OpenShift 4

Making introductions

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

Agenda

Day 1 - Overview
- Cloud-Native market
- Container Concepts
- Platform Concepts
- Platform Architecture

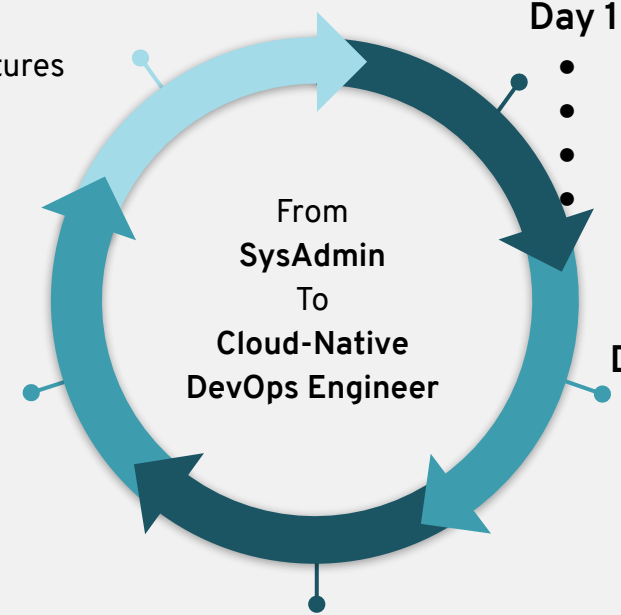
OpenShift - Technical Deep Dive

Day 2 - App Deployment
- Technical Deep Dive
- Workload: Scheduling
- Wiring: Services, Routes
- Storage: Persistent Volumes

Day 3 - Securing your App
- Network Policies
- Runtime Security
- RBAC

Day 4 - App Build
- Source-2-Image
- Jenkins
- Labs

Day 5 - Best Practises
- 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/CPET/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}

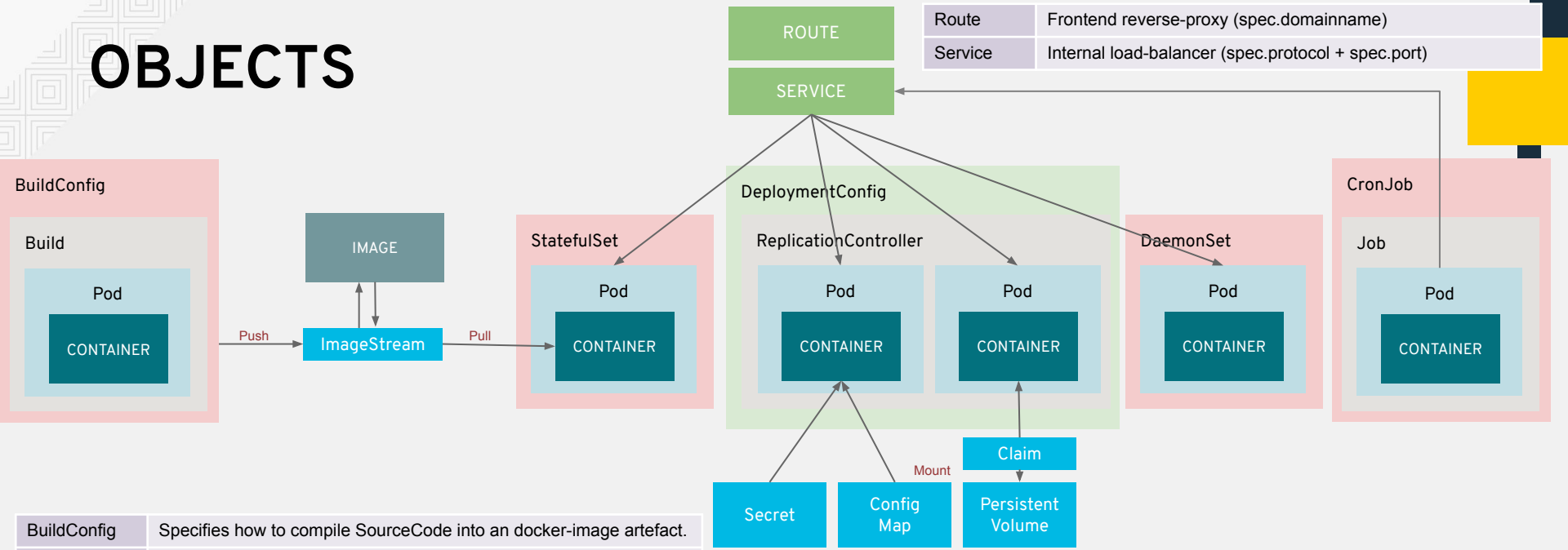
oc get pod myapp-1-abcde

{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)



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.

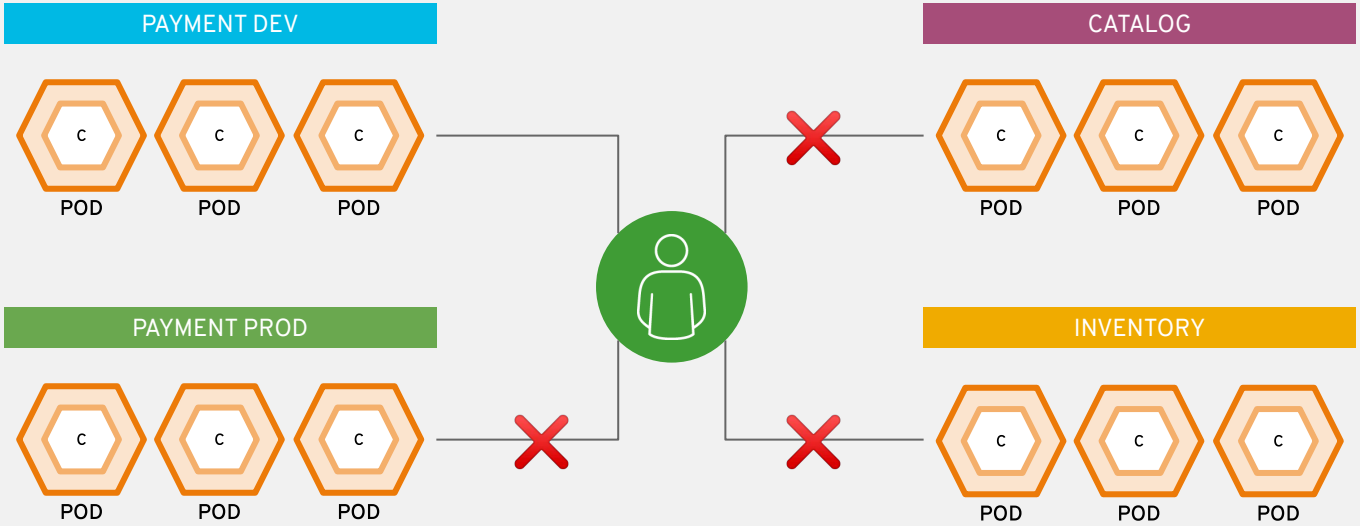
Recap - day 4

Do you still remember?

Kubernetes Resource Definitions

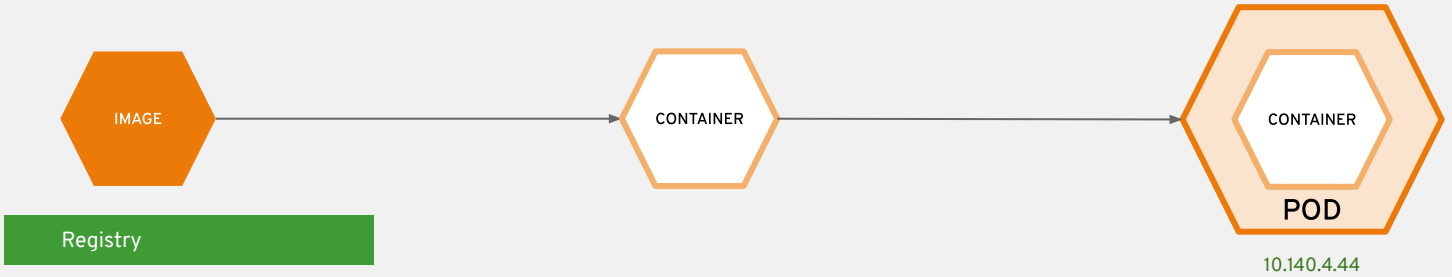
What types of workloads can you deploy on top of a Container Platform...

projects isolate apps across environments, teams, groups and departments



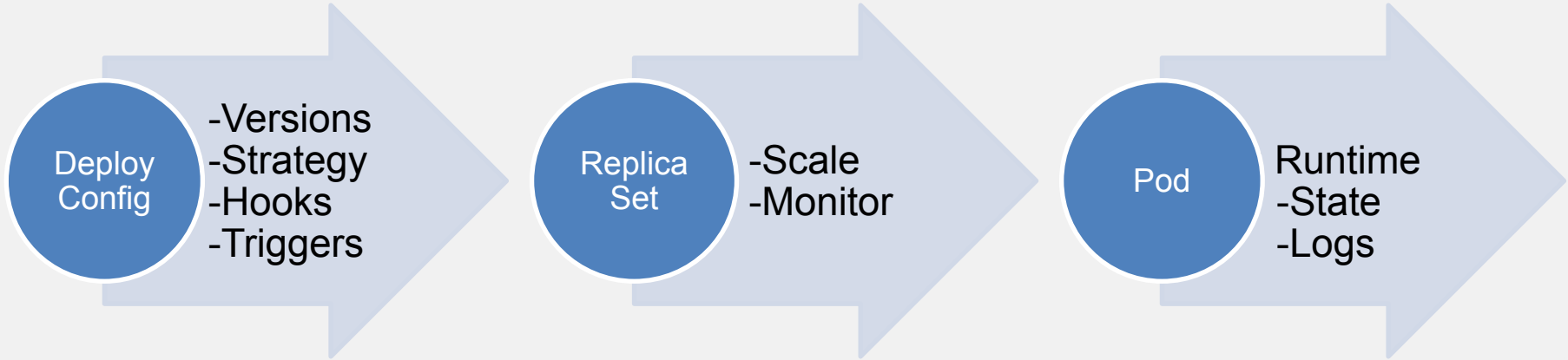
> oc new-project workshop-<vdi-user>
> oc project

