OpenShift 4

Making introductions

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Red Hat Certified Architect
Cloud-Native Expert

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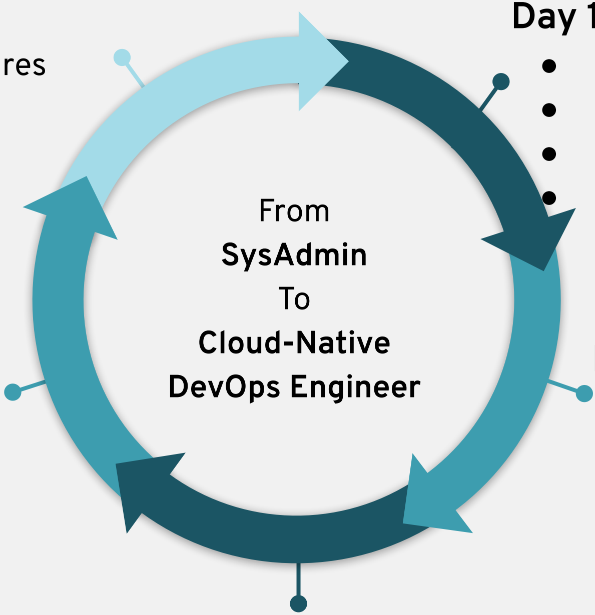
A comprehensive overview of “OpenShift Container Platform”, accompanied with interactive Lab exercises.

Agenda



From

SysAdmin

To

Cloud-Native

DevOps Engineer

Day 1 - Overview

- Cloud-Native market
- Container Concepts
- Platform Concepts
- Platform Architecture

OpenShift - Technical Deep Dive

Day 2 - App Deployment

- Technical Deep Dive
- Labs
- Compute: Pods
- Networking: Services, Routes
- Storage: Persistent Volumes

Day 3 - App Build

- Labs
- Source-2-Image
- Jenkins

Day 4 - Misc

- RBAC, IAM
-

Day 5 - Best Practices

- Reference Architectures
- Use Cases
- App OnBoarding

Client Setup

Gets you started

Interactive Workshop

OpenShift WebConsole	https://console-openshift-console.apps.learn.ont.belastingdienst.nl
OpenShift CLI	oc login -u <vdi-user> https://api.learn.ont.belastingdienst.nl:6443
Workshop url	https://lab-getting-started-workshops.apps.learn.ont.belastingdienst.nl
Confluence	https://devtools.belastingdienst.nl/confluence/displayJOS/OpenShift+Opleiding+Omgeving
Source code / Slides	https://devtools.belastingdienst.nl/bitbucket/projects/CEPT/repos/training-workshop/browse/resources

COMMANDS

Help	
oc	Openshift Client
oc types oc api-resources	Brief description of common used {object-types}
oc explain {object-type}	Details the fields/parameters of a specific {object-type}
oc {verb} --help	Help on command-line syntax (for specific {verb})

Getting Started	
oc login	Openshift Client
oc new-project	Create new Project
oc new-app	Provision new containerized application stack within your project.

oc {verb} {object-type} {object-identifier}

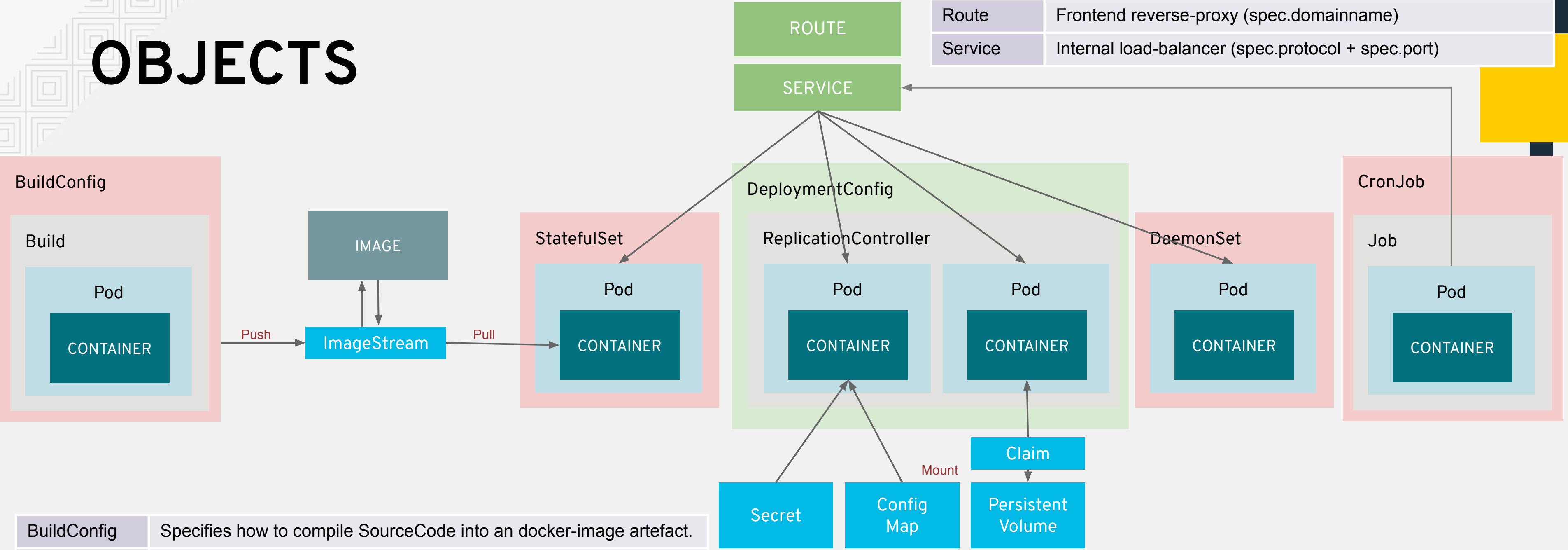
oc get pod myapp-1-abcde

{verb}	
get	A (mount)pointer to Network Storage (spec.connectionstring)
create	A mountable property file (spec.data[])
edit	A mountable base64-encoded file (spec.data[])
delete	
rsh / exec	Remote shell into a Container
project	Switch current-context to other namespaces
new-project	Create new Project
new-app	Provision new containerized application stack
cp / rsync	Copy files in/out containers

Examples	
oc get projects	Overview of all Projects running
oc get pods --all-namespaces -o wide	Overview of all Pods running
oc new-project lite3-prd oc new-app --template=mytomcat --image=tomcat8	Deploy new application stack
oc start-build bc/mytomcat	Compile new docker-image
oc -n lite3 edit configmap mytomcat-properties	Change config/property-file
oc rollout latest deployment/mytomcat	Deploy new version
oc delete pod/mytomcat-1-abcde	Restart app
oc describe svc mytomcat	Detailed Info about an object and its state
oc expose svc/mytomcat –hostname=myapp.swift.com	Expose your app to the public
oc tag mytomcat:v1.0 mytomcat:prod	Promote you app to Production

OBJECTS

Route	Frontend reverse-proxy (spec.domainname)
Service	Internal load-balancer (spec.protocol + spec.port)



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Recap - day 1+2

Do you still remember?

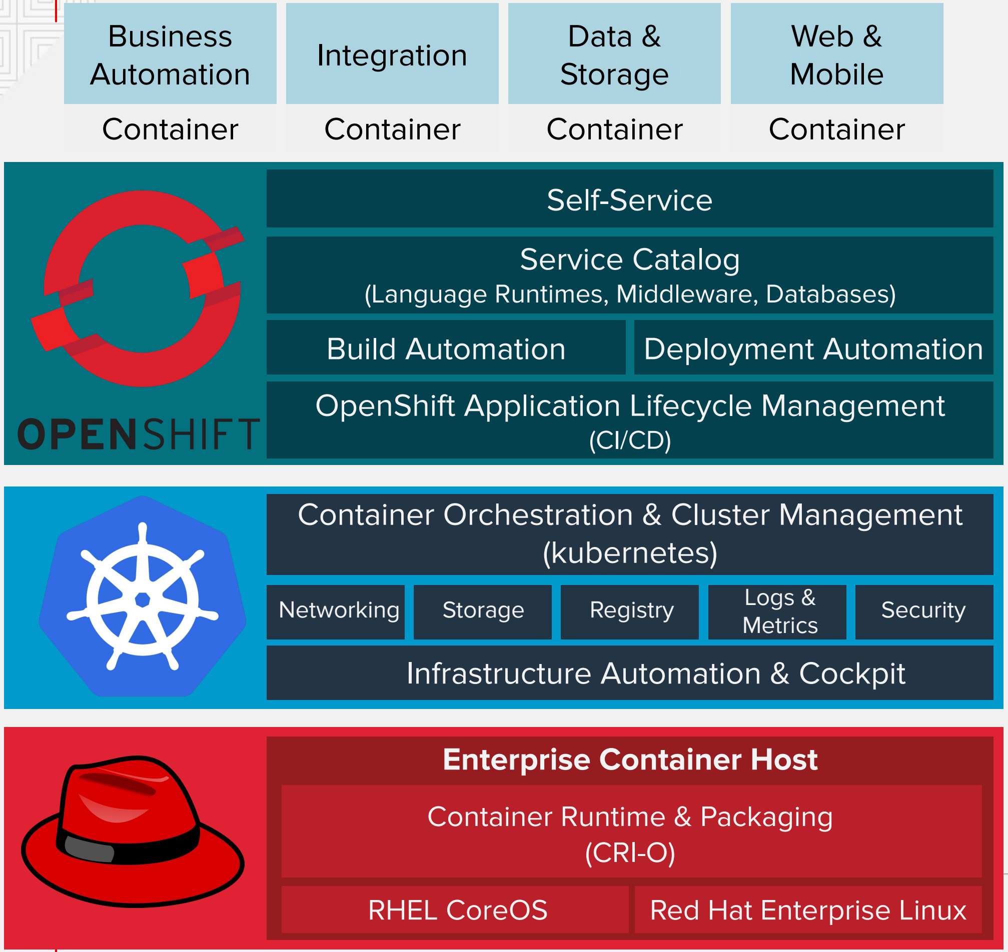
OpenShift 4 Architecture

Technical Deep Dive

on Infrastructure

Component

The abstraction layers



Business Automation | Integration | Data & Storage | Web & Mobile

Container | Container | Container | Container

OPENSHIFT

Self-Service

Service Catalog
(Language Runtimes, Middleware, Databases)

Build Automation | Deployment Automation

OpenShift Application Lifecycle Management
(CI/CD)

Container Orchestration & Cluster Management
(kubernetes)

Networking | Storage | Registry | Logs & Metrics | Security

Infrastructure Automation & Cockpit

Enterprise Container Host

Container Runtime & Packaging
(CRI-O)

RHEL CoreOS | Red Hat Enterprise Linux

OpenShift:

- Developer Experience

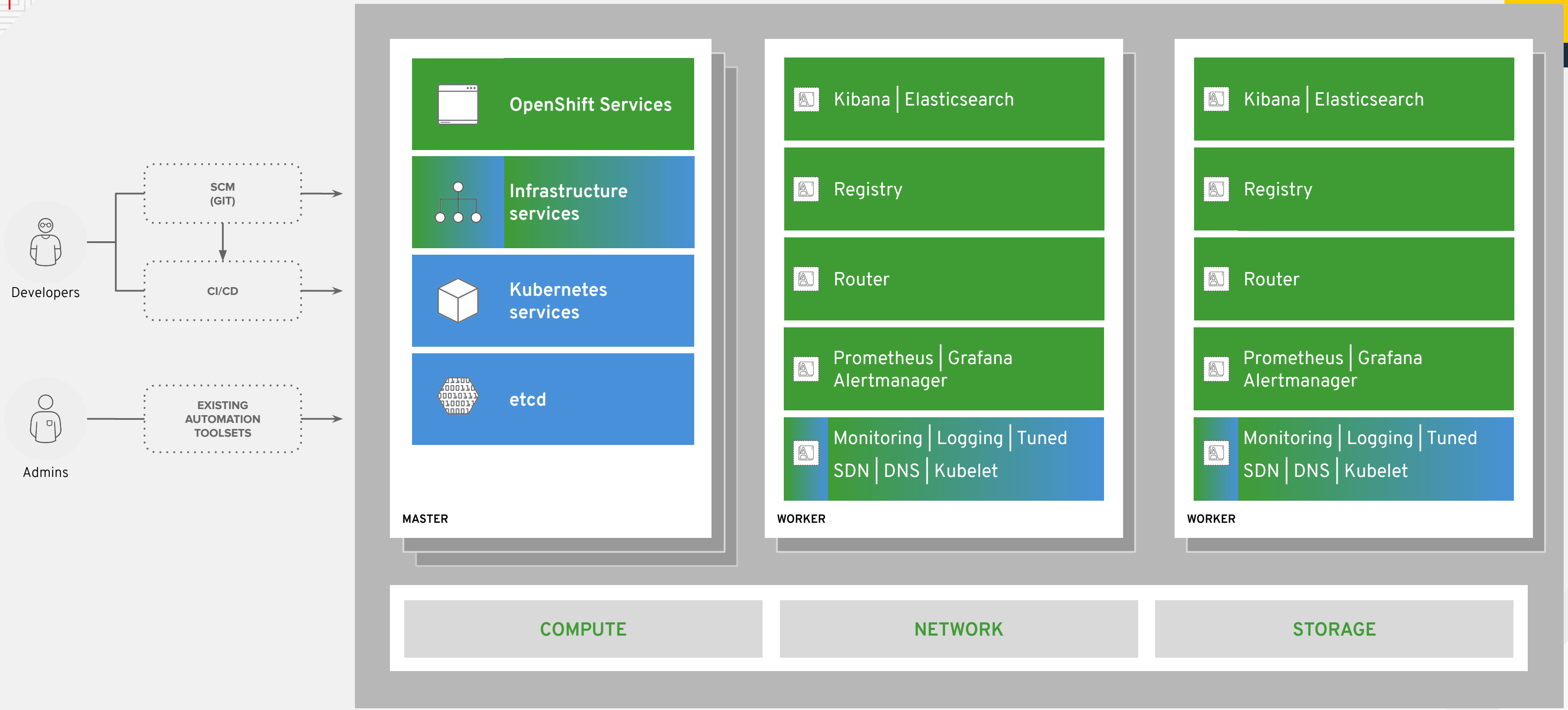
Kubernetes:

