz {
    access_log off;
    return 200;
  }

}
```

(Compute) Resources :

- Memory: number of bytes (quantity suffixes: E, P, T, G, M, k | Ei, Pi, Ti, Gi, Mi, Ki)

- CPU : millicores (m)

  millicores are the fractions of *time* of a single CPU (not the fraction of number of CPUs).
  Cgroups, and hence Docker, and hence Kubernetes, doesn't restrict CPU usage by assigning cores to processes (like VMs do), instead it restricts CPU usage by restricting the amount of time (quota over period) the process can run on each CPU (with each CPU taking up to 1000mcpus worth of allowed time).

  https://stackoverflow.com/questions/61851751/multi-threading-with-millicores-in-kubernetes
  https://sysdig.com/blog/troubleshoot-kubernetes-oom

```
apiVersion: v1
kind: Deployment
metadata:
...
template:
  spec:
   containers:
   - name: <name>
     resources:
       requests:
         memory: 64Mi
         cpu: 200m
       limits:
         memory: 128Mi
         cpu: 200m
```

Scheduling

Execution
(cgroups)

```
$ oc describe node master01
...
Allocatable:
  cpu:                3500m
  memory:             15268156Ki
Non-terminated Pods: (60 in total)
   CPU Requests CPU Limits Memory Requests Memory Limits
...
Allocated resources:
Resource           Requests      Limits
  --------           --------      ------
  cpu                2397m (68%)   0 (0%)
  memory             9347Mi (62%)  512Mi (3%)
```

resouce usage

Quotas und LimitRange:

```
$ oc create -f quotas.yml
$ oc describe resourcequotas quotas
Name:            quotas
Namespace:       demo
Resource         Used  Hard
--------         ----  ----
requests.cpu     0     100m
requests.memory  0     500M

$ oc create -f server.yml
deployment.apps/webserver created

$ oc get all
NAME                         READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/webserver    0/1     0            0           11s
...
$ oc get events
LAST SEEN   TYPE      REASON             OBJECT                           MESSAGE
50s         Warning   FailedCreate       replicaset/webserver-c48d6fbd    Error creating: pods "webserver-c48d6fbd-fh97s" is forbidden:
                                                                          failed quota: quotas: must specify requests.cpu,requests.memory

$ oc create -f limit.yml
limitrange/limits created
$ oc describe limitranges limits
Name:       limits
Namespace:  demo
Type        Resource  Min  Max  Default Request  Default Limit  Max Limit/Request Ratio
----        --------  ---  ---  ---------------  -------------  -----------------------
Container   cpu       -    -    50m              50m            -
Container   memory    -    -    200Mi            200Mi          -

$ oc rollout restart deployment webserver
deployment.apps/webserver restarted
```

```
apiVersion: v1
kind: ResourceQuota
metadata:
  name: quotas
spec:
  hard:
    requests.cpu:    100m
    requests.memory: 500M
```

```
apiVersion: v1
kind: LimitRange
metadata:
  name: limits
spec:
  limits:
  - type: Container
    default:
      memory: 200Mi
      cpu: 50m
    ...
```

Quotas:

```
$ oc rollout restart deployment webserver
deployment.apps/webserver restarted

$ oc get pods
NAME                         READY   STATUS    RESTARTS   AGE
webserver-789b574675-z4vsz   1/1     Running   0          56s

$ oc describe resourcequotas quotas
Name:            quotas
Namespace:       demo
Resource         Used   Hard
--------         ----   ----
requests.cpu     50m    100m
requests.memory  200Mi  500M

$ oc scale deployment webserver --replicas=3
deployment.apps/webserver scaled

$ oc get all
NAME                             READY   STATUS    RESTARTS   AGE
pod/webserver-789b574675-n5rp8   1/1     Running   0          12s
pod/webserver-789b574675-z4vsz   1/1     Running   0          2m10s

NAME                         READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/webserver    2/3     2            2           8m