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

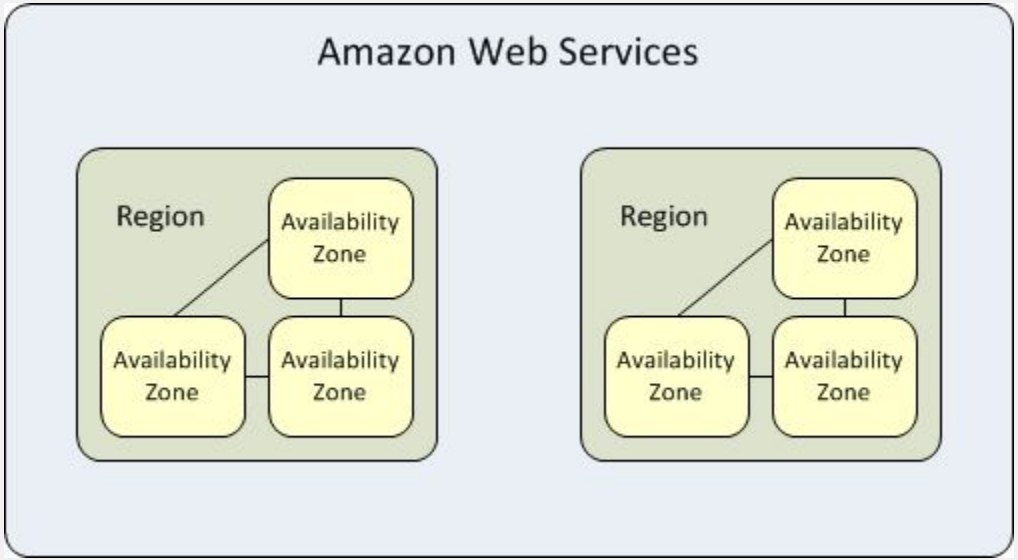
- MyJBossApp-v1 (2x)
- MyJBossApp-v2 (4x)

- 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/
```

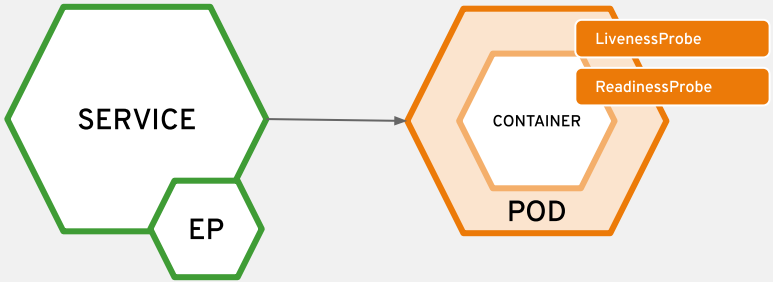
PLACEMENT BY POLICY
Pod Affinity rules



Preferred vs Required
Affinity vs Anti-Affinity
- Nodes
- Services
- Persistent Volumes

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

Health Checks

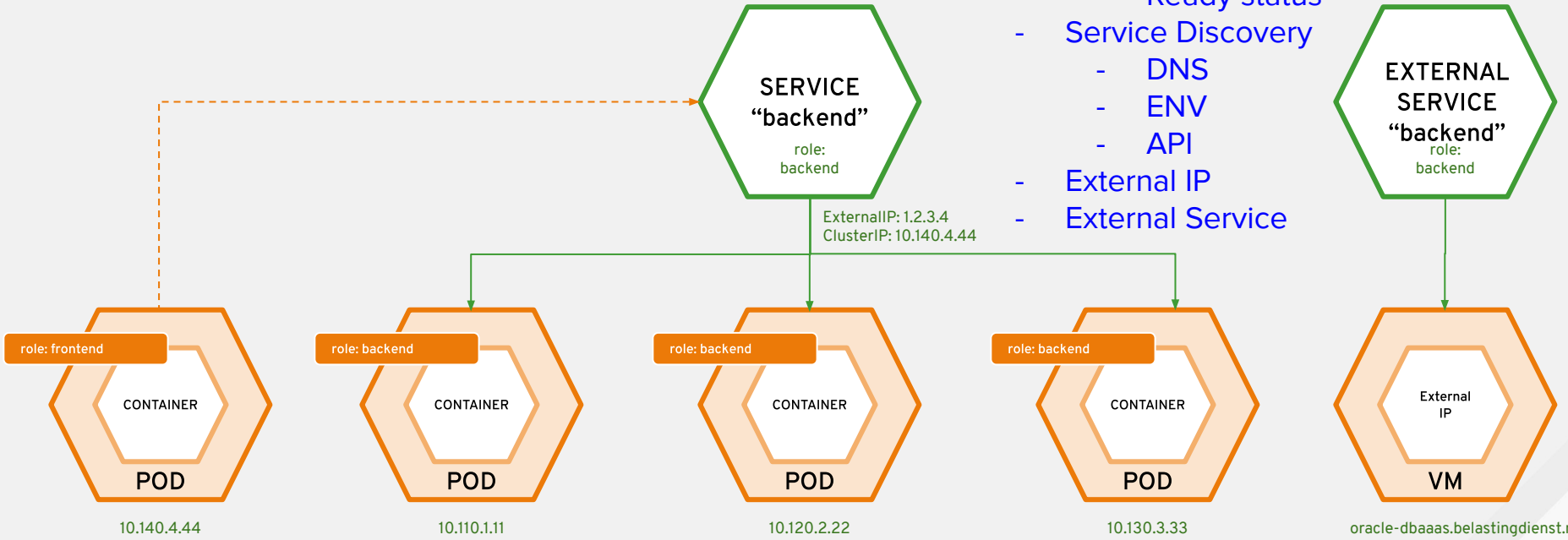


- LivenessProbe
- ReadinessProbe
  - HTTP
  - TCP
  - Shell

```
> 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
```

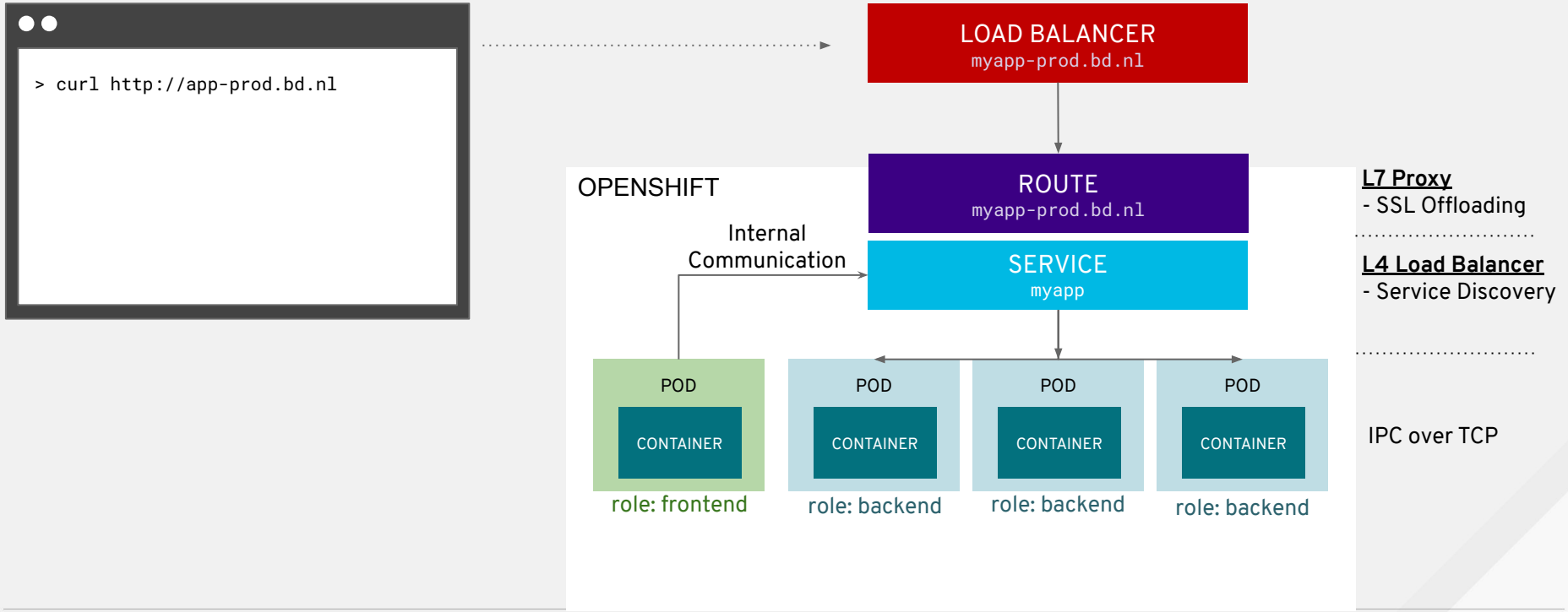
services provide internal load-balancing

- Load-Balancing
  - Ready status
- Service Discovery
  - DNS
  - ENV
  - API
- External IP
- External Service

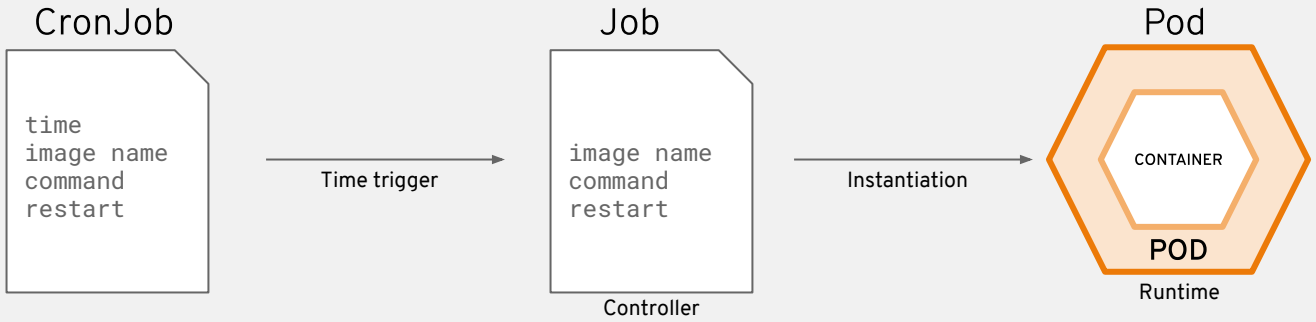


> oc describe svc/httpd |egrep “Selector|Endpoints”
> oc get pods -o wide -l app=httpd

ROUTING TRAFFIC

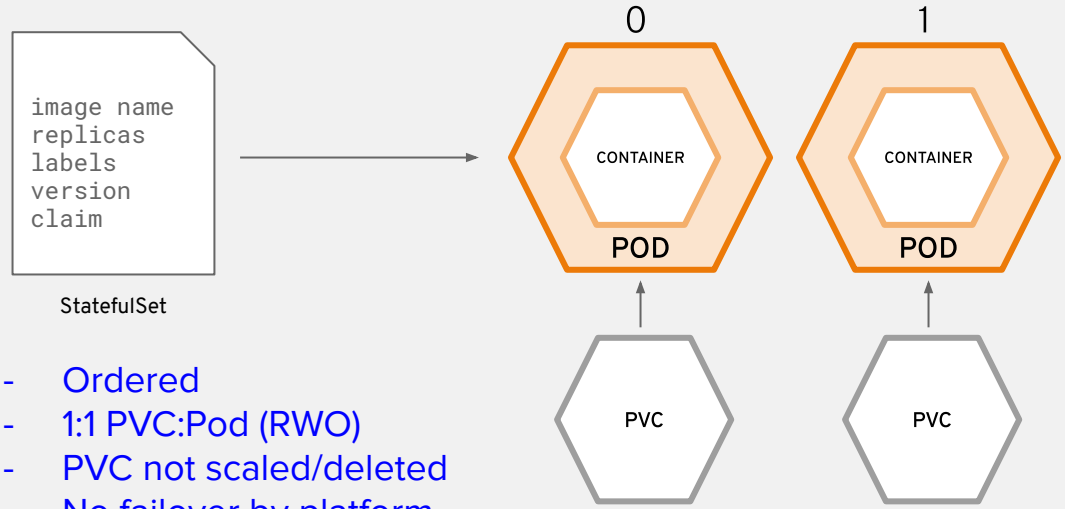


`CronJobs` run short lived pods at a specified time interval