- container orchestration

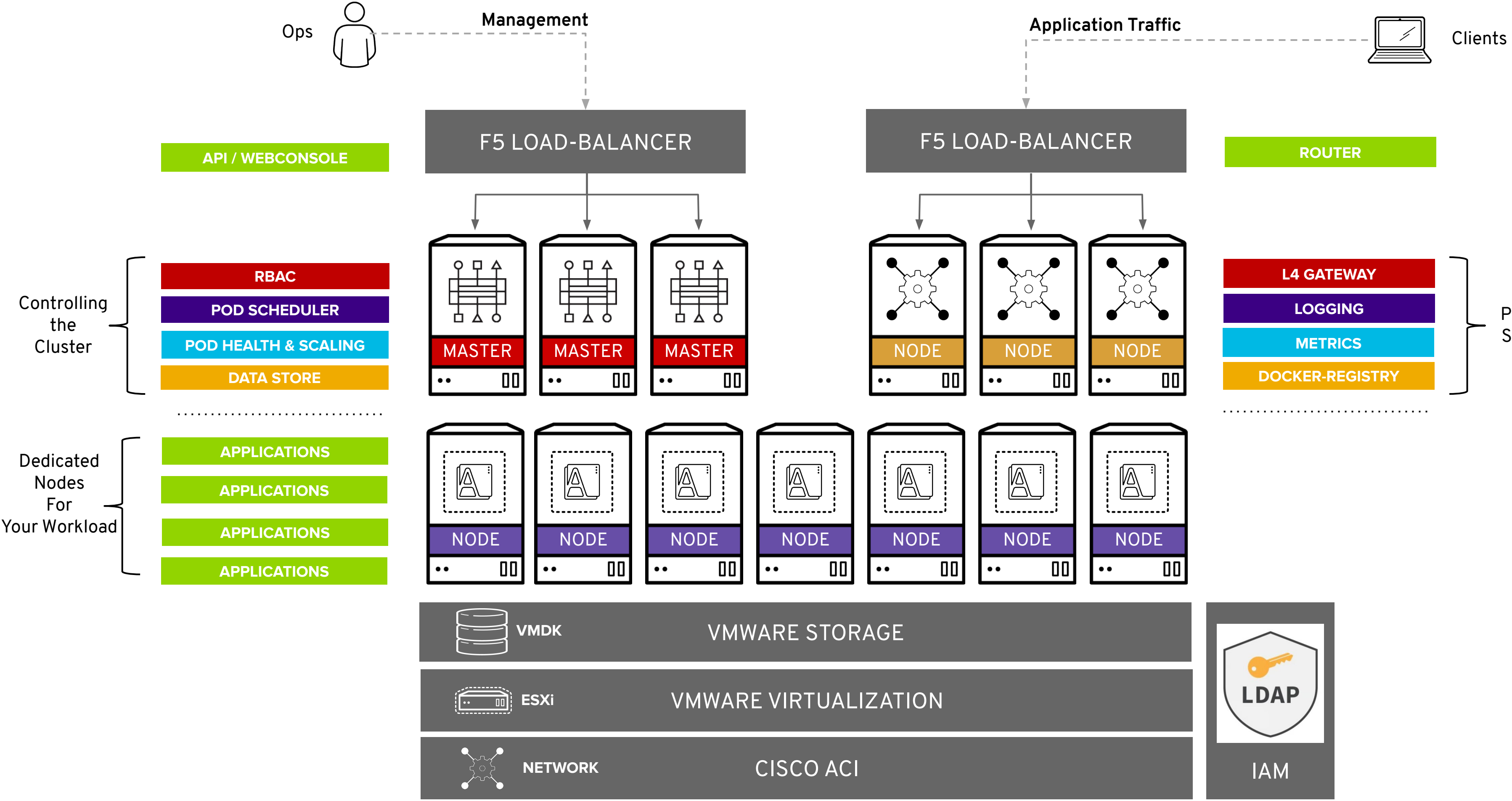
CoreOS:

- Immutable Infrastructure

dev and ops via web, cli, API, and IDE



PLATFORM ARCHITECTURE



Ops

Management

Application Traffic

Clients

API / WEBCONSOLE

F5 LOAD-BALANCER

F5 LOAD-BALANCER

ROUTER

Controlling the Cluster

RBAC

POD SCHEDULER

POD HEALTH & SCALING

DATA STORE

MASTER

MASTER

MASTER

NODE

NODE

NODE

L4 GATEWAY

LOGGING

METRICS

DOCKER-REGISTRY

Platform Services

Dedicated Nodes For Your Workload

APPLICATIONS

APPLICATIONS

APPLICATIONS

APPLICATIONS

NODE

NODE

NODE

NODE

NODE

NODE

NODE

VMDK

VMWARE STORAGE

ESXi

VMWARE VIRTUALIZATION

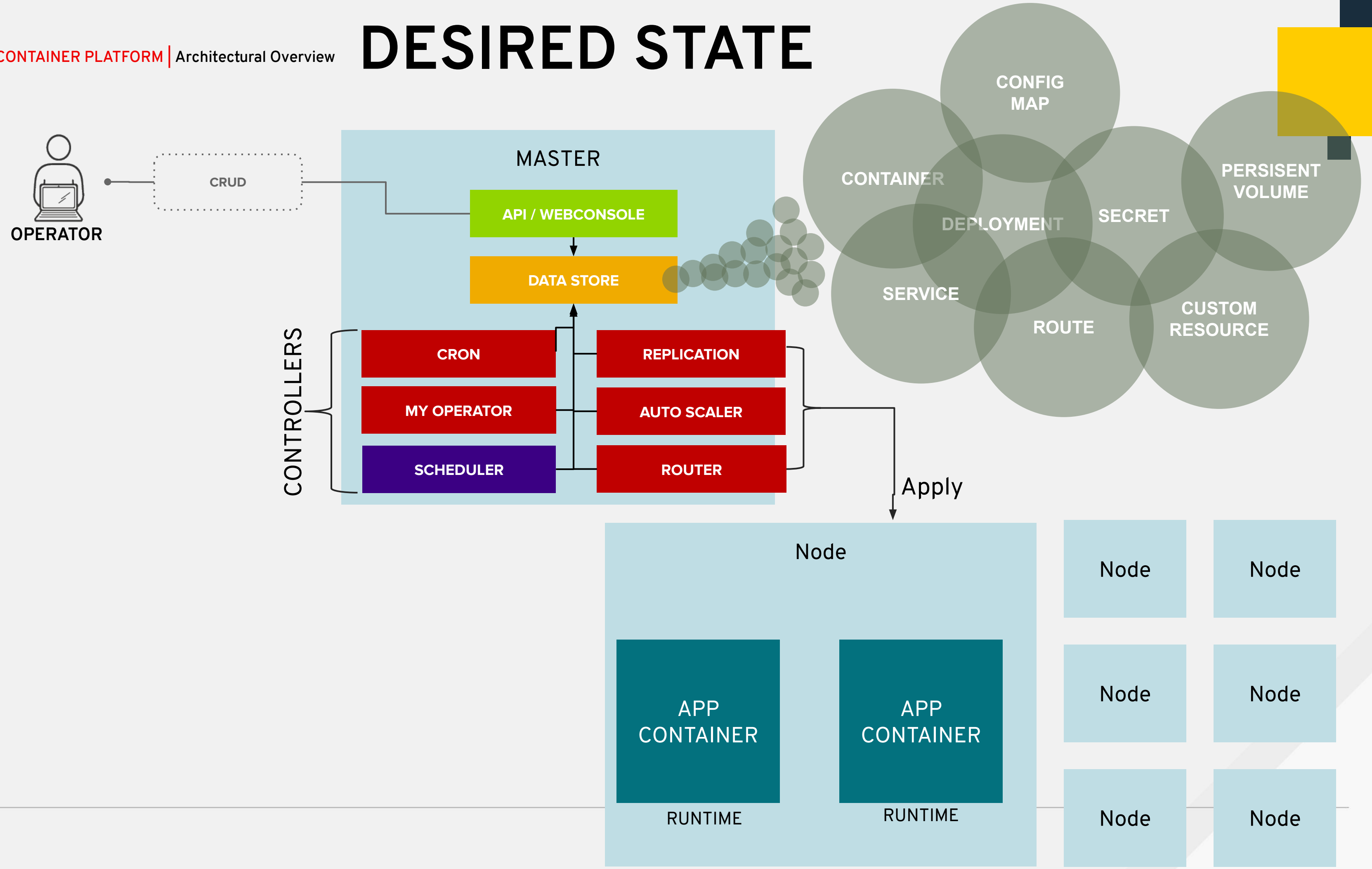
NETWORK

CISCO ACI

LDAP

IAM

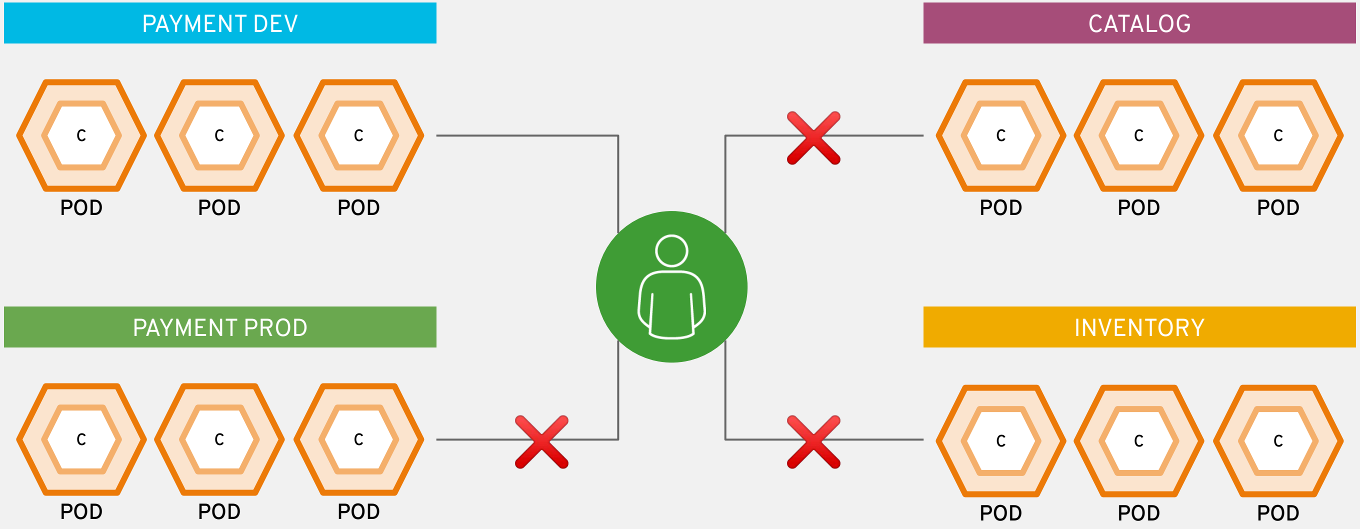
DESIRED STATE



Kubernetes Resource Definitions

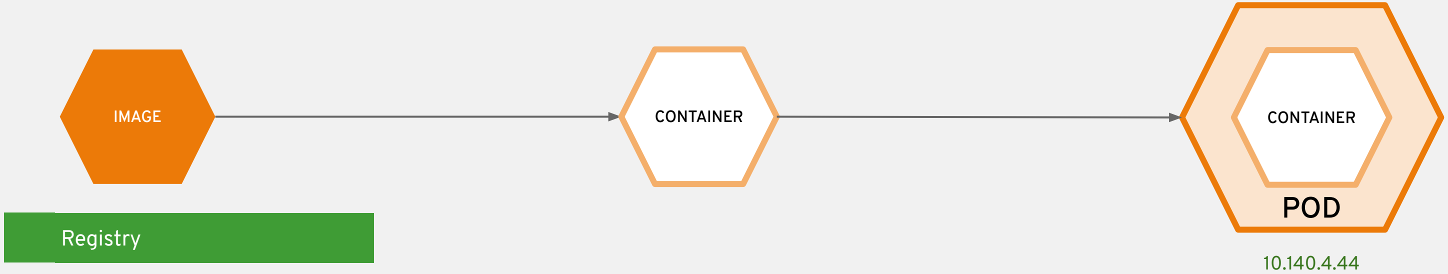
What types of workloads can you deploy on top of a Container Platform…

projects isolate apps across environments, teams, groups and departments



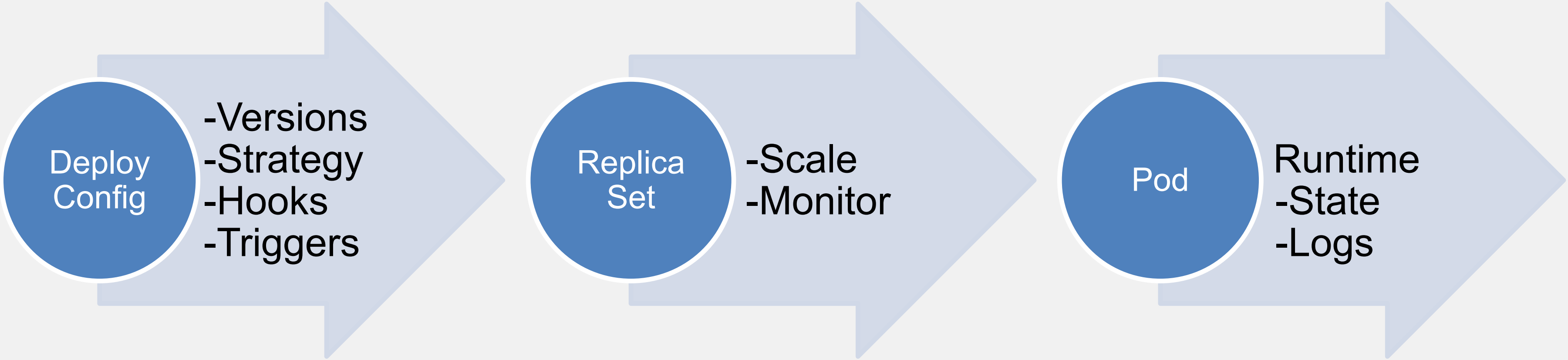
```
> oc new-project workshop-<vdi-user>
> oc project
```

It all starts with an image



```
> oc -n openshift get imagestreams
> oc -n openshift describe imagestream httpd
> oc -n <workshop> import-image docker.io/library/httpd
```

Deployment Process



- MyJBossApp

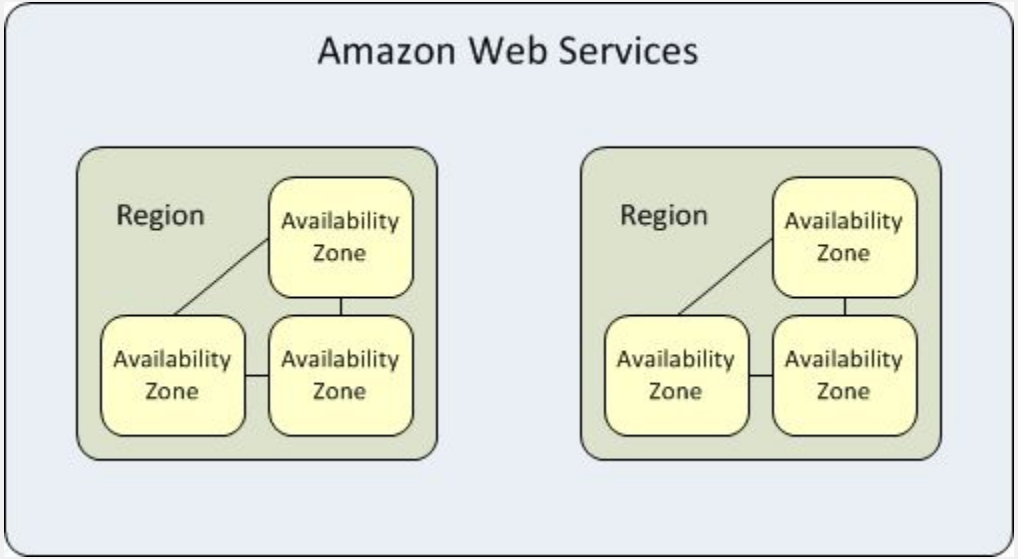
- MyJBossApp-v1 (2x)
- MyJBossApp-v2 (4x)

- MyJBossApp-v1-abcde
- MyJBossApp-v1-rando

```
> oc new-app httpd
> oc scale -replicas=2 dc/frontend
> oc rollout latest dc/frontend
```

```
> oc get pods -o wide -w
> curl http://<pod-ip>:8080/
```