$ oc describe resourcequotas quotas
Name:            quotas
Namespace:       demo
Resource         Used   Hard
--------         ----   ----
requests.cpu     100m   100m
requests.memory  400Mi  500M
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
...
spec:
  ...
  template:
    ...
    spec:
      containers:
      - image: quay.io...
        name: webserver
        resources:
          requests:
            cpu: 50m
            memory: 200Mi
```

https://docs.openshift.com/container-platform/4.10/applications/quotas/quotas-setting-per-project.html
https://docs.openshift.com/container-platform/4.10/applications/quotas/quotas-setting-across-multiple-projects.html
https://docs.openshift.com/container-platform/4.10/nodes/clusters/nodes-cluster-limit-ranges.html

Deployment-Strategien

- Rolling Updates : Pods werden der Reihe nach aktualisiert
- Recreate: existierende Pods werden beendet und neue gestartet

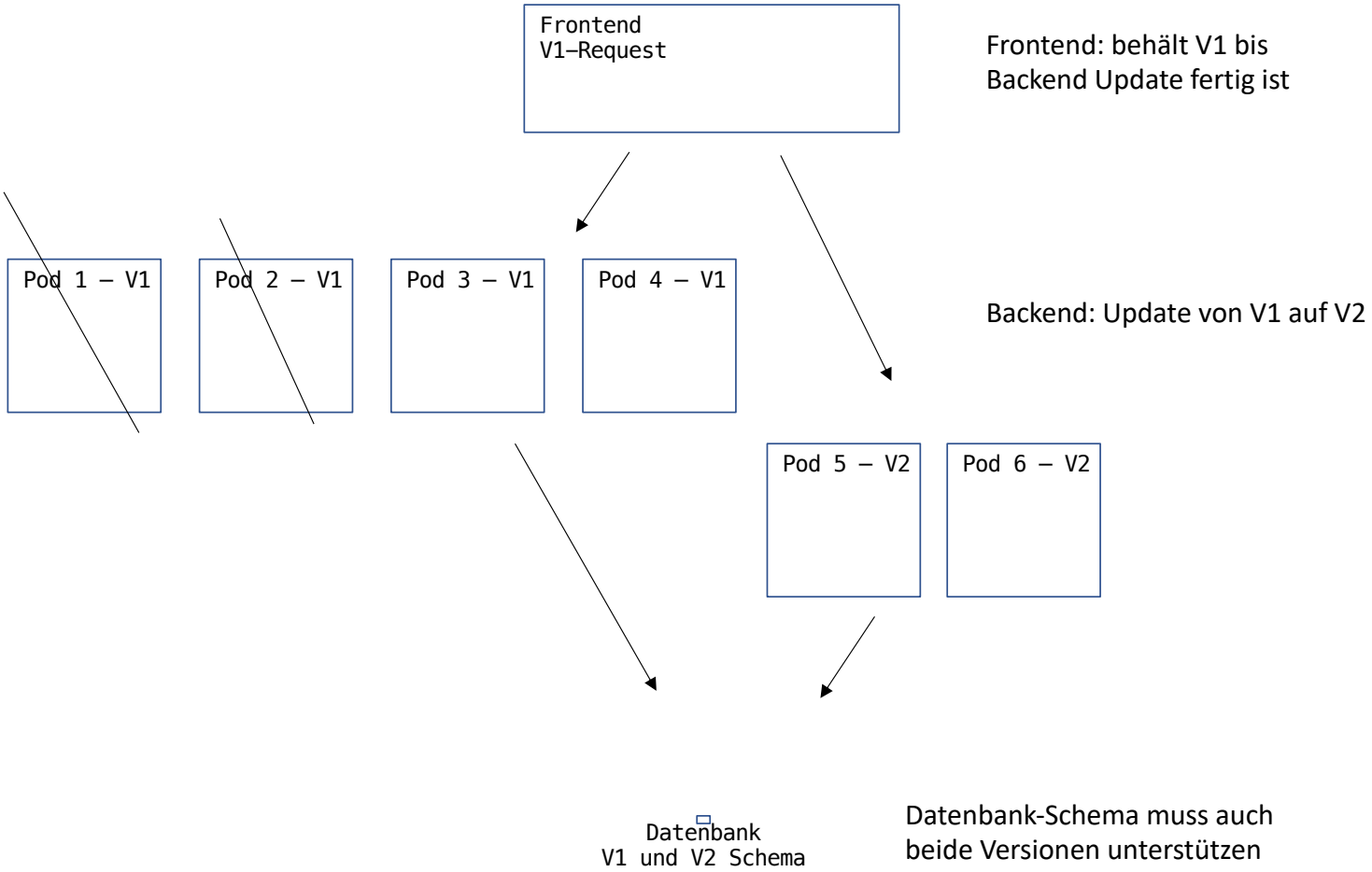
Beenden eines Pods:

- SIGTERM: Pod soll keine neuen Verbindungen annehmen und bestehenden Aktionen beenden
- SIGKILL: nach `terminationGracePeriodSeconds` (30s) wird der Pod beendet