```
> 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"] } ] } } } } } }'
```

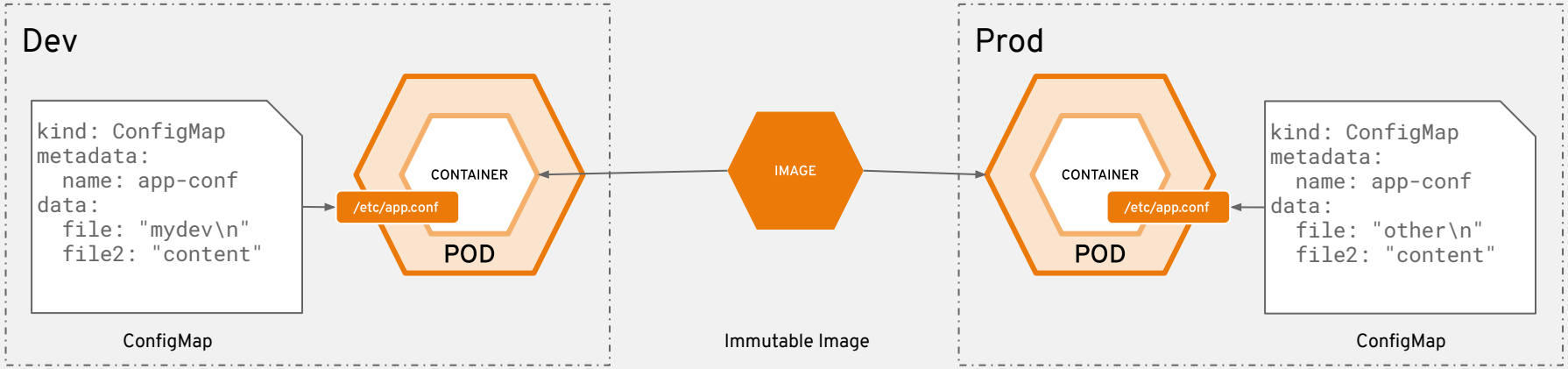
`StatefulSets` are special deployments for Stateful workloads



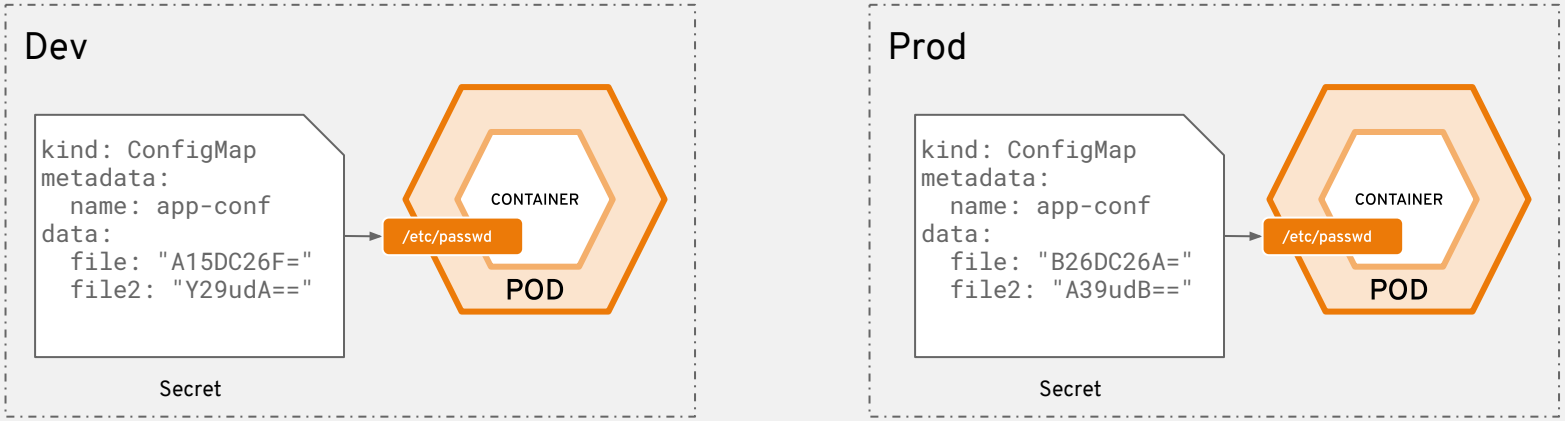
- Ordered
- 1:1 PVC:Pod (RWO)
- PVC not scaled/deleted
- No failover by platform

```yaml
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
```

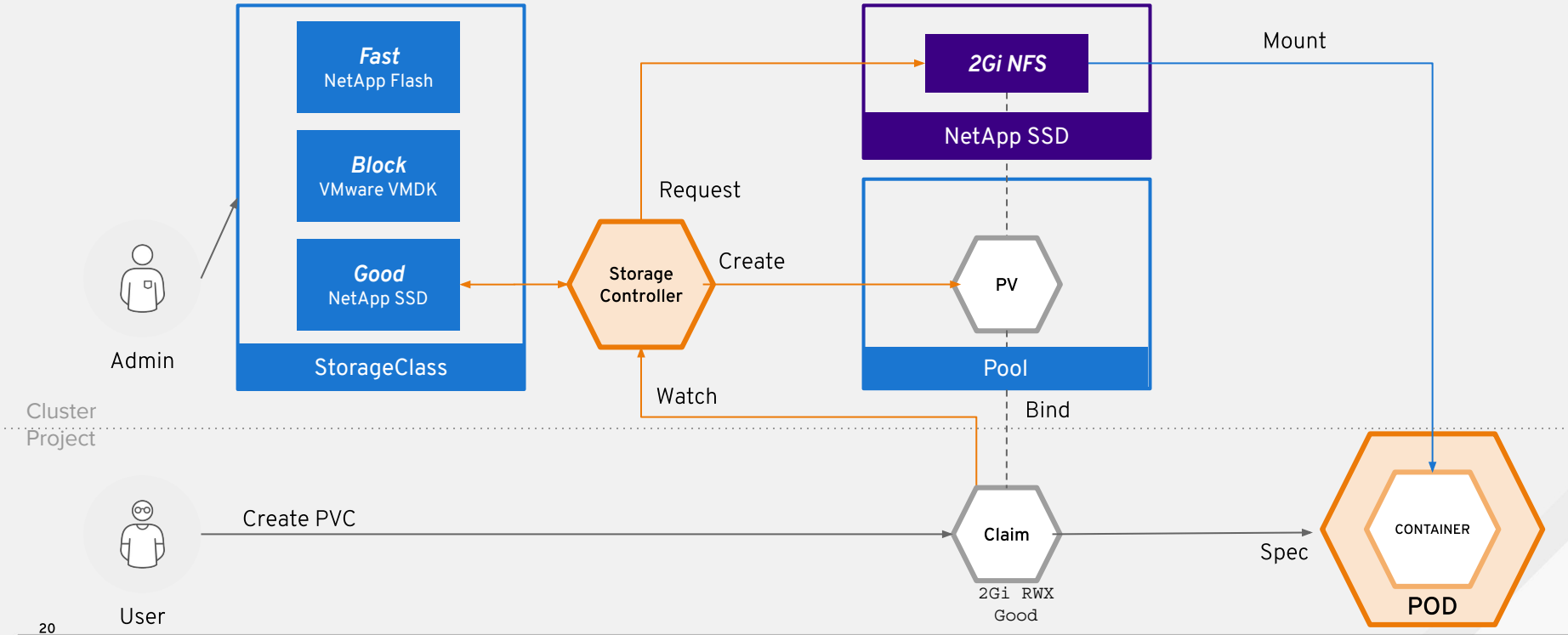
`configmaps` allow you to decouple configuration artifacts from image content



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



Dynamic Storage Provisioning



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

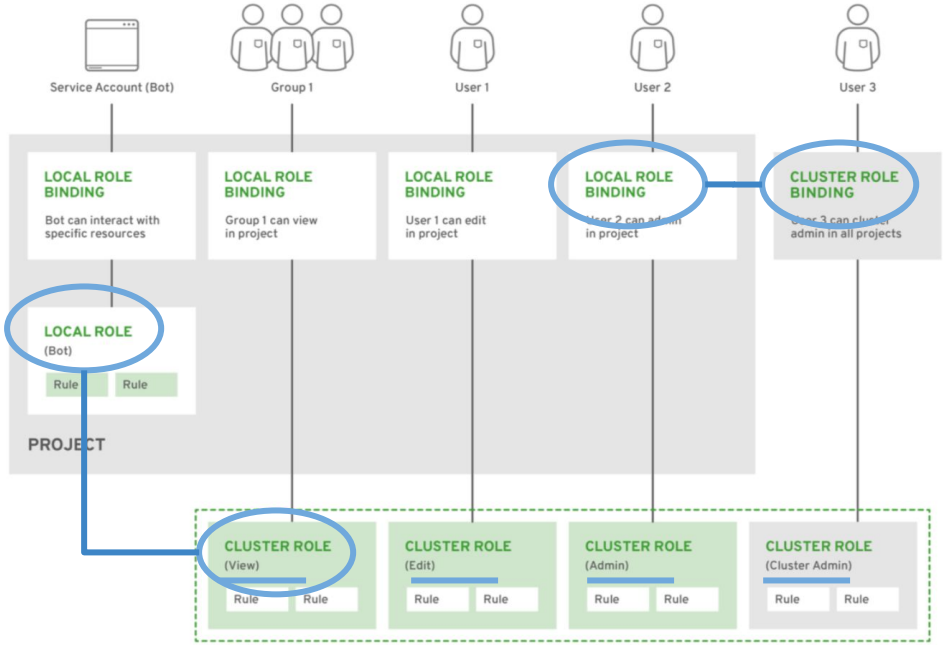


Figure 12 - Authorization Relationships

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

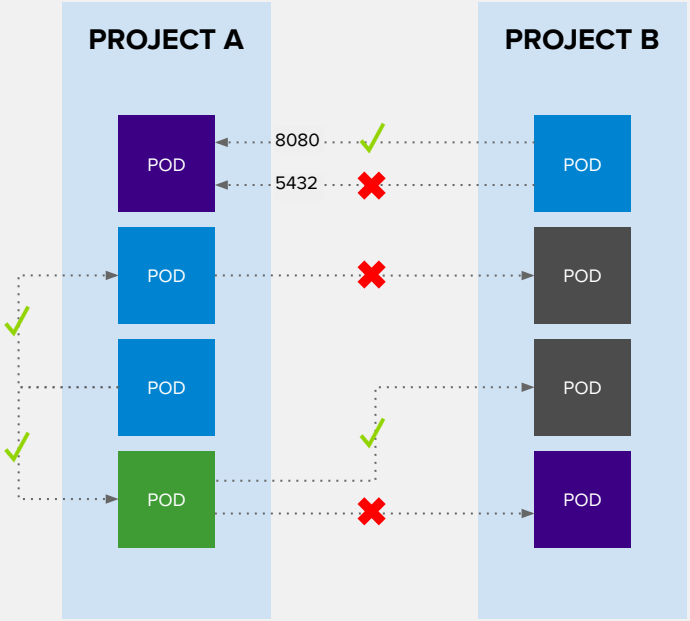
Admin can grant access to privileged SCC

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
```