PLACEMENT BY POLICY
Pod Affinity rules

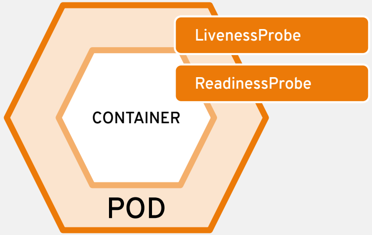


Preferred vs Required
Affinity vs Anti-Affinity

- Nodes
- Services
- Persistent Volumes

```
> ssh master1 cat /etc/origin/master/scheduler.json
```

Health Checks



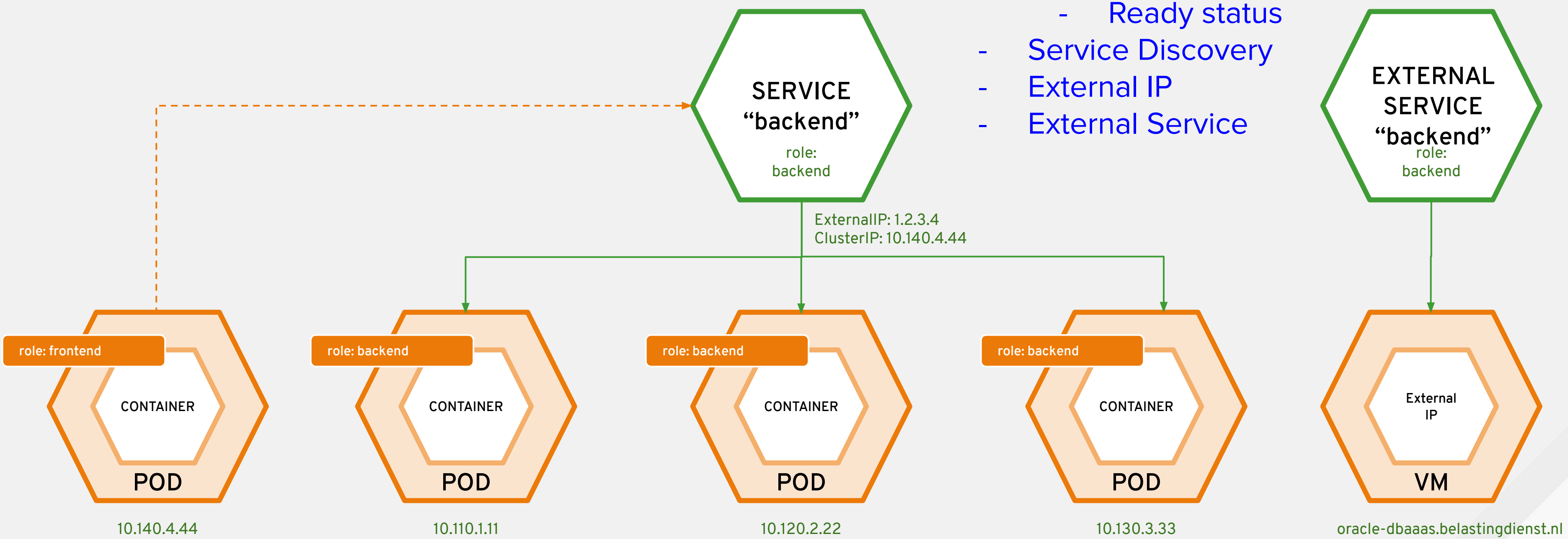
- LivenessProbe
- ReadinessProbe

HTTP
TCP
Shell

```
> oc set probe dc/httpd --readiness --get-url=http://127.0.0.1:8080/index.html --initial-delay-seconds=5
> oc set probe dc/httpd --liveness --open-tcp=8080
```

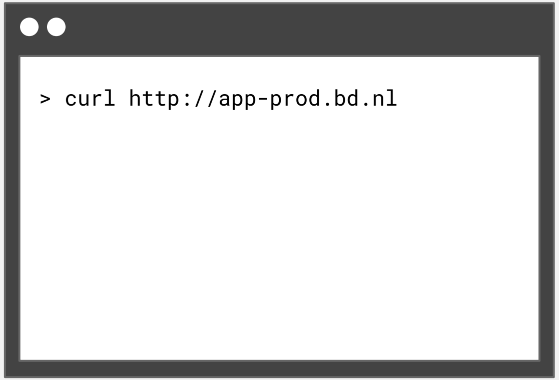
services provide internal load-balancing

- Load-Balancing
  - Ready status
- Service Discovery
- External IP
- External Service

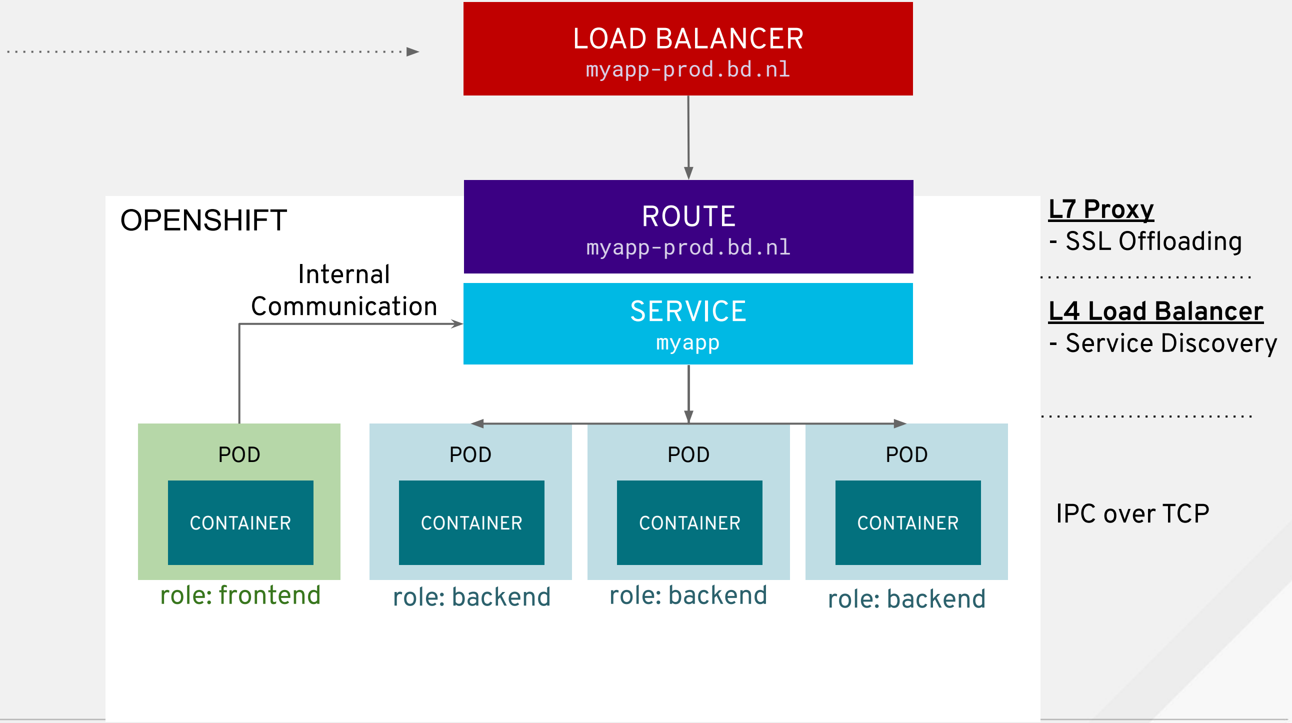


```
> oc describe svc/httpd |egrep “Selector|Endpoints”
> oc get pods -o wide -l app=httpd
```

ROUTING TRAFFIC



```
> curl http://app-prod.bd.nl
```



LOAD BALANCER
myapp-prod.bd.nl

OPENSHIFT

ROUTE
myapp-prod.bd.nl

Internal Communication

SERVICE
myapp

POD
CONTAINER
role: frontend

POD
CONTAINER
role: backend

POD
CONTAINER
role: backend

POD
CONTAINER
role: backend

L7 Proxy
- SSL Offloading

L4 Load Balancer
- Service Discovery

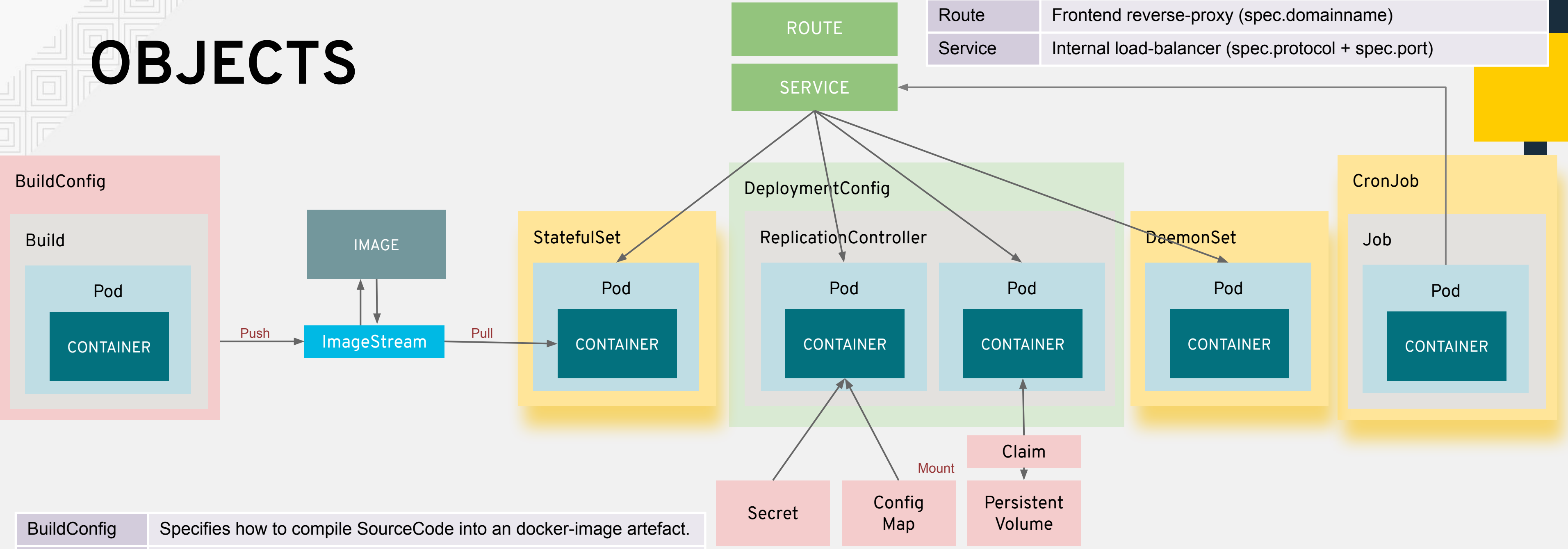
IPC over TCP

Day 3

Mount external data sources into your container.

OBJECTS

Route	Frontend reverse-proxy (spec.domainname)
Service	Internal load-balancer (spec.protocol + spec.port)



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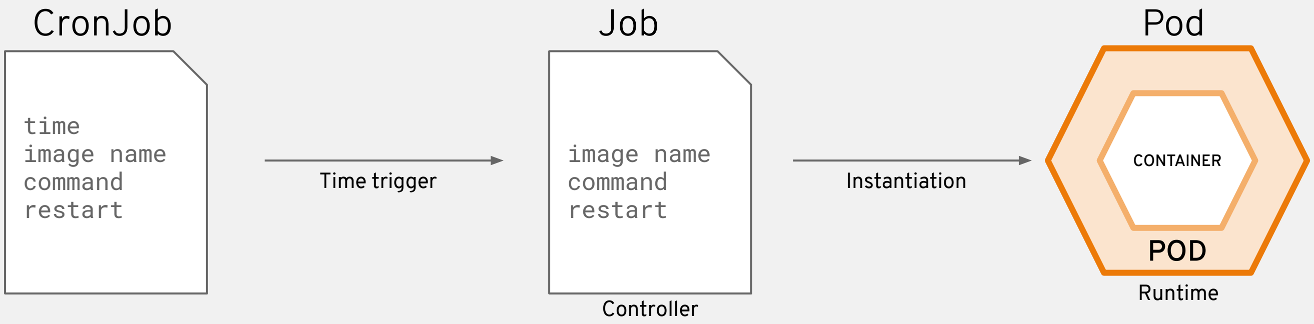
Job	Monitors the one-off Pod for successful completion, restarts if needed.

CronJobs run short lived pods at a specified time interval



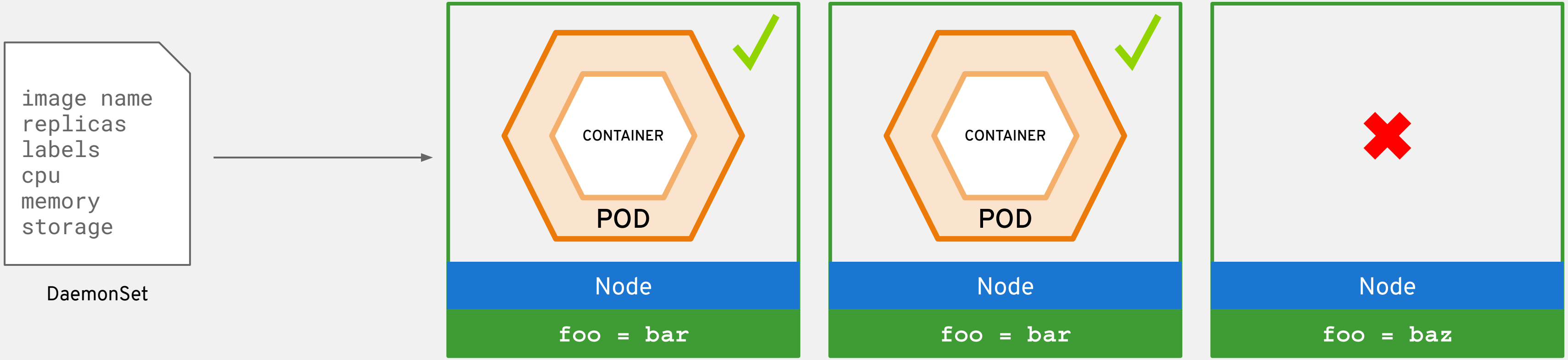
```
> oc create cronjob myjob --image=httpd --schedule="*/10 * * * *" --restart=OnFailure
> oc create job --from=cronjob/myjob
> oc patch cronjob/myjob -p '{"spec": {"jobTemplate": {"spec": {"template": {"spec": {"containers": [ {"name": "myjob", "command": ["/bin/bash","-c","echo hello world"] } ] } } } } } }'
```

CronJob

```
> oc create cronjob myjob --image=httpd --schedule="*/10 * * * *"
--restart=OnFailure
> oc edit cronjob/myjob
jobTemplate:
  spec:
    template:
      spec:
        containers:
        - name: myjob
          command:
          - /bin/bash
          - -c
          - echo hello world

> oc create job --from=cronjob/myjob
> oc get pods
> oc logs <pod-name>
```

a `daemonset` ensures that all (or some) nodes run a copy of a pod



```
> oc get -o yaml --export dc/backend |sed 's/DeploymentConfig/DaemonSet/g' |oc create -f -
```

DaemonSet

```
> oc get -o yaml --export dc/backend >daemonset.yml
> vi daemonset.yml
apiVersion: apps/v1
kind: DaemonSet
spec:
  selector:
    matchLabels:
      app: httpd
      deploymentConfig: httpd
```