```
kind: Deployment
metadata:
  name: ...
spec:
  revisionHistoryLimit: 3   (default: 10)
  replicas: 4
  strategy:
    type: RollingUpdate
    rollingUpdate:
      maxSurge: 1             ← max. 5 Pods aktiv
      maxUnavailable: 1
  ...
  template:
    spec:
      containers:
      - ...
      terminationGracePeriodSeconds: 30
```

```
oc rollout SUBCOMMAND (DEPLOYMENTCONFIG | DEPLOYMENT)

  cancel      Cancel the in-progress deployment
  history     View rollout history
  latest      Start a new rollout for deployment config with latest state
  pause       Mark the provided resource as paused
  restart     Restart a resource
  resume      Resume a paused resource
  retry       Retry the latest failed rollout
  status      Show the status of the rollout
  undo        Undo a previous rollout

oc rollback (DEPLOYMENTCONFIG | DEPLOYMENT) [--to-version=]
```

N-1 Abwärtskompatibilität bei Rolling-Update:



Frontend: behält V1 bis Backend Update fertig ist

Backend: Update von V1 auf V2

Datenbank-Schema muss auch beide Versionen unterstützen

A/B Deployment Strategy:

```
apiVersion: v1
kind: Service
metadata:
  name: service-a
spec:
ports:
  - name: http
    port: 80
    protocol: TCP
    targetPort: http
  selector:
    app.kubernetes.io/instance: deploment-a
```

```
apiVersion: v1
kind: Service
metadata:
  name: service-b
spec:
ports:
  - name: http
    port: 80
    protocol: TCP
    targetPort: http
  selector:
    app.kubernetes.io/instance: deploment-b
```

```
kind: Route
metadata:
  name: <name>
spec:
  host: <host>
  to:
    kind: Service
    name: service-a
    weight: 50
  alternateBackends:
  - kind: Service
    name: service-b
    weight: 200
```

Imagestream:

- enthält Verweise (Zeiger) auf Images und deren Tags (keine Images)
- Verwendung in Deployment als Image und Trigger oder in BuildConfig als (S2I) BuilderImage
- Import aus externer Registry oder Ergebnis eines Build

```
$ oc import-image nginx --from=quay.io/do288/nginx --confirm  ( --scheduled)
$ oc describe is nginx
Name:                           nginx
Unique Images:                  4
Tags:                           4

latest
  updates automatically from registry quay.io/do288/nginx:latest
  * quay.io/do288/nginx@sha256:c34f57431167fca470730b67a1a8636126d2464eee619ec8d0b577c8e63bffef

1.2
  updates automatically from registry quay.io/do288/nginx:1.2
  * quay.io/do288/nginx@sha256:ee508edacfe0bc1e6af43a15348b400a7d97121507348bd5fb5effb6b9f8d84e

1.1
  updates automatically from registry quay.io/do288/nginx:1.1
  * quay.io/do288/nginx@sha256:674ab485f6e83f162eb4bdaf12986469c7b4f484f65fbb18f3b03218fd5f36e4

1.0
  updates automatically from registry quay.io/
  * quay.io/do288/nginx@sha256:693b30b107da26
```

TAG	LAST MODIFIED ↓	SECURITY SCAN	SIZE	MANIFEST
1.2	40 minutes ago	8 Medium	91.9 MB	SHA256 ee508edacfe0
latest	14 hours ago	8 Medium	91.9 MB	SHA256 c34f57431167
1.1	a day ago	8 Medium	90.6 MB	SHA256 674ab485f6e8
1.0	a day ago	8 Medium	90.6 MB	SHA256 693b30b107da

imagestream