Network Policies

- Internal Pod-network
- Ingress / Egress
- From / To:
  - ipBlock
  - namespaceSelector
  - podSelector
- Default allow / deny



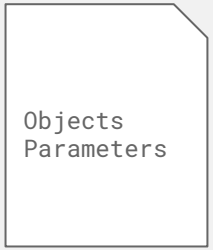
Example Policies

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

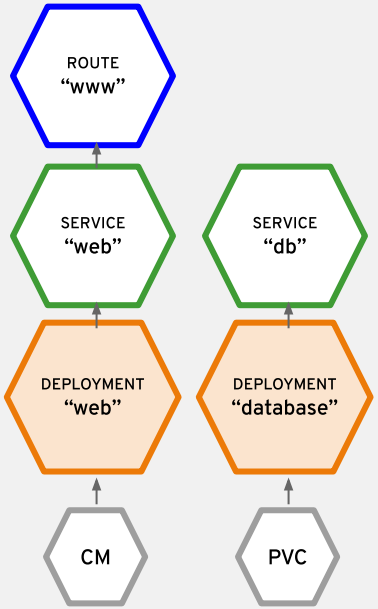
```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-to-purple-on-8080
spec:
  podSelector:
    matchLabels:
      color: purple
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          Name: default
    ports:
    - protocol: tcp
      port: 8080
```

a `Template` is a list of composite resources

- Parameter / Interpolation
- Expression generator
- No intelligence
- Param-file



Template




```
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
```



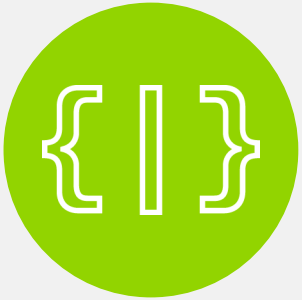
```
> oc create -f template.yaml
```

Build & Deploy Images

Let’s discuss the built-in CI/CD tools and processes

BUILD CONTAINER IMAGES

BUILD FROM BINARY



BUILD FROM SOURCE CODE

BUILD FROM Dockerfile

BUILD FROM Jenkinsfile

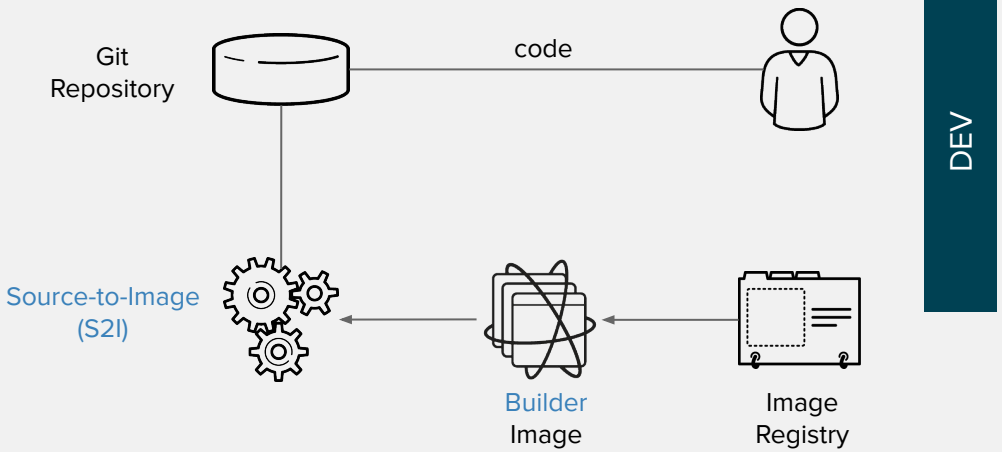
CUSTOM BUILDER IMAGE

- Git
- S2I Builder Image needed
- Build tools included
- Bash scripts

BUILD

S2I starts a builder containers using the chosen builder image (language and application runtime) and a /tmp/src mounted with source-code from the git repository. Executes the /usr/local/s2i/assemble script. Resulting in a new target image pushed back into the docker-registry.

BUILD SOURCE-CODE



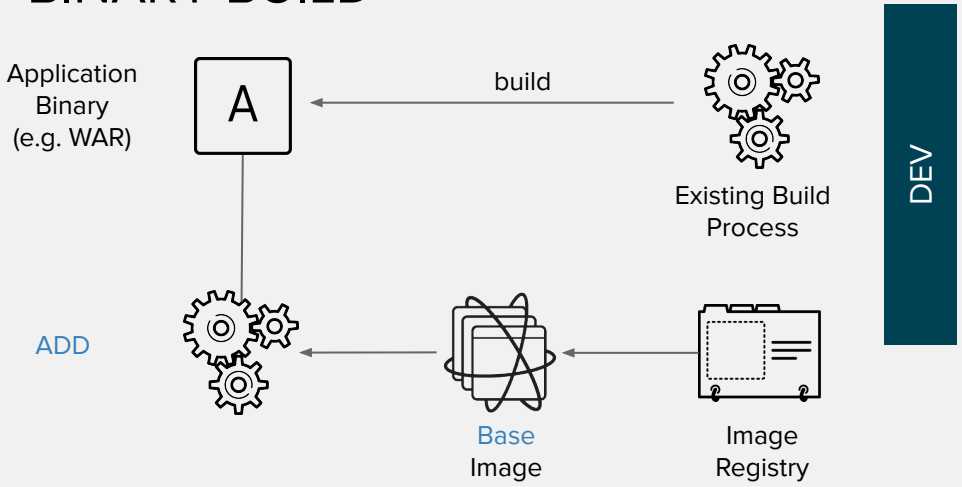
> oc new-build https:/github.com/openshift/java-example.git

- Upload file/dir
- Needs existing BuildConfig
- Source/Docker strategy supported

BUILD IMAGE

S2I adds the app binary file (e.g. JAR, WAR, EAR) as a new layer on top of the base image (language and application runtimes) and stores the resulting application image in the image registry under its new target image name.

BINARY BUILD



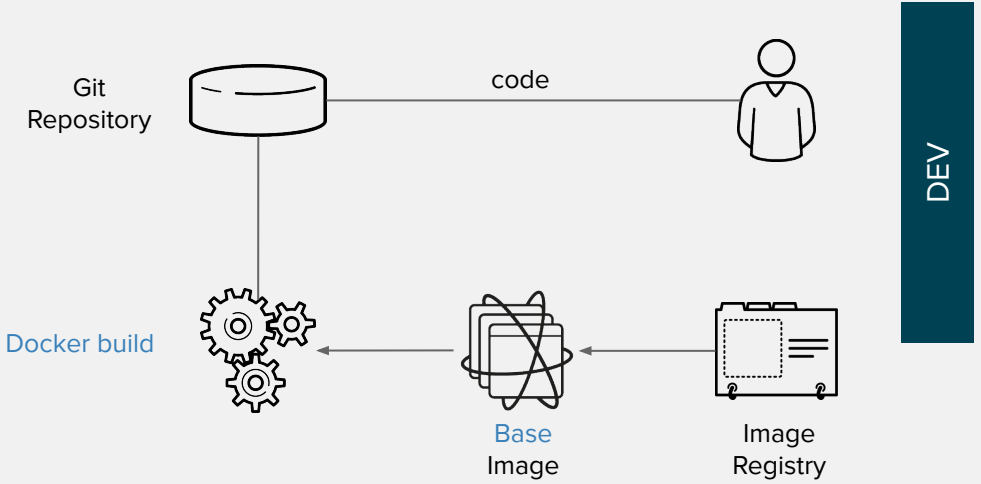

```
> oc start-build bc/mlbparks --from-dir=.
```

BUILD Dockerfile

- Git | Inline
- Traditional
- FROM replaced with IS

BUILD

S2I Build process `git clone`'s the source-code, then simply run a `docker build` to build started image.
Source image is extracted from 1st FROM line in Dockerfile.



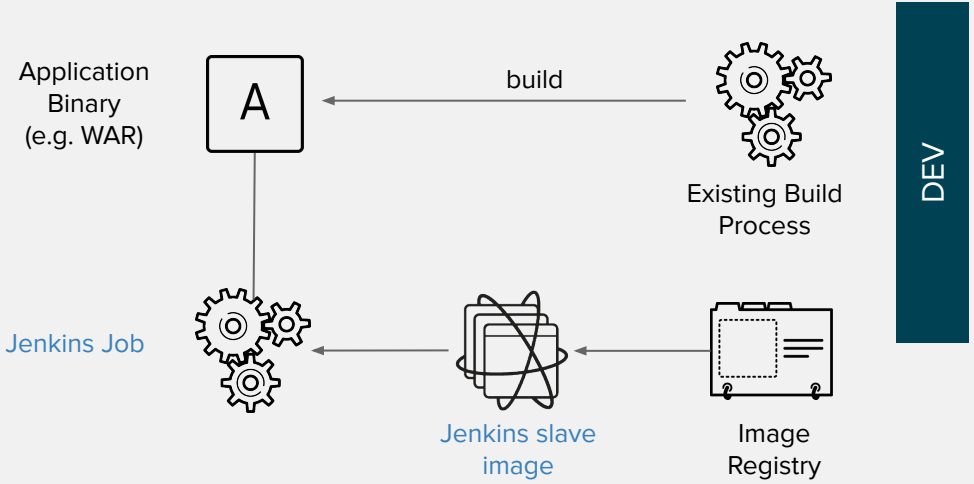
> cat Dockerfile | oc new-build myapp

BUILD Jenkinsfile

- Git | Inline
- Starts Jenkins pod + job
- OCP/K8s plugins

BUILD IMAGE

For every BuildConfig openshift creates a Job in Jenkins. For every Build openshift triggers that Jenkins Job. Jenkins takes care of everything.