OBJECTS

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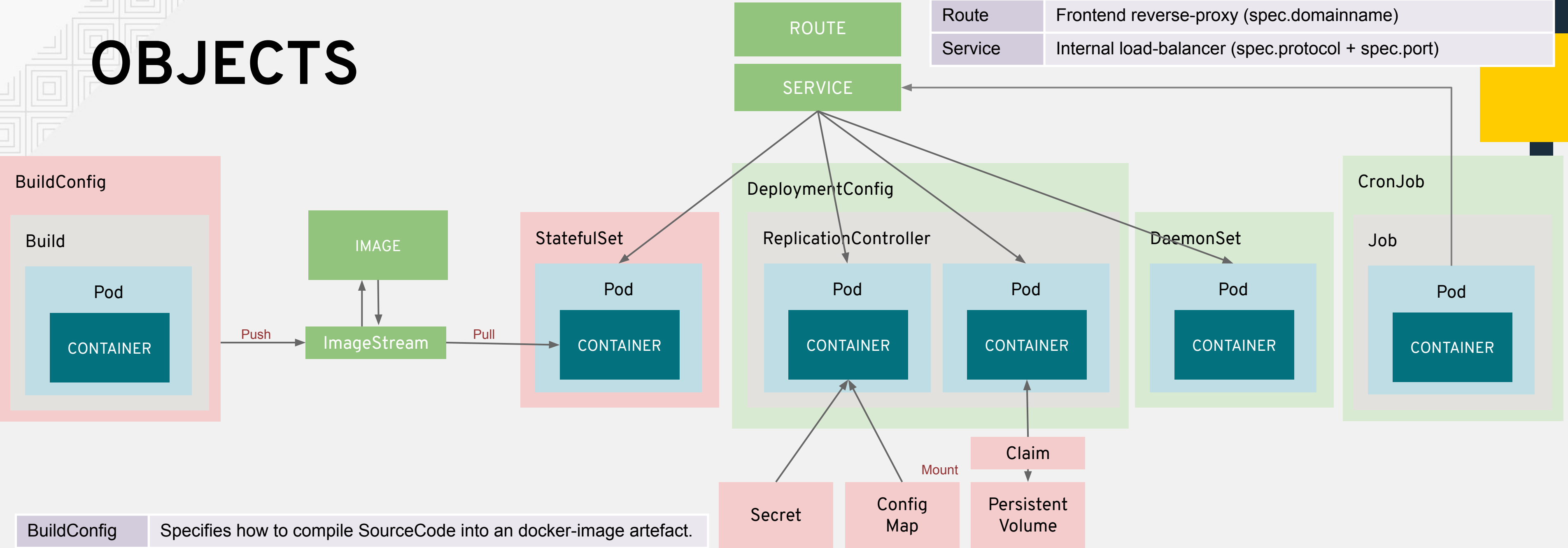
Service	Internal load-balancer (spec.protocol + spec.port)



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Persistent Volumes

Mount external data sources into your container.

OBJECTS

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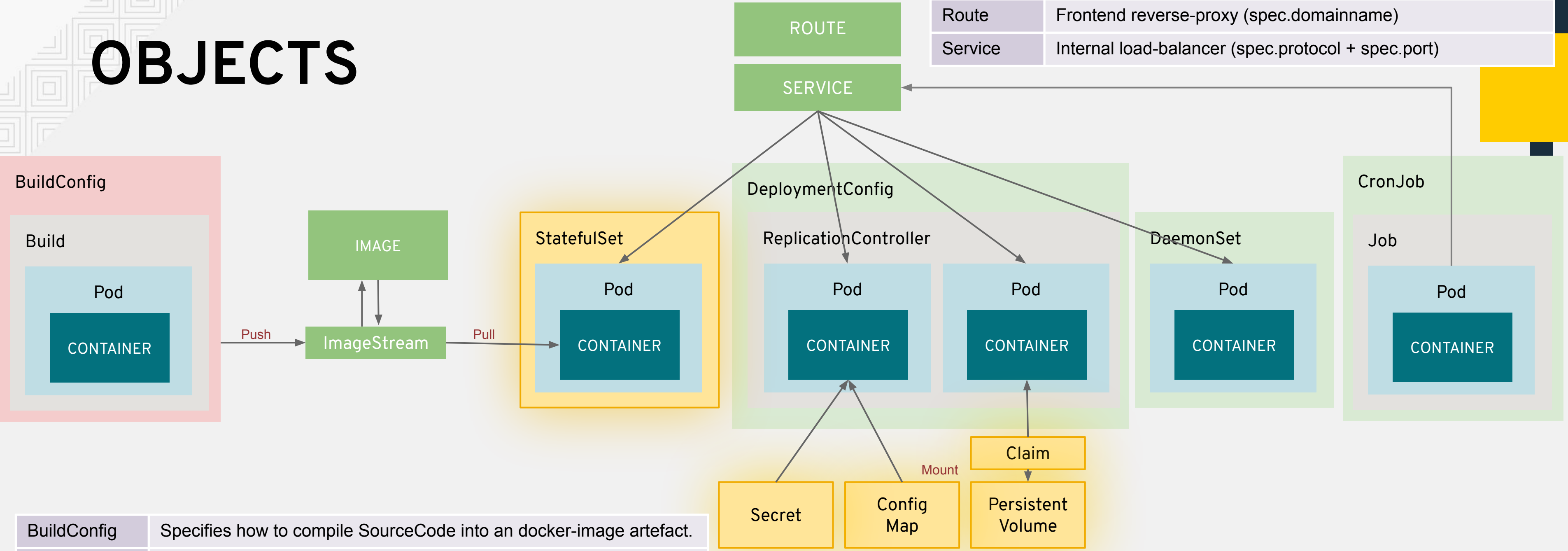

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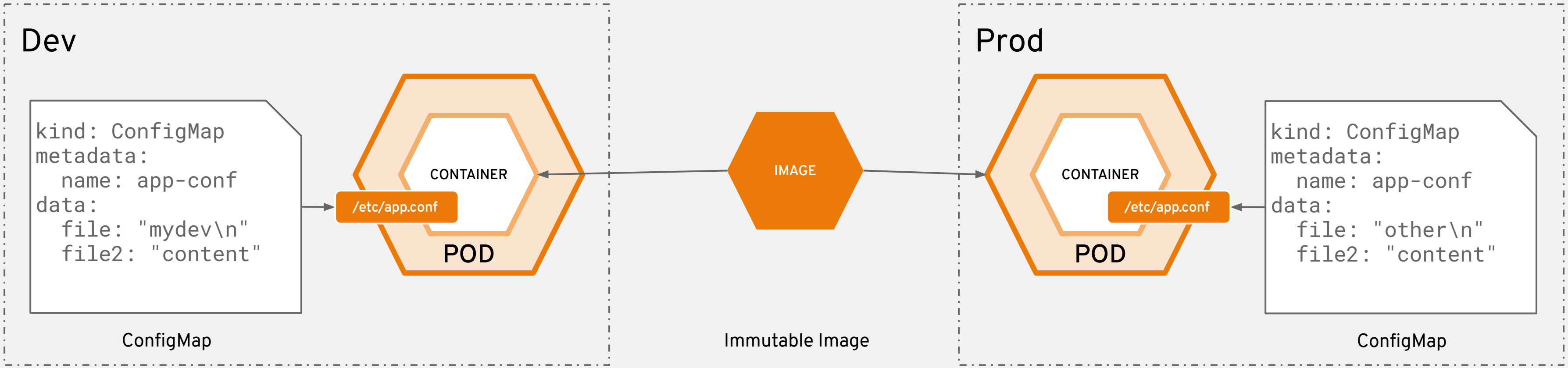
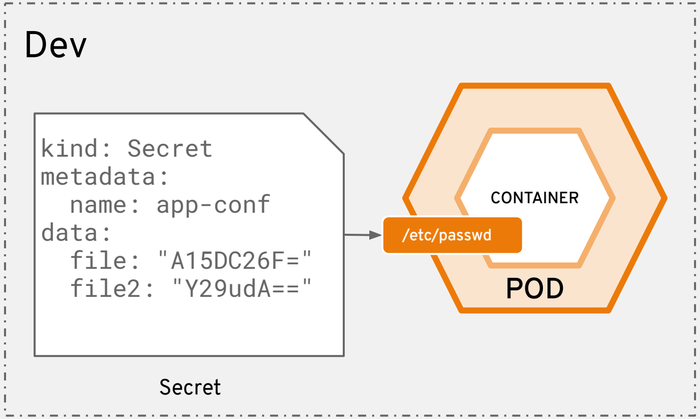
`configmaps` allow you to decouple configuration artifacts from image content



```
kind: ConfigMap
metadata:
  name: app-conf
data:
  file: "mydev\n"
  file2: "content"
```

```
kind: ConfigMap
metadata:
  name: app-conf
data:
  file: "other\n"
  file2: "content"
```

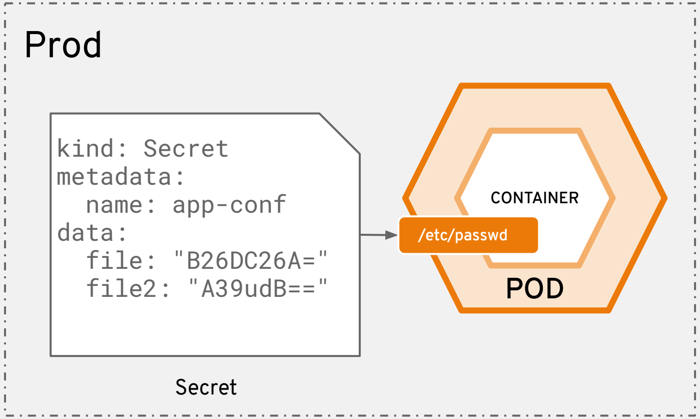
`secrets` provide a mechanism to hold sensitive information such as passwords



Dev

```
kind: Secret
metadata:
  name: app-conf
data:
  file: "A15DC26F="
  file2: "Y29udA=="
```

Secret



Prod

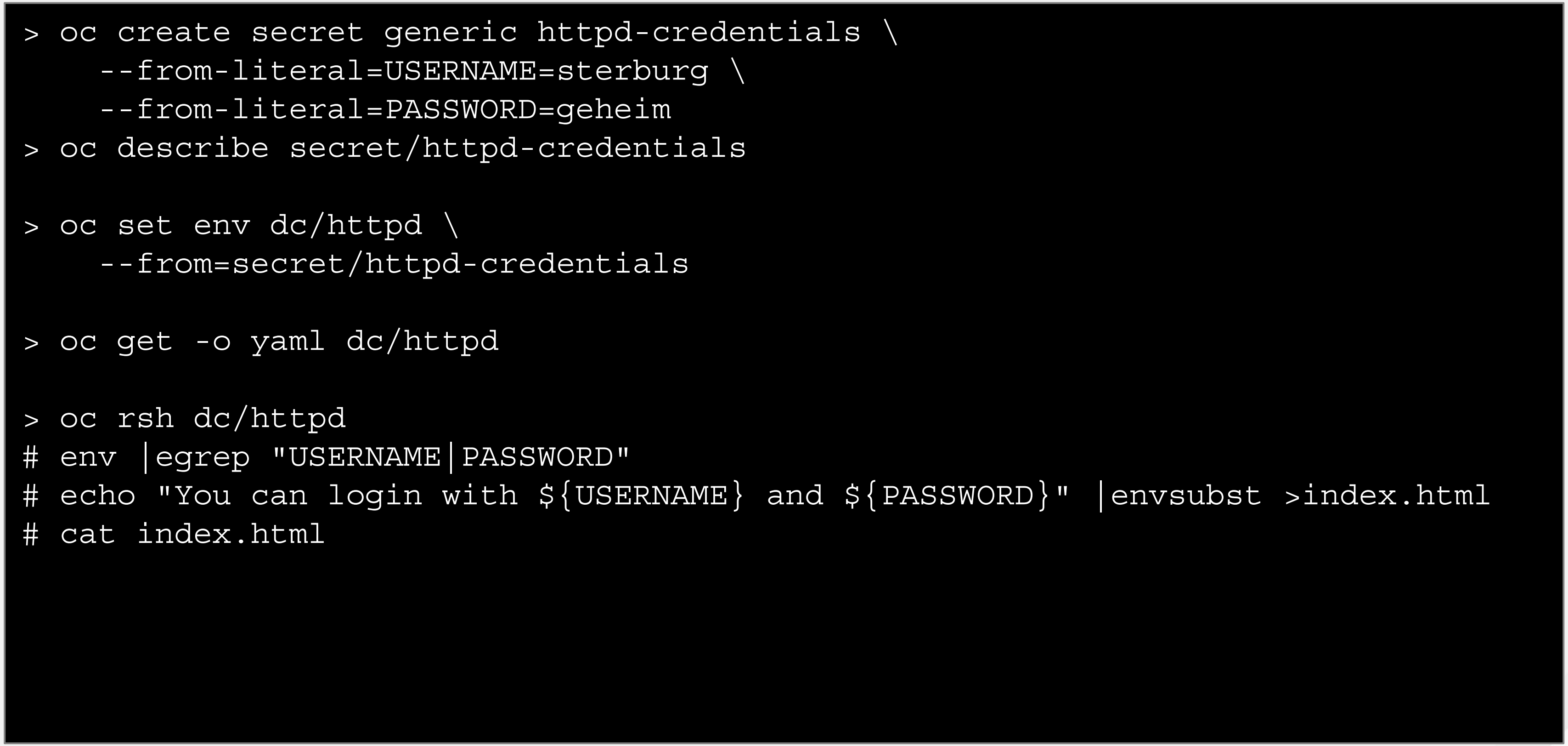
```
kind: Secret
metadata:
  name: app-conf
data:
  file: "B26DC26A="
  file2: "A39udB=="
```

Secret

ConfigMap

```
> oc cp httpd-persistent-0:/etc/httpd/conf/httpd.conf httpd.conf
> vi httpd.conf
DocumentRoot /var/www/html
> oc create configmap httpd-conf \
    --from-file=httpd.conf \
    --from-file=author.txt=/etc/hostname \
    --from-literal=author.sh=username=sterburg
> oc describe cm/httpd-conf |less

> oc set volumes dc/httpd \
    --add \
    --name=httpd-conf \
    --type=configmap  \
    --configmap-name=httpd-conf \
    --sub-path=httpd.conf
    --mount-path=/etc/httpd/conf2/httpd.conf

> oc set volumes sts/httpd-persistent
> oc get dc/httpd -o yaml
> oc delete pod -l app=httpd-persistent
> oc rsh pod/httpd-2-abcde grep DocumentRoot /etc/httpd/conf2/httpd.conf
```

Secrets



```
> oc create secret generic httpd-credentials \
    --from-literal=USERNAME=sterburg \
    --from-literal=PASSWORD=geheim
> oc describe secret/httpd-credentials

> oc set env dc/httpd \
    --from=secret/httpd-credentials

> oc get -o yaml dc/httpd

> oc rsh dc/httpd
# env |egrep "USERNAME|PASSWORD"
# echo "You can login with ${USERNAME} and ${PASSWORD}" |envsubst >index.html
# cat index.html
```

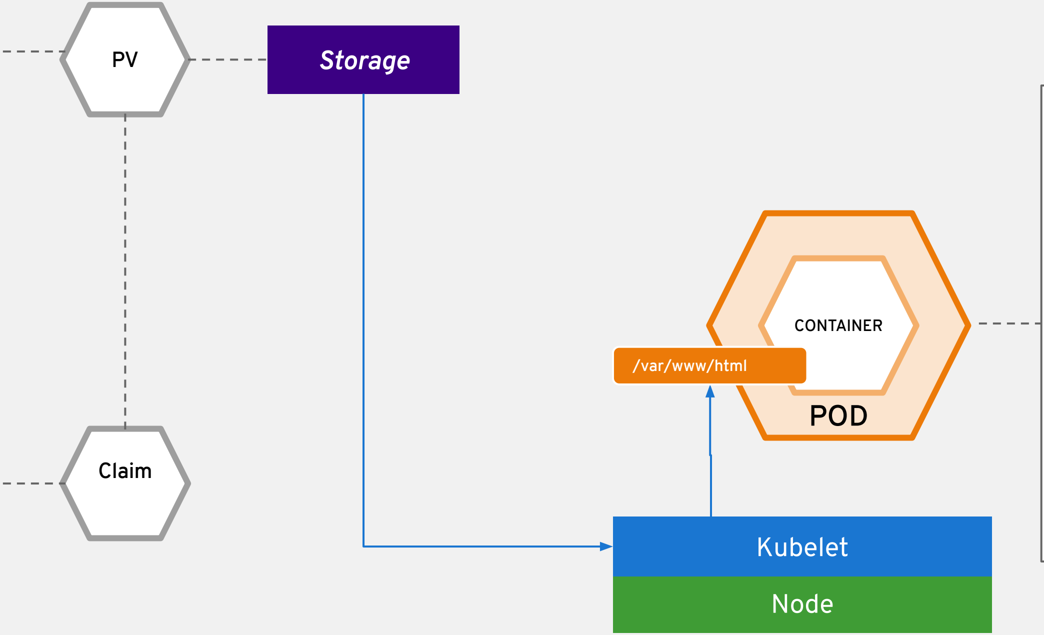
A broad spectrum of static and dynamic storage endpoints

- NFS
- OpenStack Cinder
- iSCSI
- Azure Disk
- AWS EBS
- FlexVolume
- GlusterFS
- Ceph RBD
- Fiber Channel
- Azure File
- GCE Persistent Disk
- VMWare vSphere VMDK
- NetApp Trident*
- Container Storage Interface (CSI)**

Claiming storage space

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: pv0030
spec:
  accessModes:
  - ReadWriteOnce
  - ReadWriteMany
  - ReadOnlyMany
  capacity:
    storage: 100Gi
  nfs:
    server: nfs
    path: /exports/pv1
  reclaim: Recycle
```

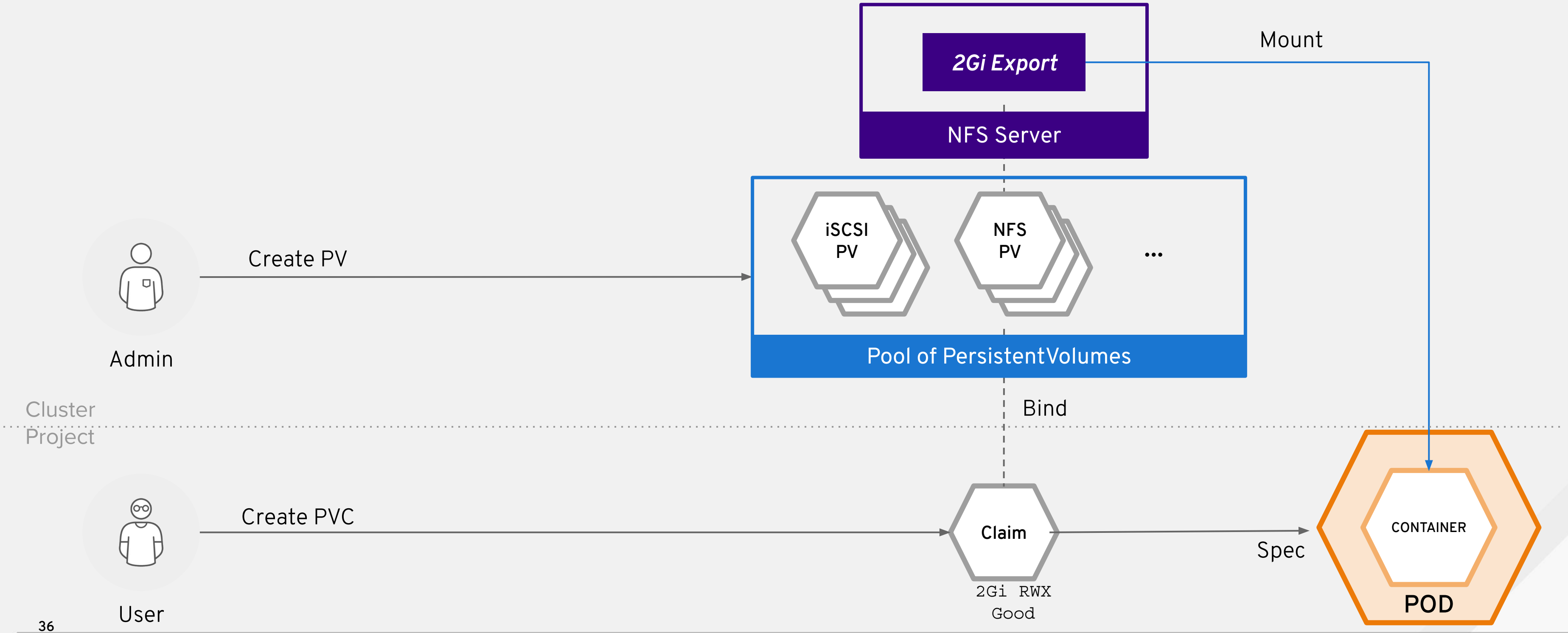
```
apiVersion: v1
kind:
PersistentVolumeClaim
metadata:
  name: www-data
spec:
  accessModes:
  - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
```



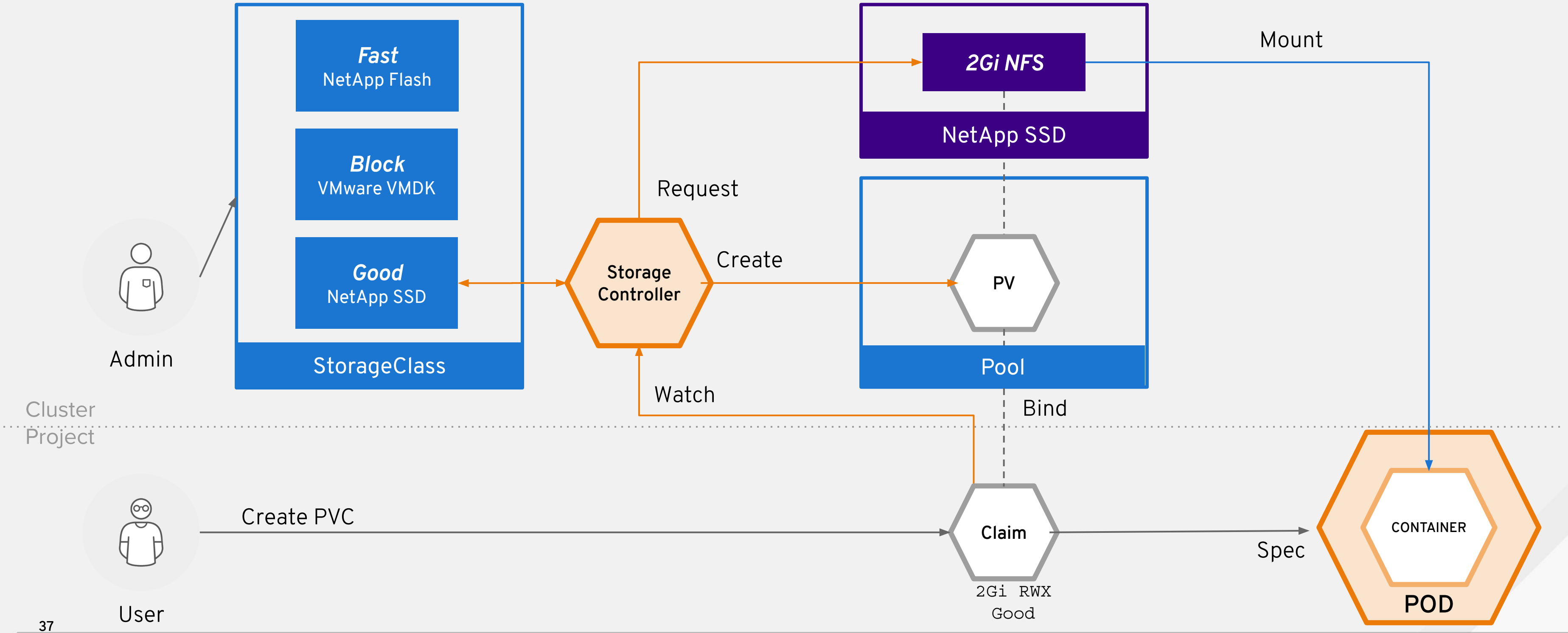
```
apiVersion: v1
kind: Pod
metadata:
  name: mypod
spec:
  containers:
    - name: myfrontend
      image: nginx
      volumeMounts:
      - mountPath: "/var/www/html"
        name: mypd
  volumes:
    - name: mypd
      persistentVolumeClaim:
        claimName: www-data
```

```
oc set volume --add dc/httpd --type=pvc --claim-name=www-data --claim-size=1Gi -m /var/www/html
```

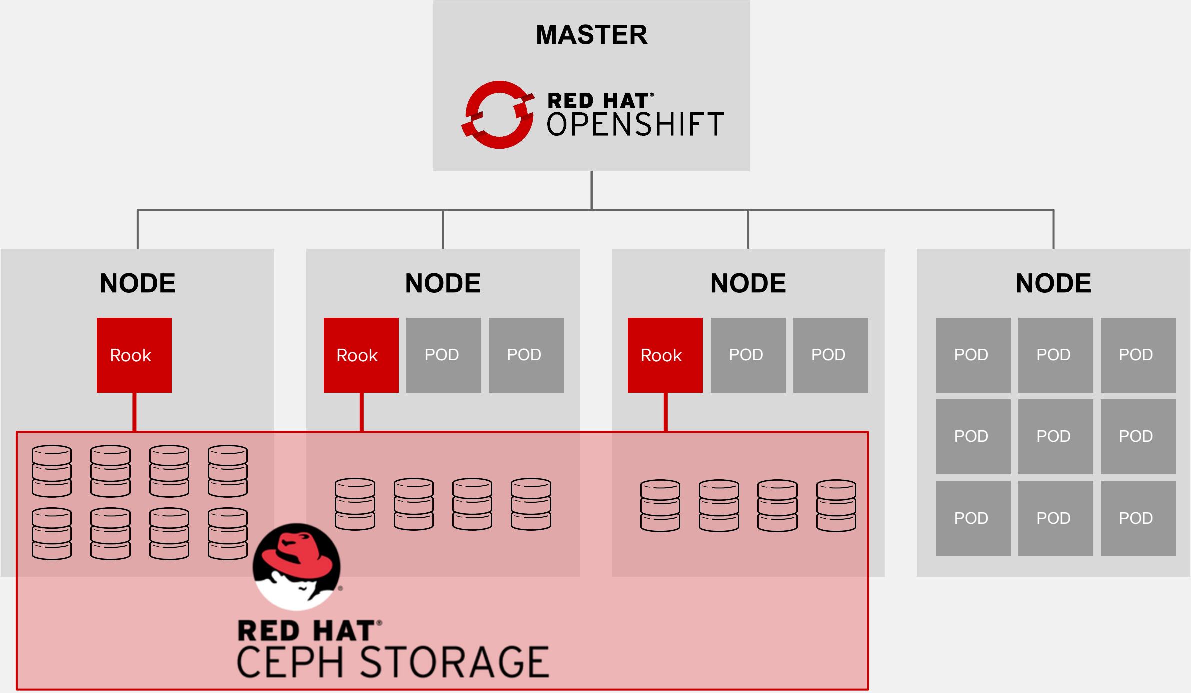
Static Storage Provisioning



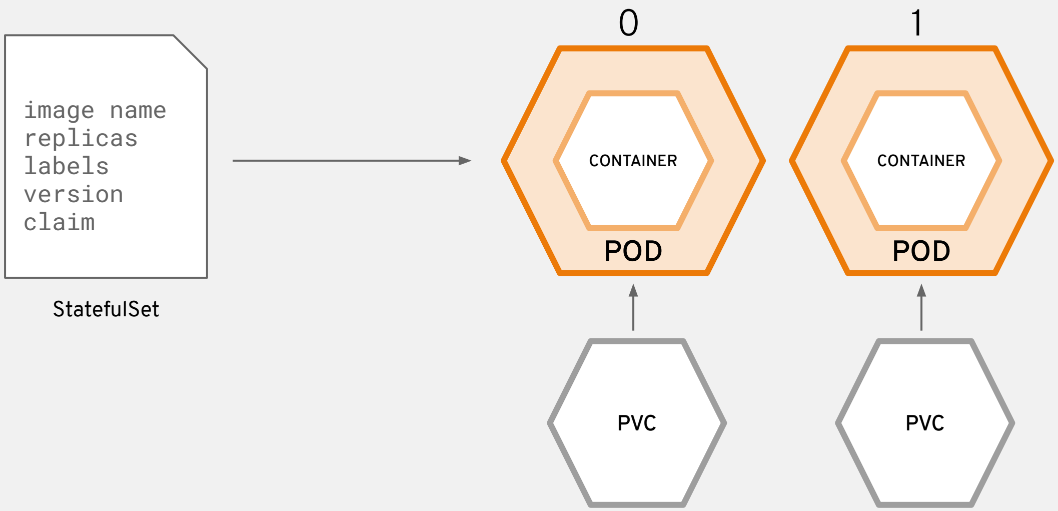
Dynamic Storage Provisioning



CONTAINER-NATIVE STORAGE (OCS)



StatefulSets are special deployments for Stateful workloads



```
apiVersion: apps/v1
kind: StatefulSet
metadata:
  name: httpd-persistent
spec:
  serviceName: "backend"
  replicas: 2
  selector:
    matchLabels:
      app: httpd-persistent
  template:
    metadata:
      labels:
        app: httpd-persistent
    spec:
      containers:
      - name: httpd
        image: httpd:latest
        volumeMounts:
        - name: www
          mountPath: /var/www/html
  volumeClaimTemplates:
  - metadata:
      name: www
    spec:
      accessModes: [ "ReadWriteOnce" ]
      resources:
        requests:
            storage: 1Gi
```

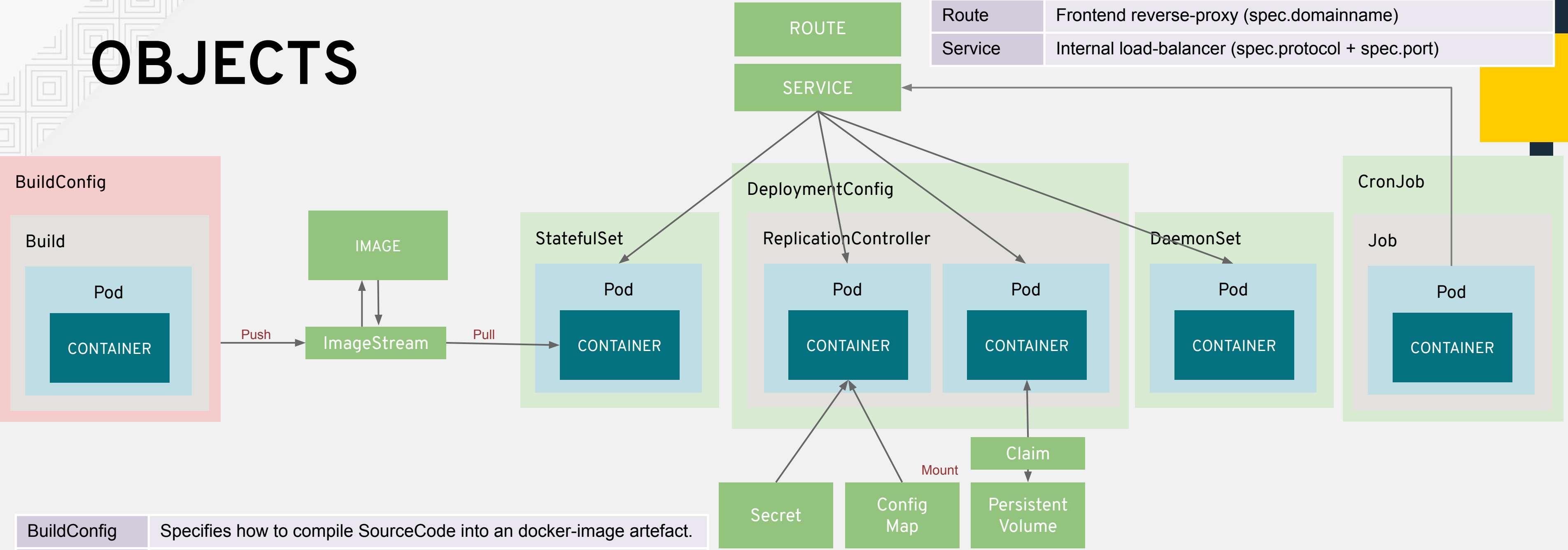
```
> oc create -f statefulset.yaml
```

StatefulSet