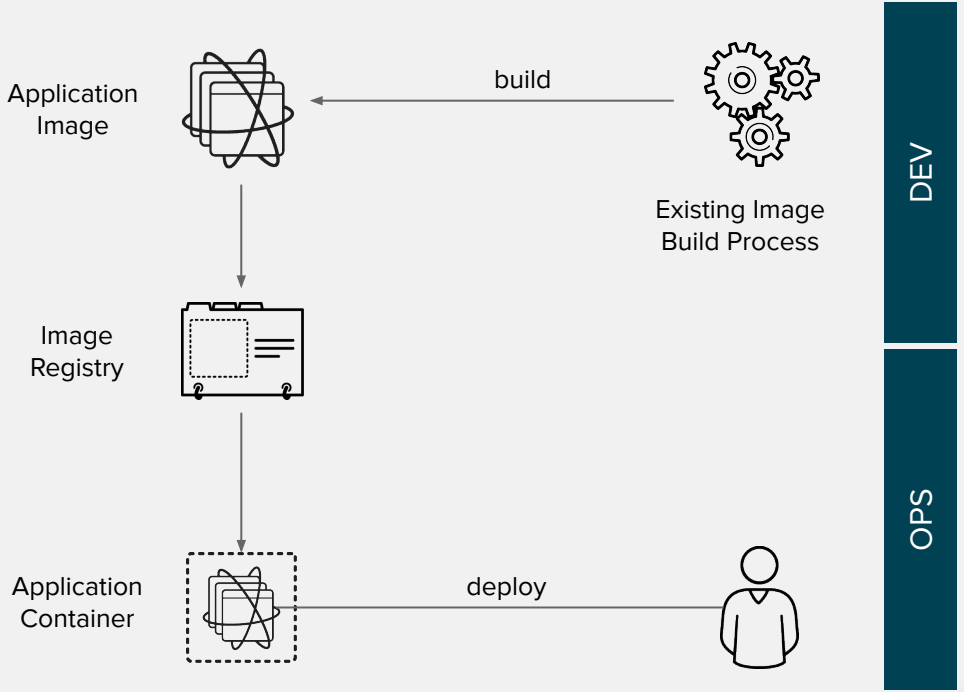


DEPLOY DOCKER IMAGE

BUILD

App images are built using an existing image build process. OpenShift automates the deployment of app containers across multiple hosts via the Kubernetes. Users can trigger deployments, rollback, configure A/B, etc

DEPLOY




```
> oc new-app external-registry/external-project/myimage:latest
```

Jenkins Integrations

Let’s discuss the Jenkins CI/CD tools and processes

CI/CD WITH BUILD AND DEPLOYMENTS

BUILDS

- Webhook triggers: build the app image whenever the code changes
- Image trigger: build the app image whenever the base language or app runtime changes
- Build hooks: test the app image before pushing it to an image registry

DEPLOYMENTS

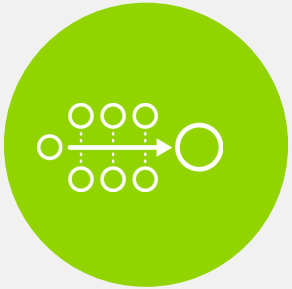
- Deployment triggers: redeploy app containers whenever configuration changes or the image changes in the OpenShift integrated registry or upstream registries

```
> oc new-app httpd-example
> oc get bc/httpd-example -o yaml |grep triggers: -A10
```

OPENSHIFT LOVES CI/CD

JENKINS-AS-A SERVICE ON OPENSHIFT

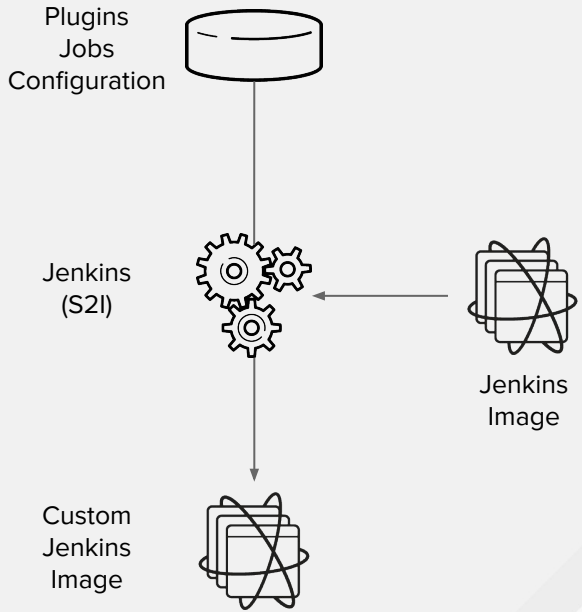
HYBRID JENKINS INFRA WITH OPENSHIFT



EXISTING CI/CD DEPLOY TO OPENSHIFT

1) JENKINS-AS-A-SERVICE ON OPENSHIFT

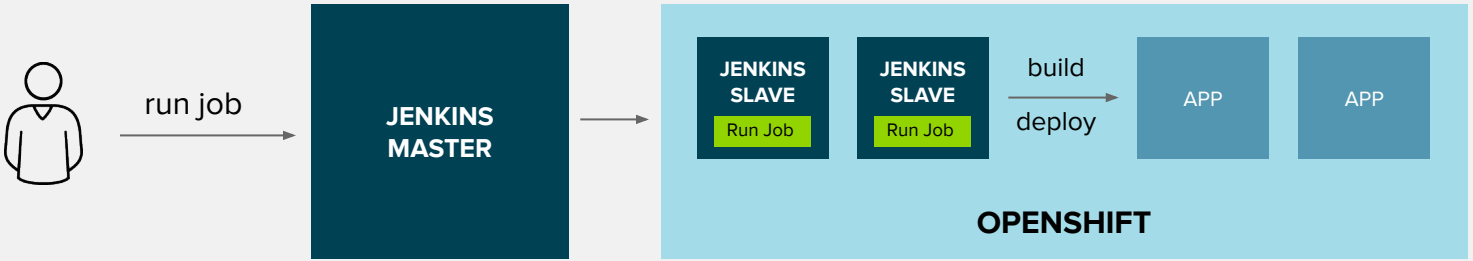
- Certified Jenkins images with pre-configured plugins
  - Provided out-of-the-box
  - Follows Jenkins 1.x and 2.x LTS versions
- Jenkins S2I Builder for customizing the image
  - Install Plugins
  - Configure Jenkins
  - Configure Build Jobs
- OpenShift plugins to integrate authentication with OpenShift and also CI/CD pipelines
- Dynamically deploys Jenkins slave containers



> oc new-app jenkins-ephemeral
> ssh master1 grep -A7 jenkinsPipelineConfig: /etc/origin/master/master-config.yaml

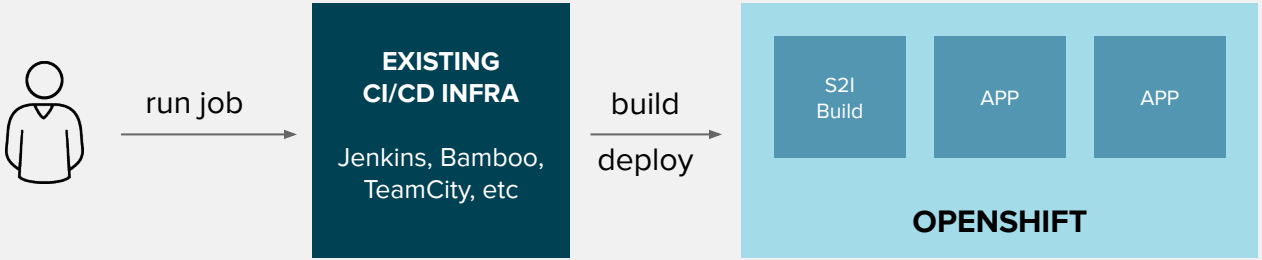
2) HYBRID JENKINS INFRA WITH OPENSHIFT

- Scale existing Jenkins infrastructure by dynamically provisioning Jenkins slaves on OpenShift
- Use Kubernetes plug-in on existing Jenkin servers



3) EXISTING CI/CD DEPLOY TO OPENSHIFT

- Existing CI/CD infrastructure outside OpenShift performs operations against OpenShift
  - OpenShift Pipeline Jenkins Plugin for Jenkins
  - OpenShift CLI for integrating other CI Engines with OpenShift
- Without disrupting existing processes, can be combined with previous alternative



OPENSHIFT PIPELINES

- OpenShift Pipelines allow defining a CI/CD workflow via a Jenkins pipeline which can be started, monitored, and managed similar to other builds
- Dynamic provisioning of Jenkins slaves
- Auto-provisioning of Jenkins server
- OpenShift Pipeline strategies
  - Embedded Jenkinsfile
  - Jenkinsfile from a Git repository

```
apiVersion: v1
kind: BuildConfig
metadata:
  name: app-pipeline
spec:
  strategy:
    type: JenkinsPipeline
    jenkinsPipelineStrategy:
      jenkinsfile: |-
        node('maven') {
          stage('build app') {
            git url: 'https://git/app.git'
            sh "mvn package"
          }
          stage('build image') {
            sh "oc start-build app --from-file=target/app.jar
          }
          stage('deploy') {
            openshiftDeploy deploymentConfig: 'app'
          }
        }
```

Provision a Jenkins slave for running Maven

Design Patterns

Commonly used

workflows

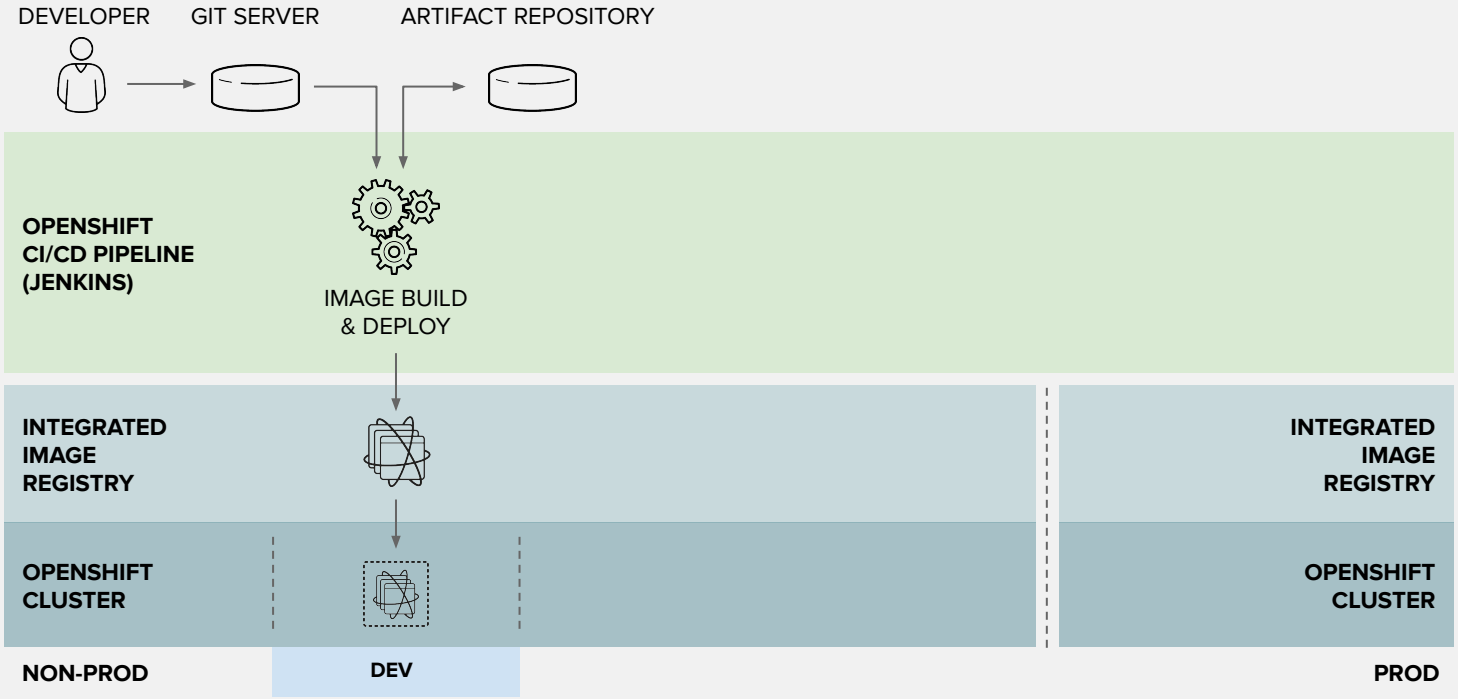
Image Promotion

Promote & Deploy into

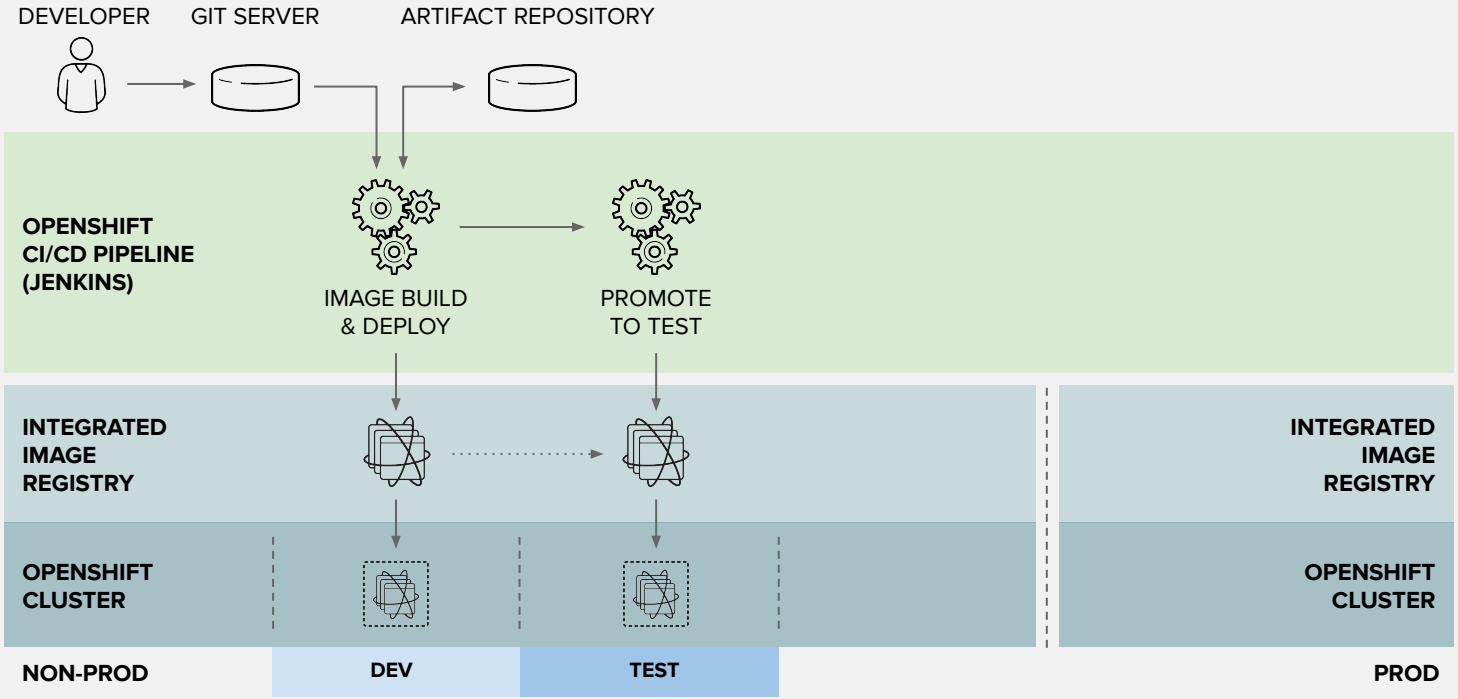
Production

automatically

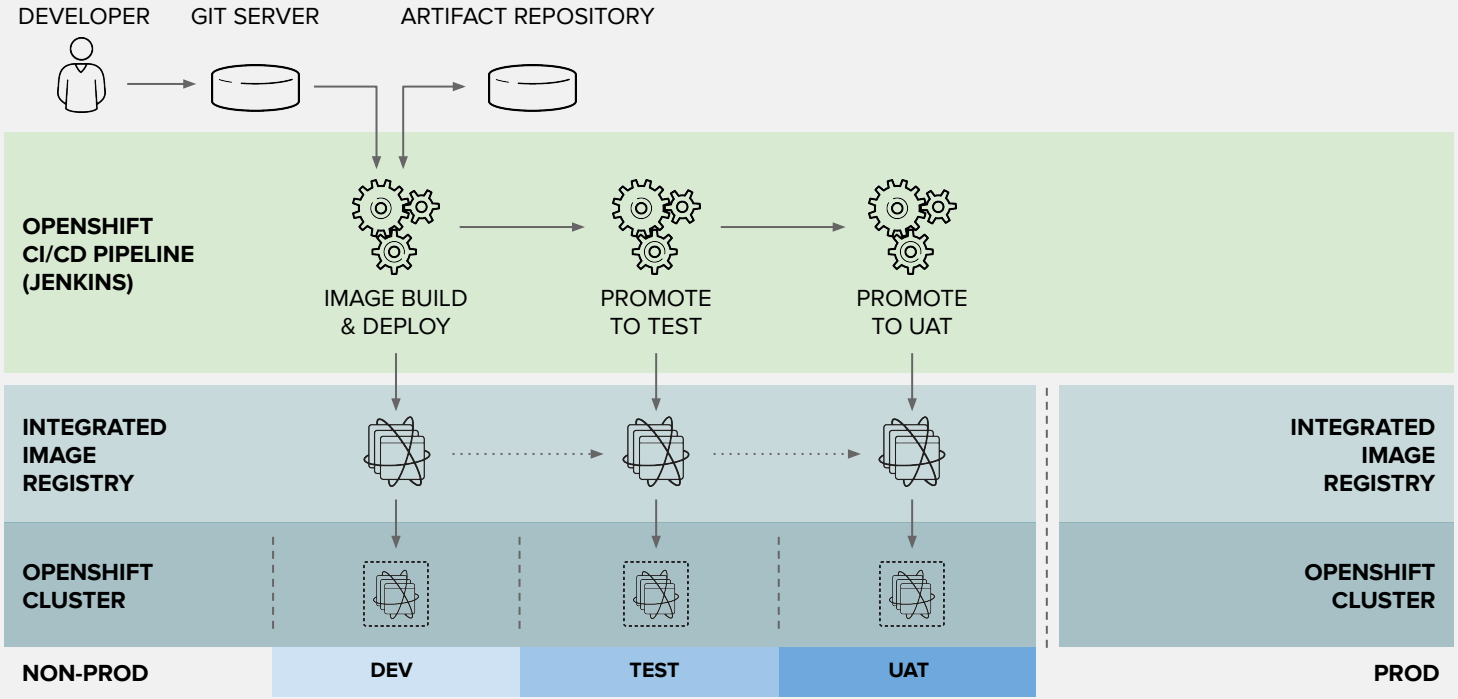
CONTINUOUS DELIVERY PIPELINE



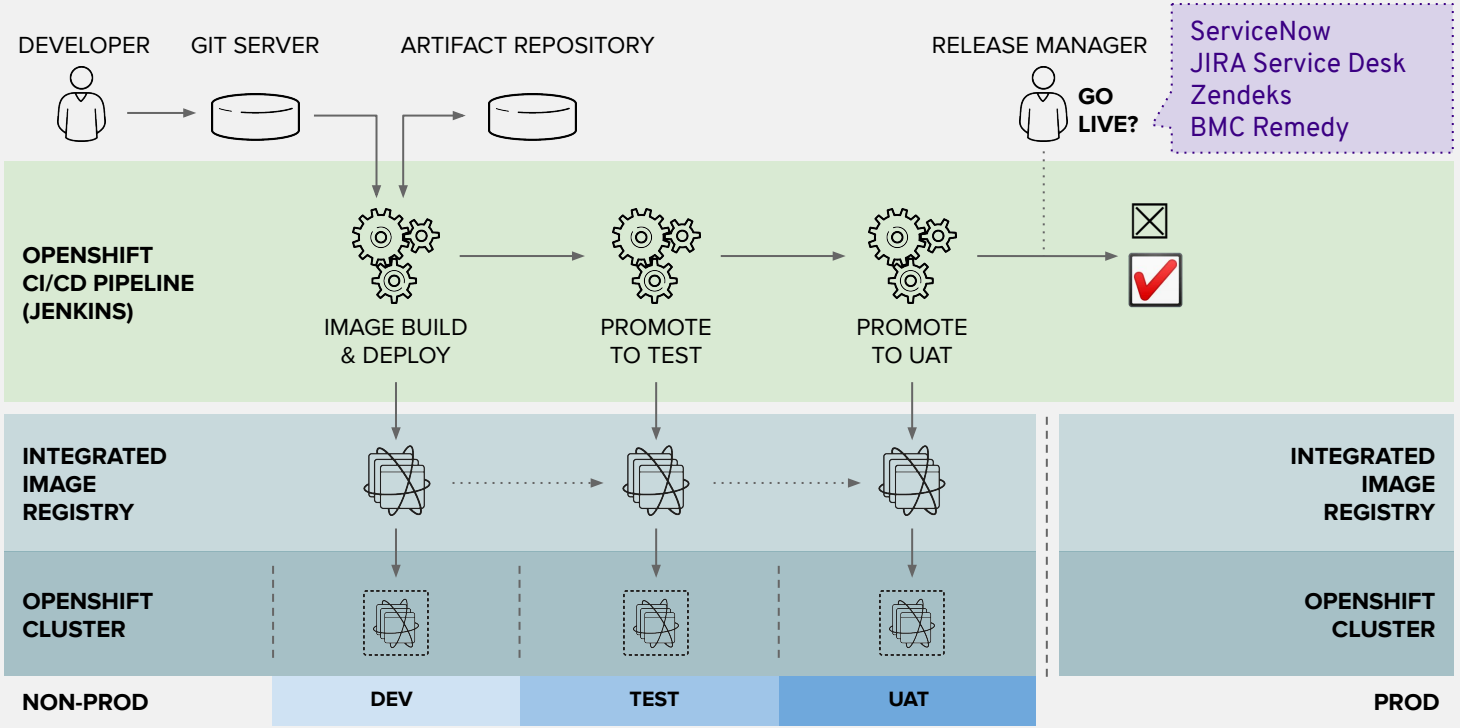
CONTINUOUS DELIVERY PIPELINE



CONTINUOUS DELIVERY PIPELINE



CONTINUOUS DELIVERY PIPELINE



CONTINUOUS DELIVERY PIPELINE

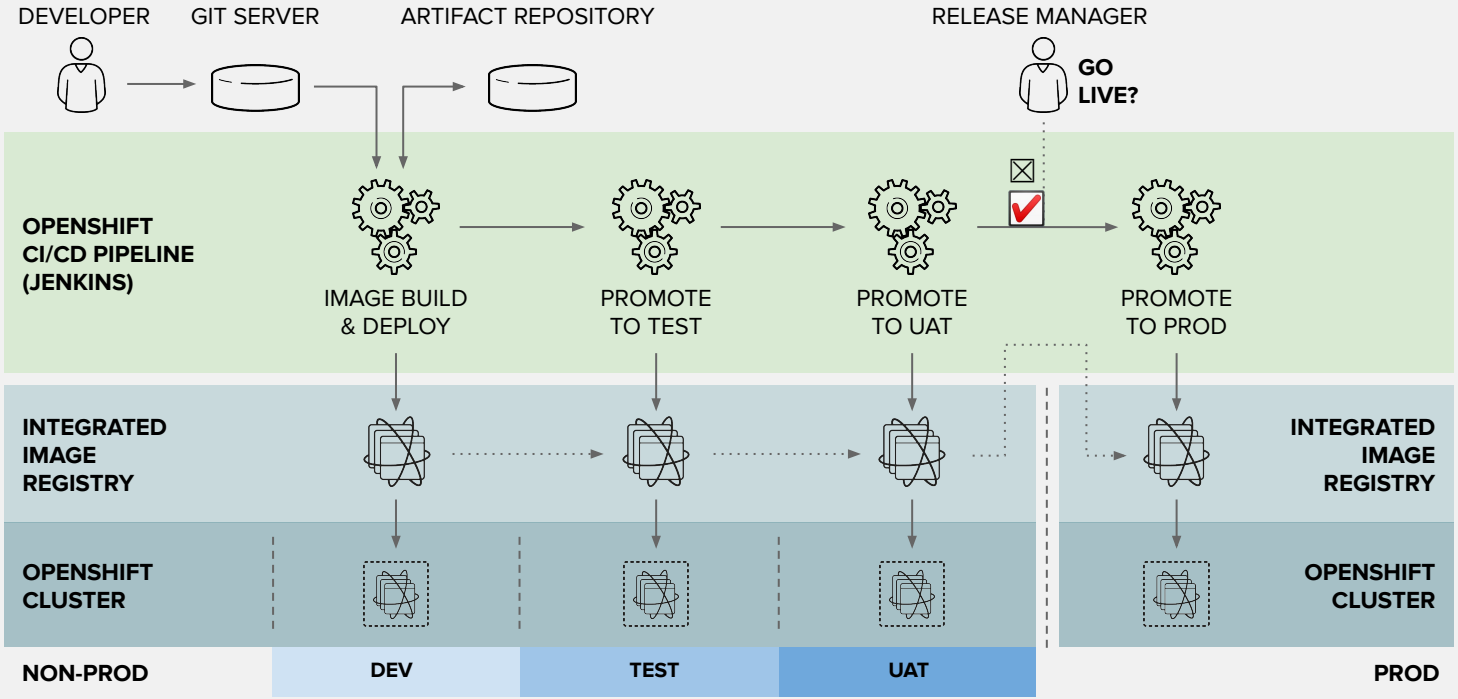