```
> oc create -f statefulset.yaml
> oc scale --replicas=4 sts/httpd-persistent

> oc get pods
> oc get persistentvolumeclaims
> oc set volumes pod/httpd-persistent-0
> oc set volumes pod/httpd-persistent-1

> oc rsh httpd-persistent-0 bash -c "hostname >/var/www/html/index.html"
> oc rsh httpd-persistent-1 bash -c "hostname >/var/www/html/index.html"
> oc rsh httpd-persistent-2 bash -c "hostname >/var/www/html/index.html"
> oc rsh httpd-persistent-3 bash -c "hostname >/var/www/html/index.html"

> oc create service clusterip httpd-persistent --tcp=80:8080 -o yaml
> oc rsh httpd-persistent-0
# curl http://httpd-persistent
```

OBJECTS

Route	Frontend reverse-proxy (spec.domainname)
Service	Internal load-balancer (spec.protocol + spec.port)



BuildConfig	Specifies how to compile SourceCode into an docker-image artefact.
Build	Runs the build process (spec.gitref + spec.buildImage + spec.targetImage)
ImageStream	A pointer to an external image (spec.imageUrl)
Image	Application binary (content)

PersistentVolumeClaim	A “request” for storage space (spec.size)
PersistentVolume	A (mount)pointer to Network Storage (spec.connectionstring)
ConfigMap	A mountable property file (spec.data[])
Secret	A mountable base64-encoded file (spec.data[])

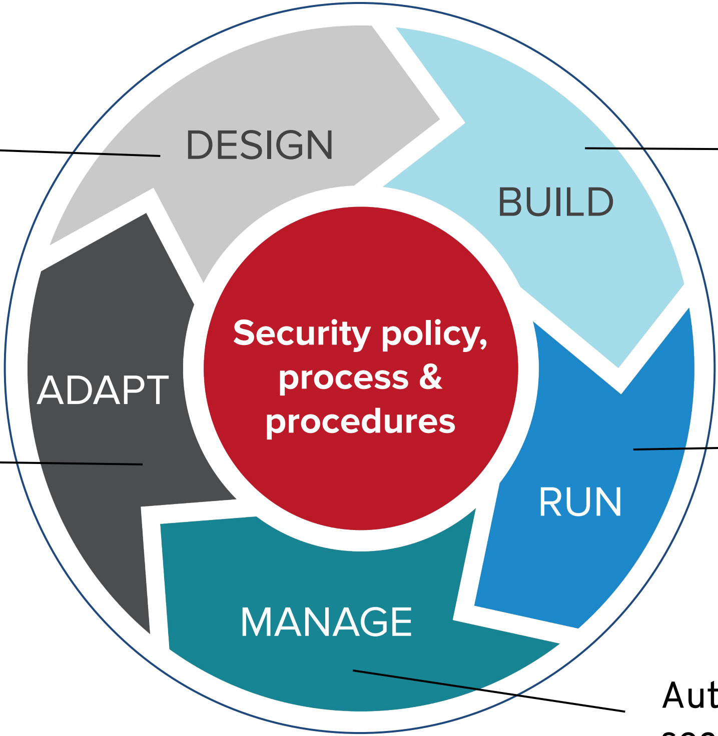
DeploymentConfig	Specifies how to deploy your application (rolloutStrategy + imageChangeTriggers)
ReplicaSet	Monitors the Pods and restarts if needed (spec.healthcheck + spec.replicas)
Pod	A grouping of tightly-coupled containers (spec.containers[] + spec.node)
Container	Running your application process (spec.command + spec.security
StatefulSet	Same a Deployment, but then for Statefull workloads
DaemonSet	Same a Deployment, but exactly 1 Pod per Node. (spec.nodeSelector)
CronJob	Schedules a Pod at a specified time. (spec.schedule)
Job	Monitors the one-off Pod for successful completion, restarts if needed.

OpenShift Security

Features, mechanisms and processes for container and platform isolation

SECURITY MUST BE CONTINUOUS

And integrated throughout the IT lifecycle



Identify security requirements & governance models

Built-in from the start; not bolted-on

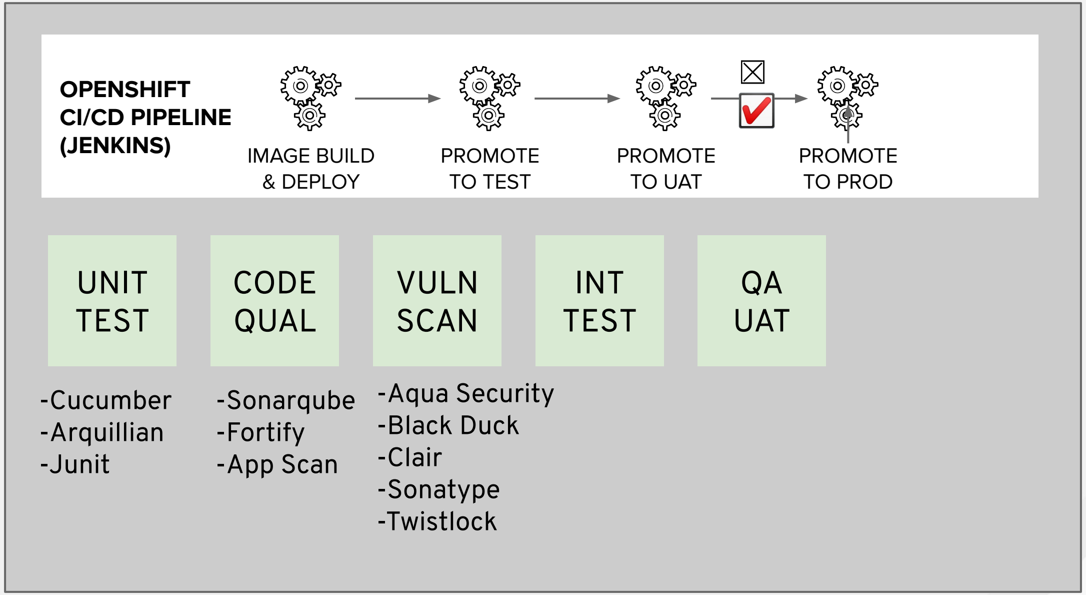
Deploy to trusted platforms with enhanced security capabilities

Automate systems for security & compliance

Revise, update, remediate as the landscape changes

CI/CD MUST INCLUDE SECURITY GATES

- Integrate security testing into your build / CI process
- Use automated policies to flag builds with issues
- Sign your custom container images



OPENSHIFT CI/CD PIPELINE (JENKINS)

IMAGE BUILD & DEPLOY → PROMOTE TO TEST → PROMOTE TO UAT ☒ ☑ → PROMOTE TO PROD

UNIT TEST	CODE QUAL	VULN SCAN	INT TEST	QA UAT
-Cucumber -Arquillian -Junit	-Sonarqube -Fortify -App Scan	-Aqua Security -Black Duck -Clair -Sonatype -Twistlock		

SECURITY FEATURES

DEFENSE IN DEPTH - Control, Defend, Extend

Linux Host Security

- RHCOS minimal, immutable OS
- RHCOS updates managed and delivered as integrated part of the OpenShift platform

Authentication & Authorization

- Integration with external Keycloak
- Use group membership from external IPs

Secrets & Certificates

- Encrypted certs stored in etcd (4.0)
- Improved cert management and Integration with external CAs via ACME