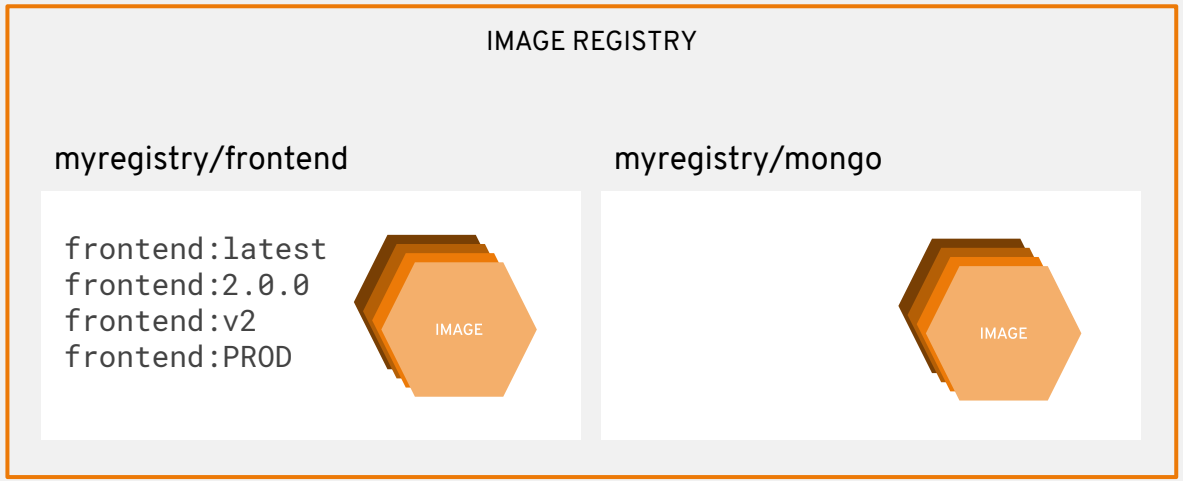


Image versioning

- docker:tag == git#tag
- latest == snapshot == master/develop (not a tag)

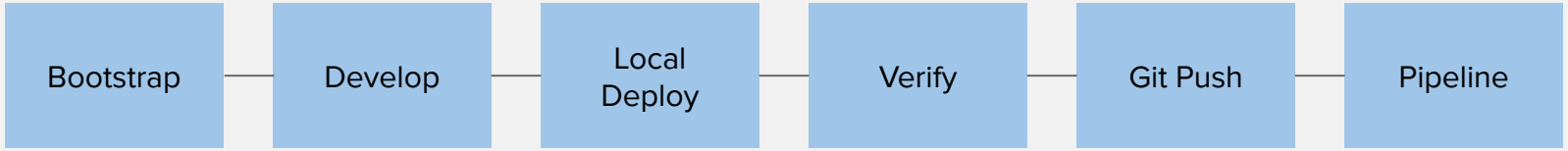


```
oc project dev-<vdiuser>
oc new-app https://bitbucket/mywebsite.git
oc get is,bc,dc,svc,route
oc get -o yaml --export is/httpd dc/httpd svc/httpd route/httpd >template.yml

oc new-project prod-<viduser>
oc create -f template.yml
oc import-image httpd:latest --from=registry-dev/dev-<vdiuser>/httpd:prod
oc tag prod/httpd:prod dev/httpd:latest
```