- Integration with external Key Management Systems

Integrated Audit & Logging

- East / West traffic tracing with OpenShift Service Mesh

Network Policies

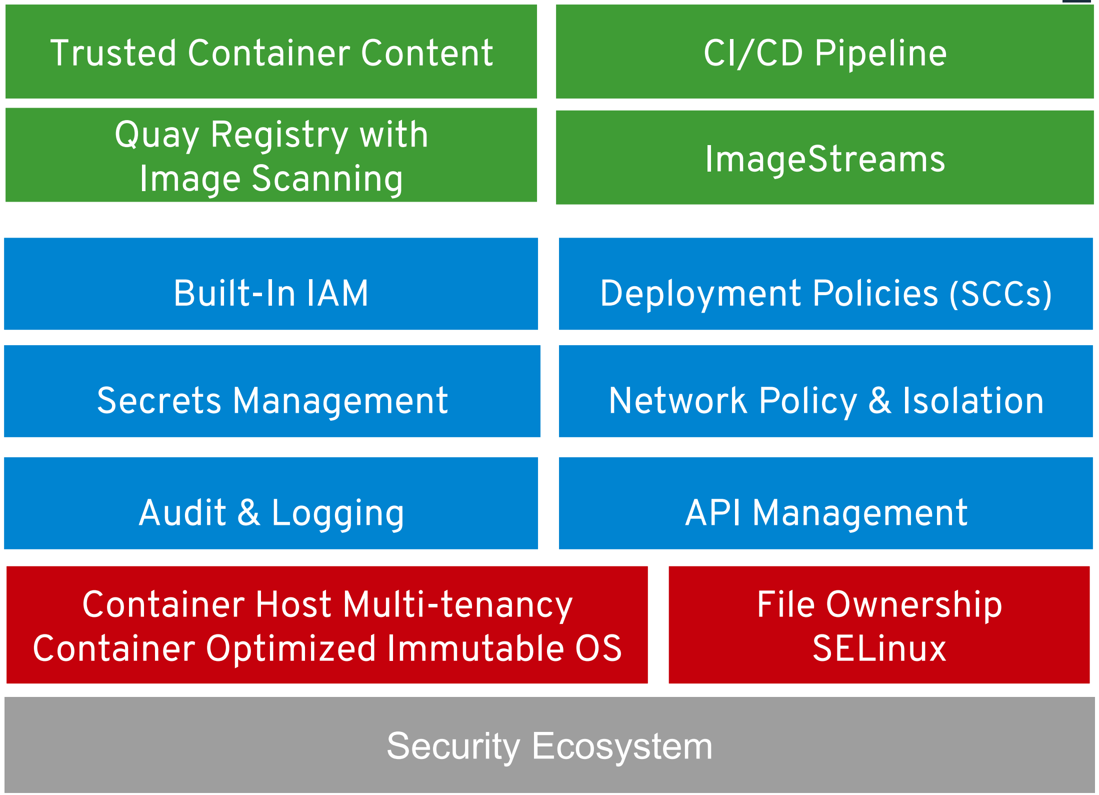
- Control service access flow with OpenShift Service Mesh

Networking Isolation

- East / West mutual TLS authentication with OpenShift Service Mesh
- Multus to isolate control plane / data plane (4.0)

Image Security

- Clair v3 covers more content



Trusted Container Content

CI/CD Pipeline

Quay Registry with Image Scanning

ImageStreams

Built-In IAM

Deployment Policies (SCCs)

Secrets Management

Network Policy & Isolation

Audit & Logging

API Management

Container Host Multi-tenancy Container Optimized Immutable OS

File Ownership SELinux

Security Ecosystem

MULTI-TENANCY

Container Security starts with Linux Security

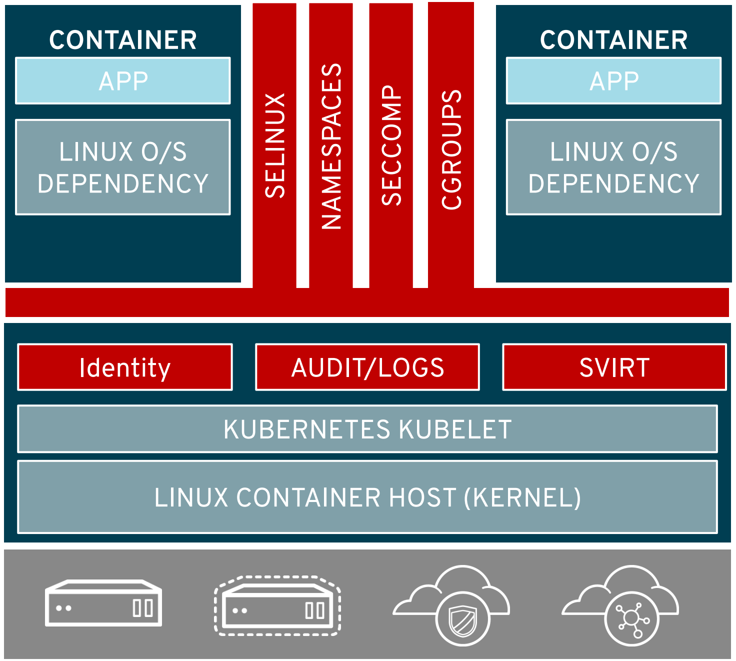
Security in the RHEL host applies to the container

SELINUX and Kernel Namespaces are the one-two punch no one can beat

Protects not only the host, but containers from each other

RHEL CoreOS provides minimized attack surface

Common Criteria certification



HARDENING TOOLS & APPLICABILITY GUIDES

Product Applicability Guides

- FISMA Moderate & FISMA (NIST)
- ISO 27001
- PCI-DSS
- PCI-DSS Reference Architecture
- AVG

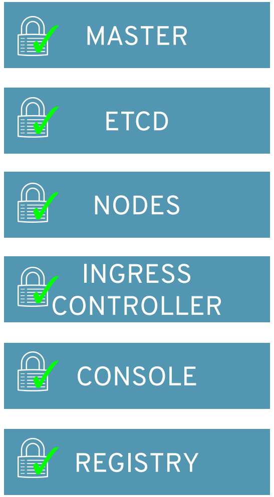
OpenShift Hardening Guide for OpenShift 4.

Upstream, 3rd party tools

- docker-bench
- kube-bench

Certificates and Certificate Management

- OpenShift provides its own internal CA
- Certificates are used to provide secure connections to
  - master (APIs) and nodes
  - Ingress controller and registry
  - etcd
  - optional: services/pods
- Certificate rotation is automated
- Optionally configure external endpoints to use custom certificates
- Let’s Encrypt also supported as add-on to provide secure connections to:
  - Routes
- Istio ServiceMesh provides equal functionality



MASTER

ETCD

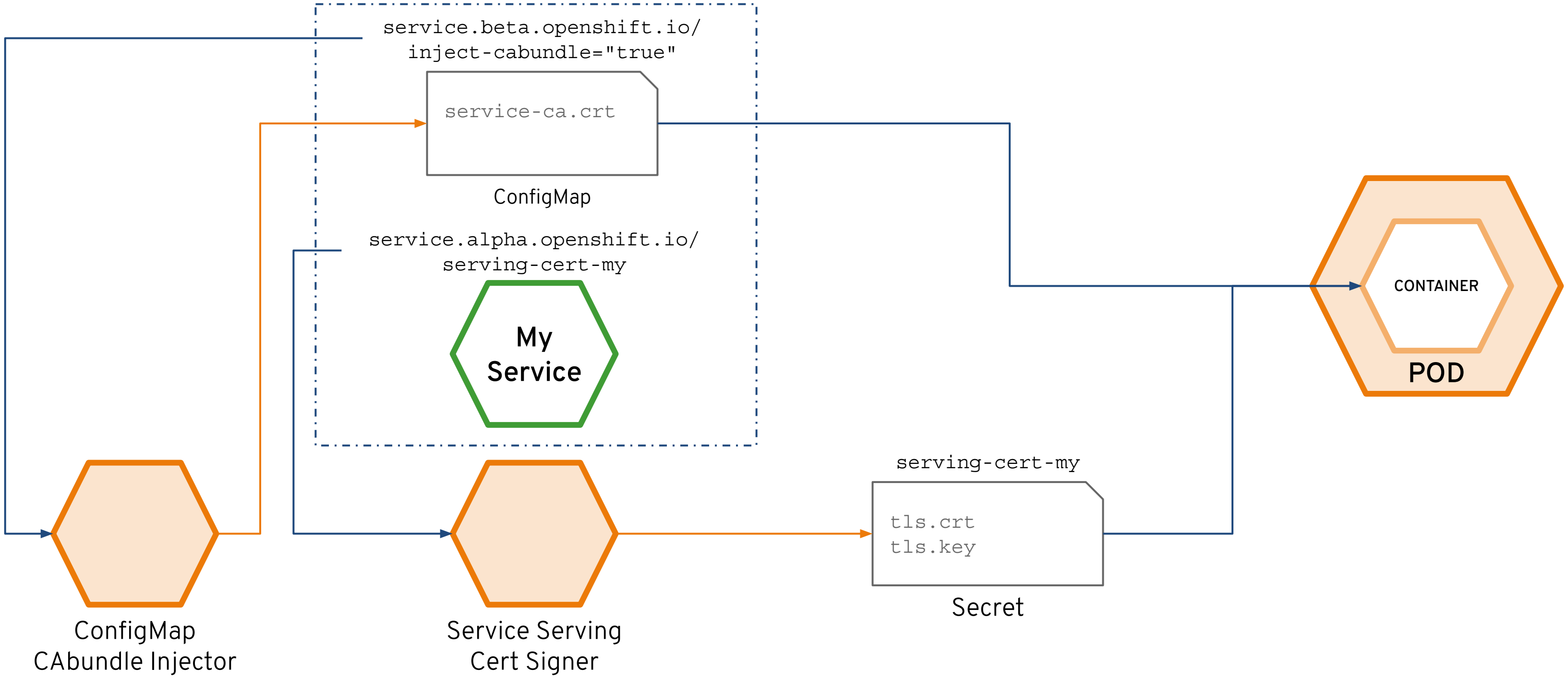
NODES

INGRESS CONTROLLER

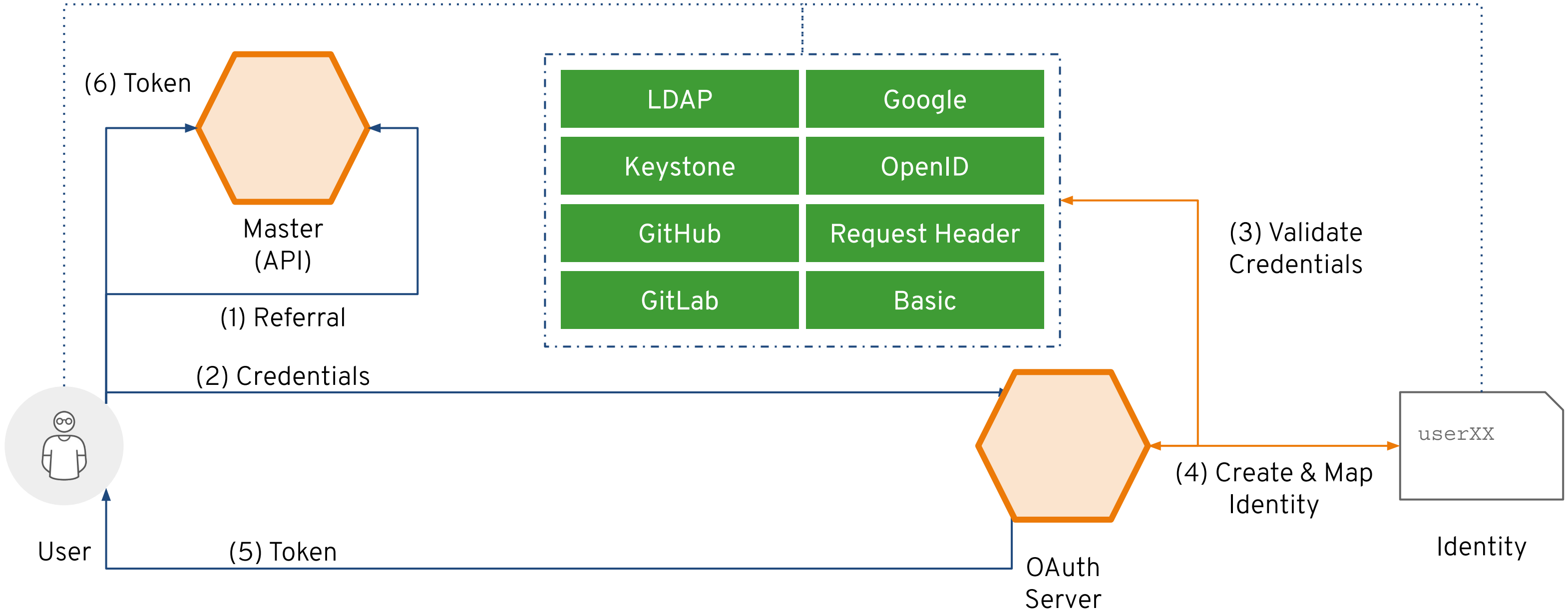
CONSOLE

REGISTRY

Service Certificates



Identity and Access Management



LDAP	Google
Keystone	OpenID
GitHub	Request Header
GitLab	Basic

IDENTITY AND ACCESS MANAGEMENT

OpenShift includes an OAuth server, which does three things:

- Identifies the person requesting a token, using a configured identity provider
- Determines a mapping from that identity to an OpenShift user
- Issues an OAuth access token which authenticates that user to the API

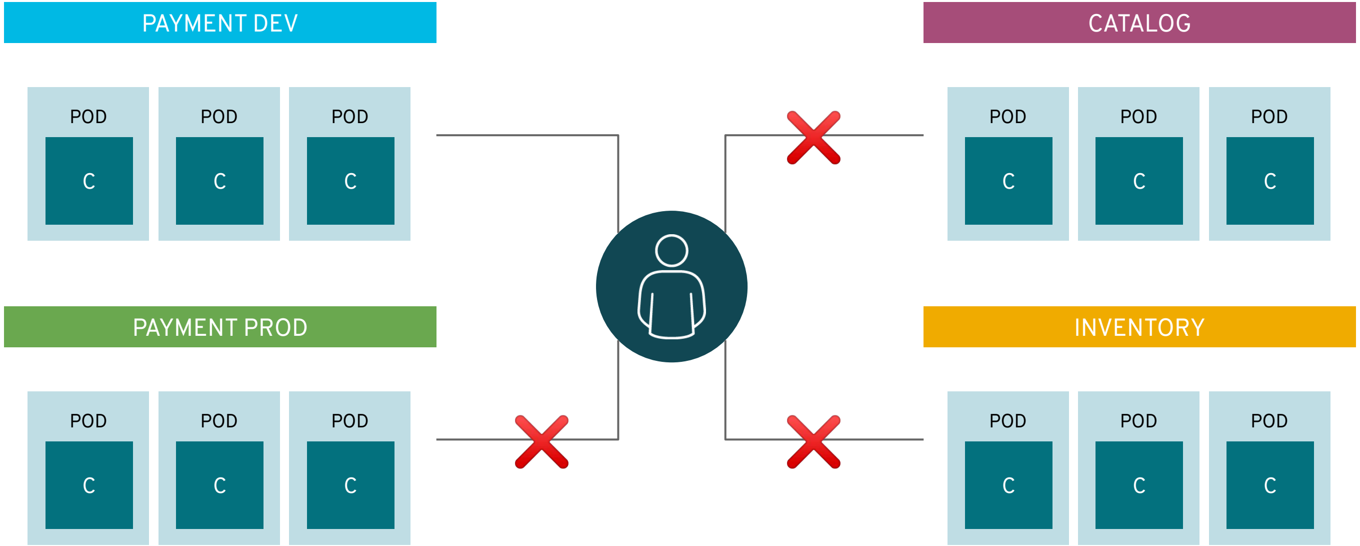
[Managing Users and Groups in OpenShift](#)
[Configuring Identity Providers](#)

Supported Identity Providers include

Keystone
LDAP
GitHub
GitLab
GitHub Enterprise
Google
OpenID Connect
Security Support Provider Interface (SSPI) to support SSO flows on Windows (Kerberos)

PROJECTS ISOLATE APPLICATIONS

“Global” vs “Project” scoped



ROLE BASED ACCESS CONTROL

- Project scope & cluster scope available
- Matches request attributes (verb,object,etc)
- If no roles match, request is denied (deny by default)
- Operator- and user-level roles are defined by default
- Custom roles are supported

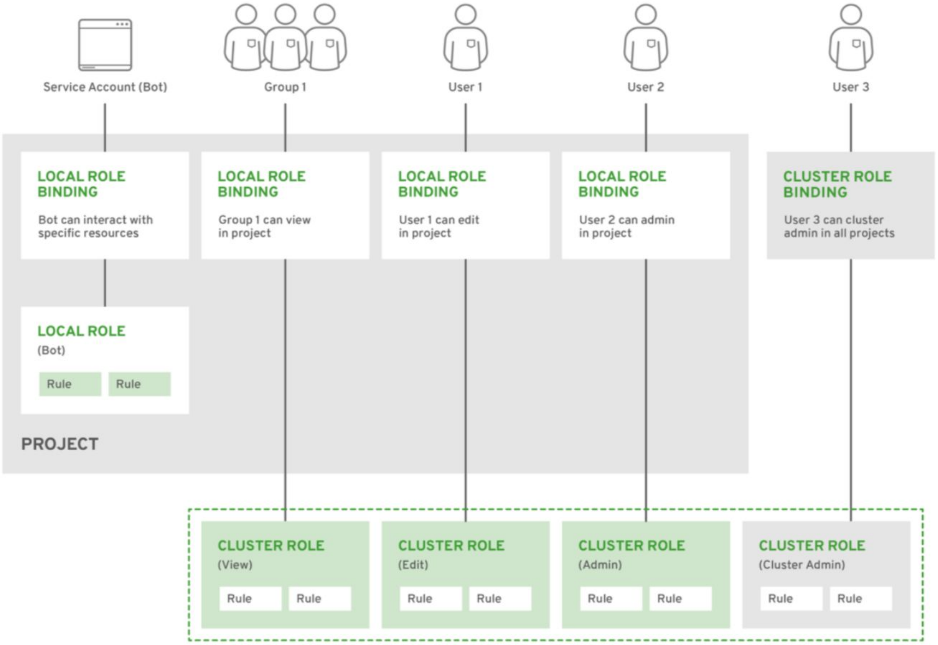


Figure 12 - Authorization Relationships

RoleBinding

```
oc get clusterroles |egrep "^(view|edit|admin)"
oc get roles

oc describe clusterrole/view
cat >view.yml
oc policy add-role-to-user --role-namespace=<project> view-secrets <username>
oc get roles,rolebindings
oc policy who-can list secrets

oc get serviceaccounts
oc describe sa default
oc describe secret <default-token-34c0o>
oc rsh dc/httpd
# cd /run/secrets/kubernetes.io/serviceaccount/
# ls
# cat token
oc login --token=<token>
oc whoami
oc get all
```

```
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: view-secrets
rules:
- apiGroups:
  - ""
resources:
- secrets
verbs:
  - list
  - get
```

RUNTIME SECURITY POLICIES

SCC (Security Context Constraints)

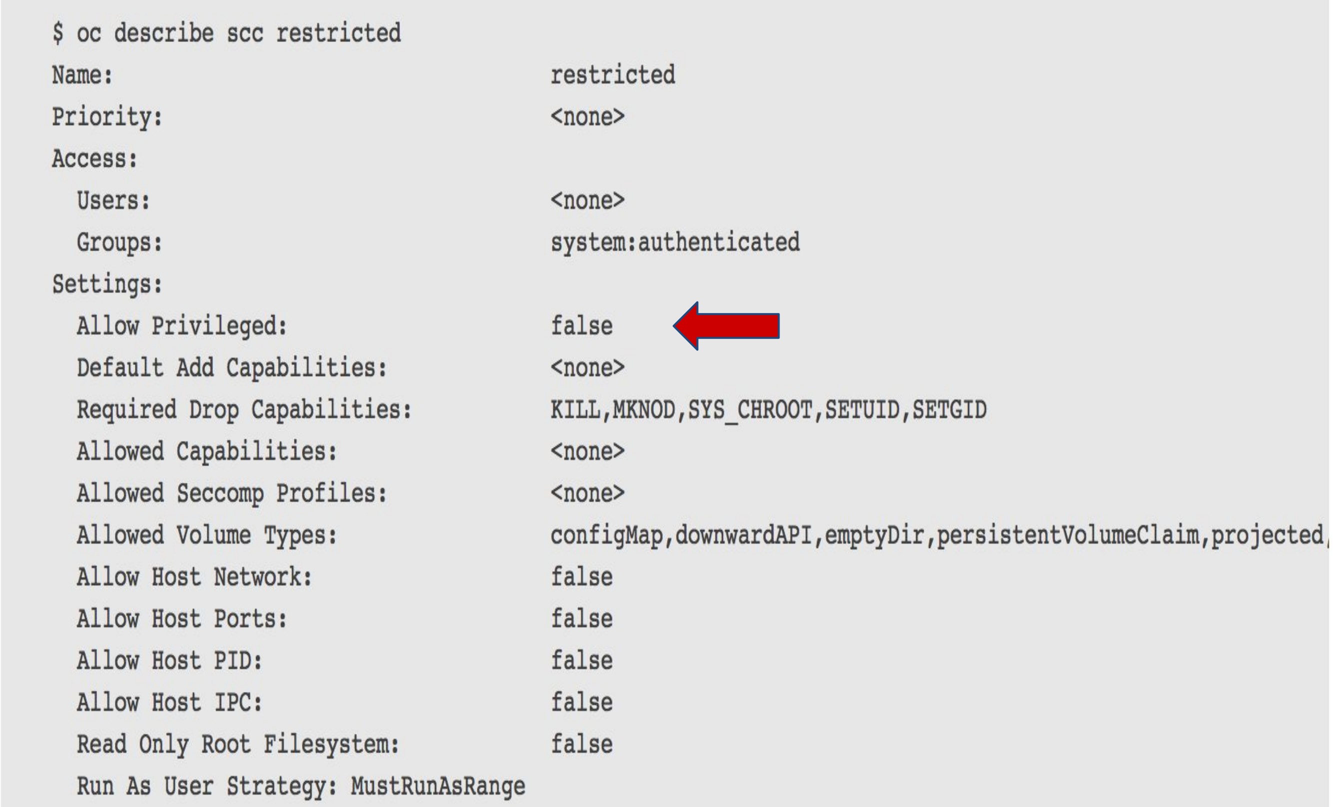
Allow administrators to control permissions for pods

Restricted SCC is granted to all users

By default, no containers can run as root

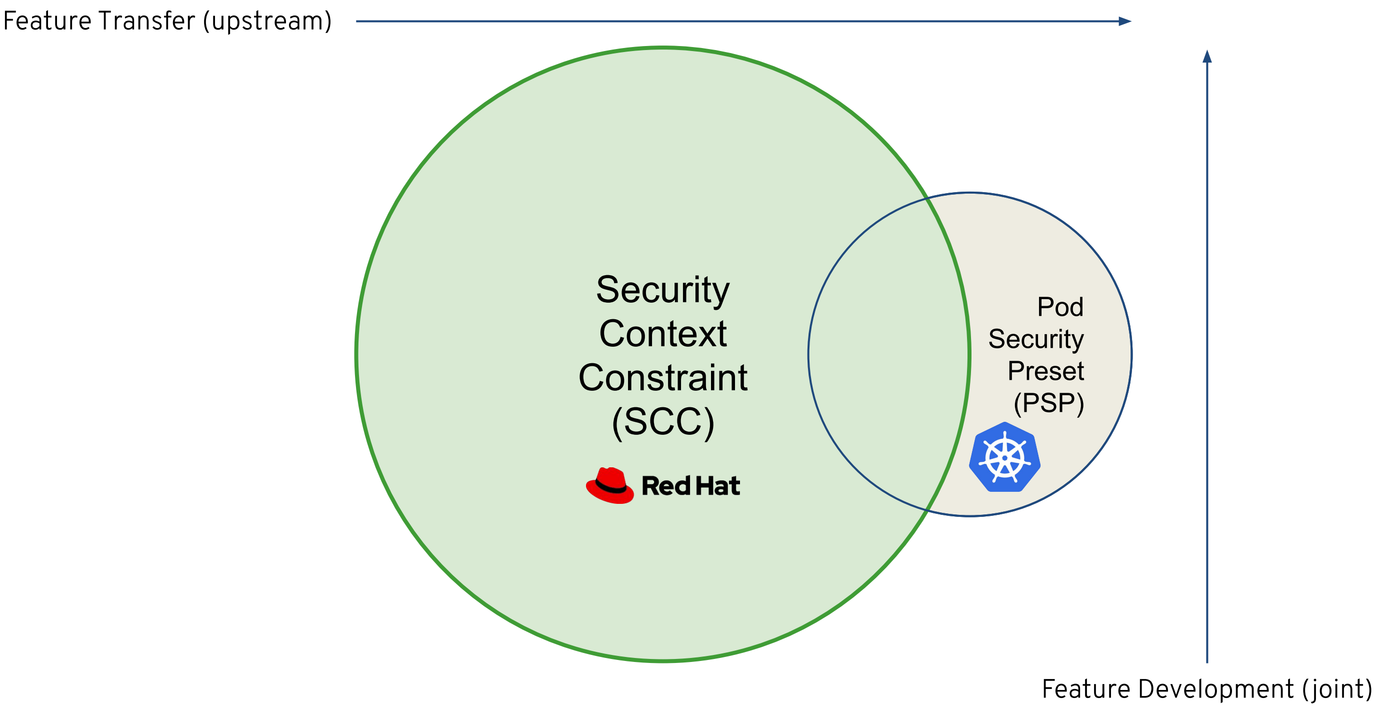
Admin can grant access to privileged SCC

Custom SCCs can be created



```
$ oc describe scc restricted
Name:                                   restricted
Priority:                               <none>
Access:
  Users:                                <none>
  Groups:                               system:authenticated
Settings:
  Allow Privileged:                     false
  Default Add Capabilities:             <none>
  Required Drop Capabilities:           KILL,MKNOD,SYS_CHROOT,SETUID,SETGID
  Allowed Capabilities:                 <none>
  Allowed Seccomp Profiles:             <none>
  Allowed Volume Types:                 configMap,downwardAPI,emptyDir,persistentVolumeClaim,projected,
  Allow Host Network:                   false
  Allow Host Ports:                     false
  Allow Host PID:                       false
  Allow Host IPC:                       false
  Read Only Root Filesystem:            false
  Run As User Strategy: MustRunAsRange
```

Extended Depth of Protection


Feature Transfer (upstream)
Security Context Constraint (SCC)
Red Hat
Pod Security Preset (PSP)
Feature Development (joint)

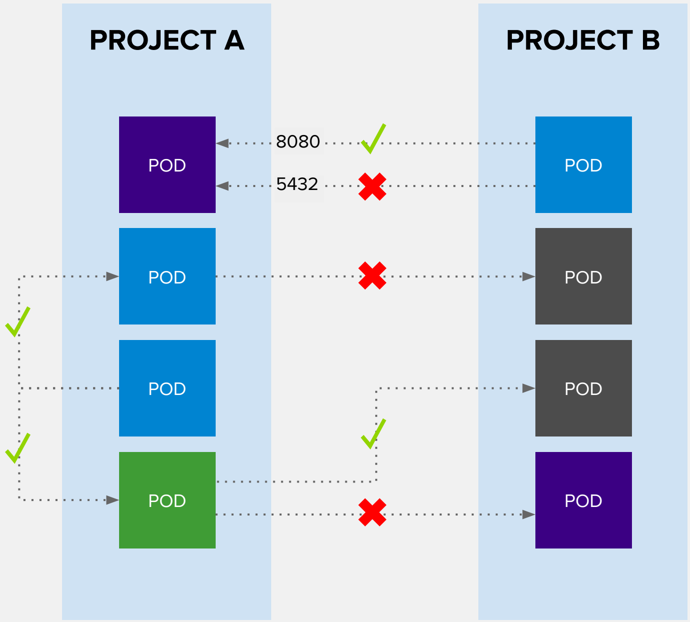
```
> oc adm policy add-scc-to-user privileged -z system:serviceaccount:workshop-sterburg:default
```

Privilege Escalation

```
> oc create serviceaccount httpd-root
> oc get serviceaccounts #sa
> oc get securitycontextconstraints #scc
> oc adm policy add-scc-to-user privileged -z httpd-root
> oc get -o yaml scc/privileged
> oc set serviceaccount dc/httpd httpd-root
> oc set volume --add dc/httpd --type=hostPath --path=/ -m /host
> oc edit dc/httpd
> oc rsh dc/httpd
# id
# ps -ef
# ls /host
```

```
kind: DeploymentConfig
spec:
  template:
    spec:
      hostPID: true
      containers:
        securityContext:
          privileged: true
          runAsUser: 0 #root
```

Network Policies



Example Policies

- Allow all traffic inside the project
- Allow traffic from green to gray
- Allow traffic to purple on 8080

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-to-purple-on-8080
spec:
  podSelector:
    matchLabels:
      color: purple
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          Name: default
    ports:
    - protocol: tcp
      port: 8080
```

NetworkPolicy

```
oc rsh dc/httpd
# curl http://httpd.workshop-<otherUser>.svc.cluster.local:8080/

oc create -f -

oc rsh dc/httpd
# curl http://httpd.workshop-<otherUser>.svc.cluster.local:8080/

oc explain NetworkPolicy.spec.ingress \
  --api-version=networking.k8s.io/v1

oc edit networkpolicy/allow-friends
```

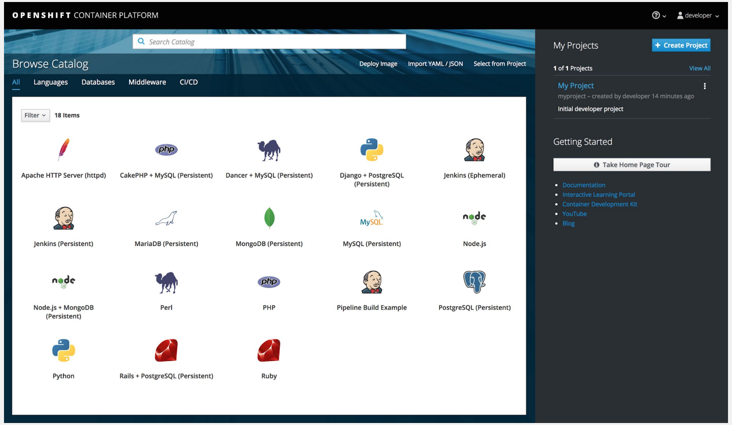
```
kind: List
items:
- kind: NetworkPolicy
  apiVersion: networking.k8s.io/v1
  metadata:
    name: deny-all
  spec:
    podSelector: {}
- apiVersion: networking.k8s.io/v1
  kind: NetworkPolicy
  metadata:
    name: allow-myself
  spec:
    podSelector:
    ingress:
    - from:
      - podSelector: {}
    - from:
      - namespaceSelector:
          matchLabels:
            name: default
```

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-friends
spec:
  podSelector: {}
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          openshift.io/requester: <otherUser>
```

Templates

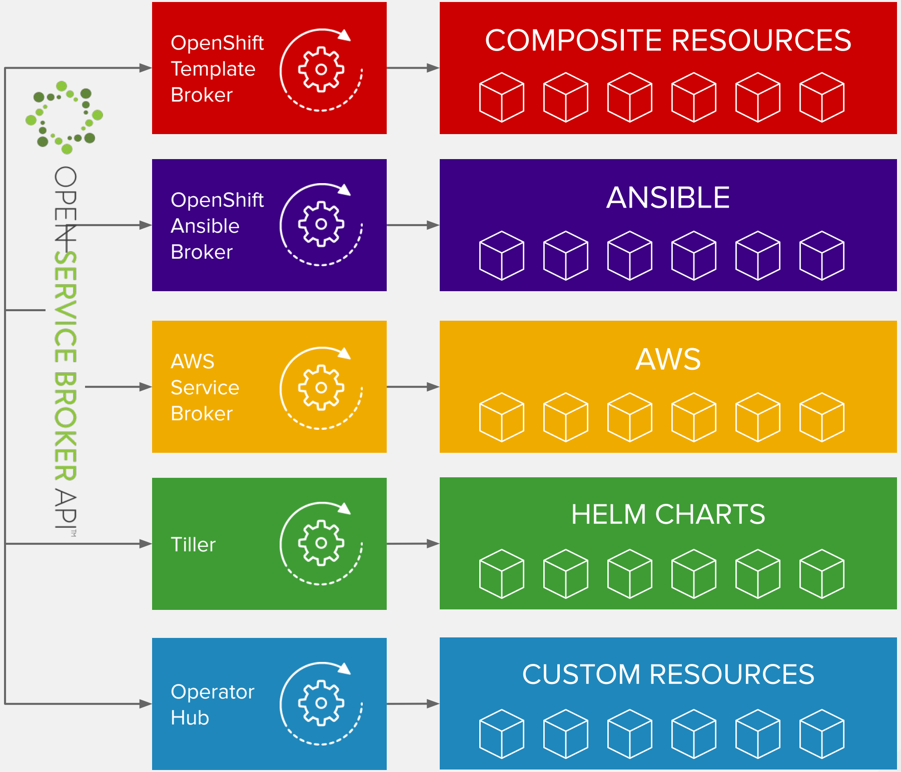
Easily deploy a complete application stack comprised of multiple services.

SERVICE CATALOG



My Project
myproject – created by developer 14 minutes ago
Initial developer project

OPENSHIFT DEVELOPER CATALOG



OpenShift Templates

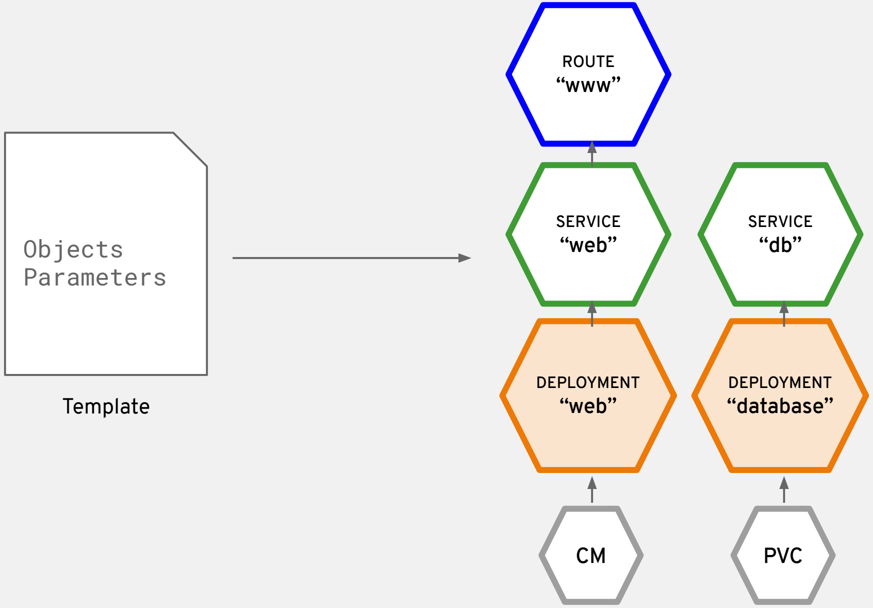
Ansible Playbook Bundles

AWS Services

Helm Charts

Operators

a `Template` is a list of composite resources



```
apiVersion: template.openshift.io/v1
kind: Template
metadata:
  name: tomcat9-mysql-persistent-s2i
  namespace: openshift
objects:
- apiVersion: v1
  kind: Service
  metadata:
    name: ${APPLICATION_NAME}
  spec:
    ports:
    - port: ${LISTEN_PORT}
      targetPort: 8080
- apiVersion: v1
  kind: Service
  metadata:
    name: ${APPLICATION_NAME}-mysql
  spec:
    ports:
    - port: 3306
parameters:
- displayName: Application Name
  name: APPLICATION_NAME
  required: true
  value: jws-app
  from: '[A-Z0-9]{8}'
  generate: expression
```

```
> oc create -f template.yaml
```

Templates

```
oc get templates -n openshift
oc new-app mysql-persistent

oc get -o yaml --export \
  is/httpd dc/httpd svc/httpd \
  secret/mysql svc/mysql pvc/mysql dc/mysql \
  >template.yaml
vi template.yaml  #cleanup, parameterize
vi prod.properties

oc new-project template-<username>
oc new-app \
   -f template.yaml \
   -p APPLICATION_NAME=myhttpd \
   --param-file=prod.properties
oc process \
   -f template.yaml \
   -p APPLICATION_NAME=otherhttpd \
   --param-file=prod.properties \
 |oc apply -f -
oc -n openshift create -f template.yaml

oc delete project template-<username>
```

```
prod.properties:

MEMORY_LIMIT=2Gi
VOLUME_CAPACITY=1Gi
MYSQL_ROOT_PASSWORD=production
```

a `Template` is useful for:

- Infrastructure-as-Code
  - Stored in Git
    - Alongside your app code as deployment instructions
    - Peer Review
- Sharing your app-stack with others (Service Catalog)
- CI/CD
- Release Management

```
> oc create -f http://raw.github.com/openshift/examles.git/template.yaml
```