Local Development

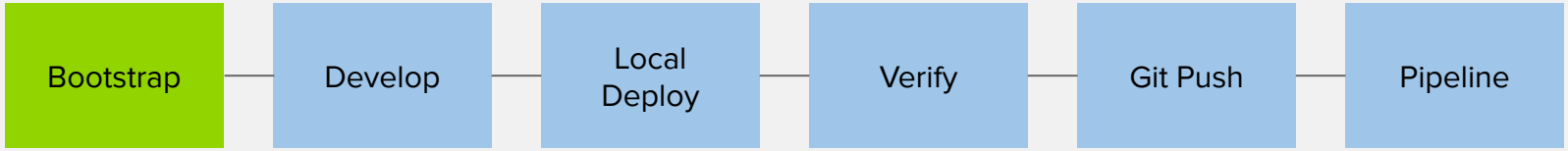
Local Development

LOCAL DEVELOPMENT WORKFLOW



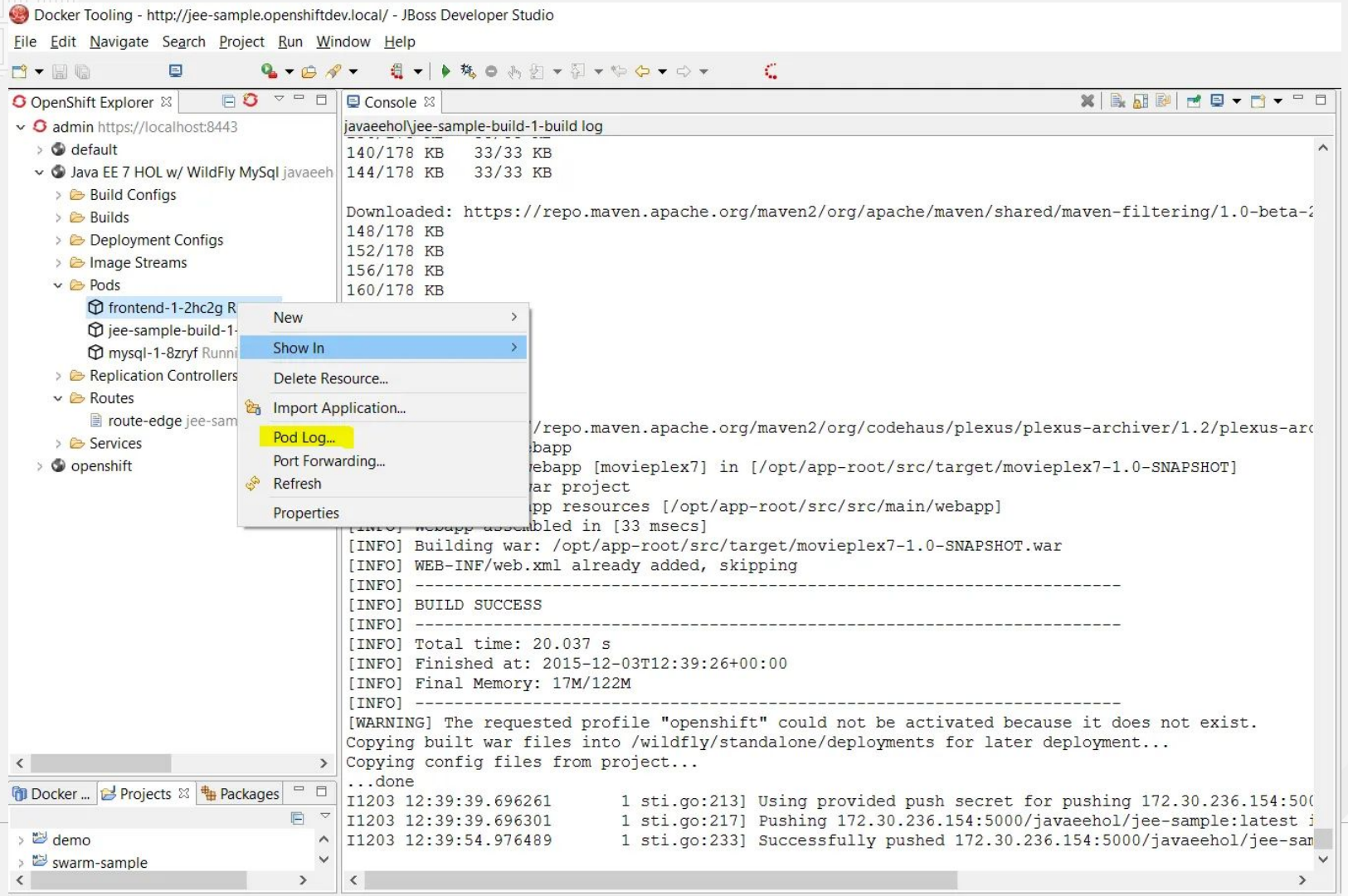
RED HAT® OPENSHIFT Container Platform

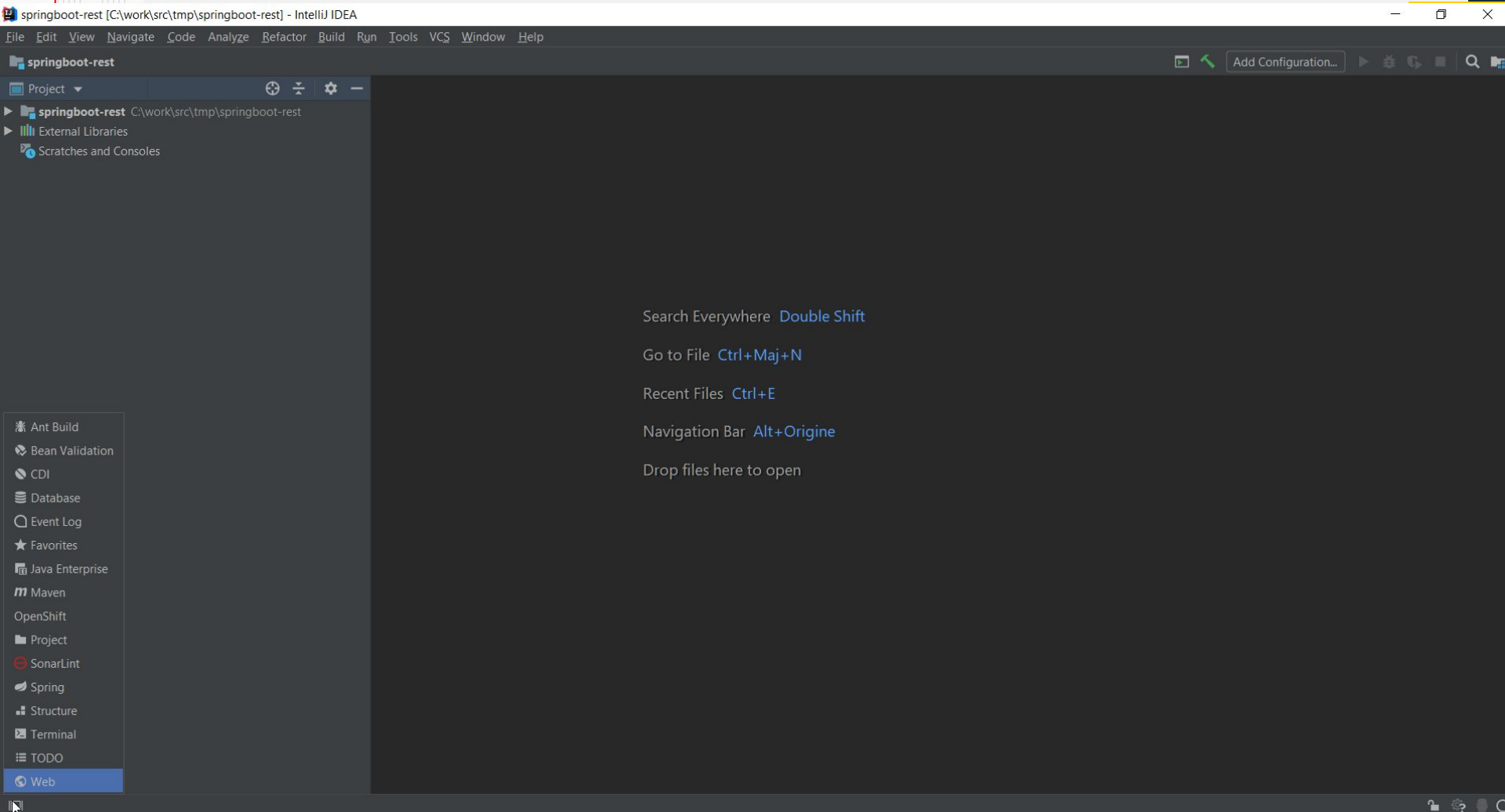
LOCAL DEVELOPMENT WORKFLOW

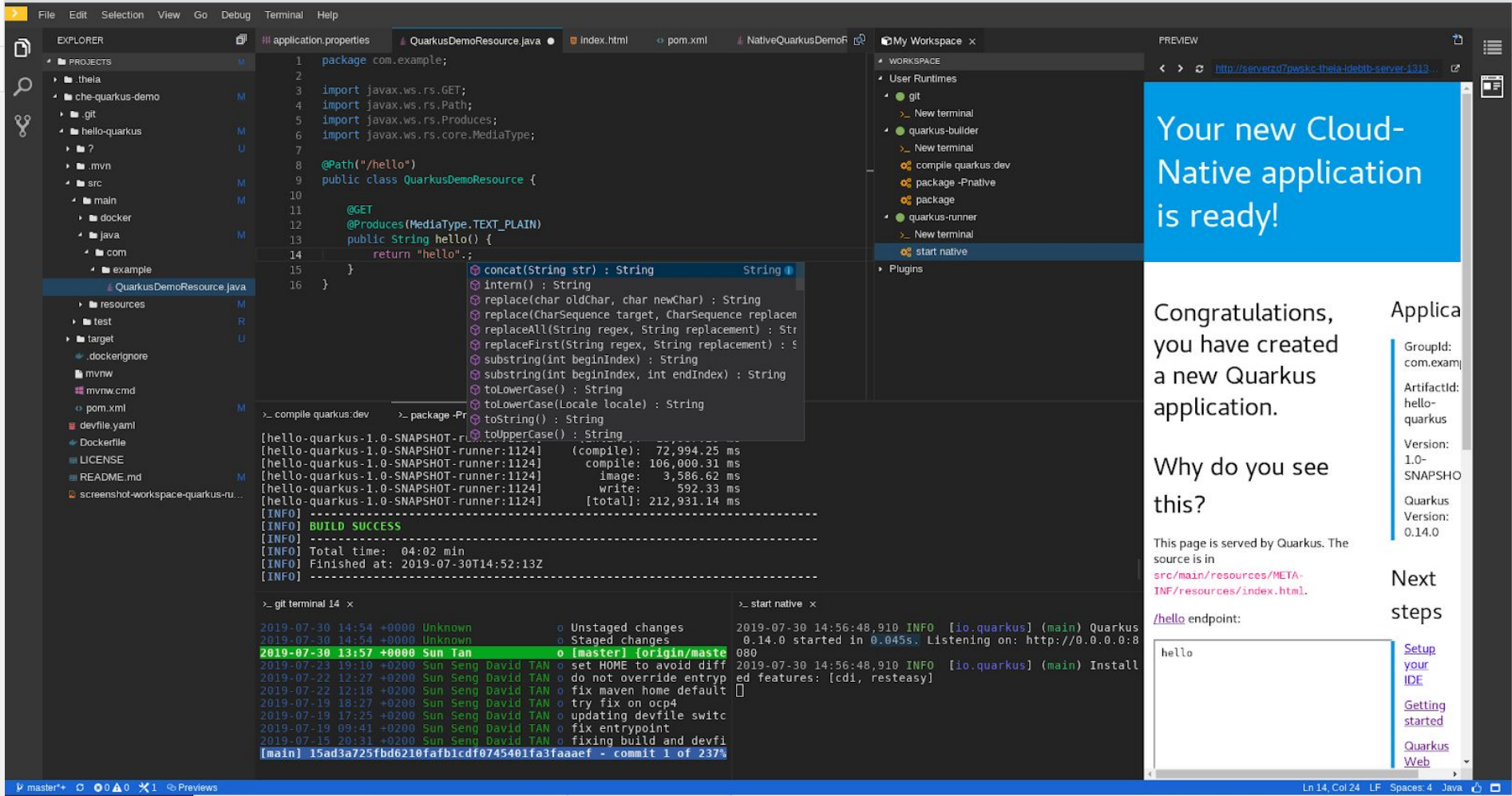


BOOTSTRAP

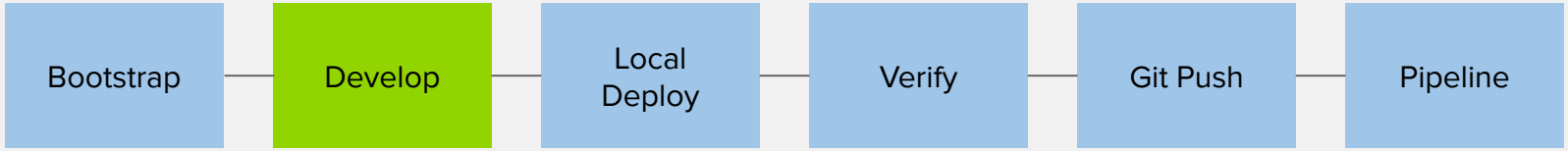
- Pick your programming language and application runtime of choice
- Create the project skeleton from scratch or use a generator such as
  - Maven archetypes
  - Quickstarts and Templates (oc new-app)
  - OpenShift Generator
  - Spring Initializr


Docker Tooling - http://jee-sample.openshiftdev.local/ - JBoss Developer Studio
File Edit Navigate Search Project Run Window Help
OpenShift Explorer
admin https://localhost:8443
default
Java EE 7 HOL w/ WildFly MySql javaeeh
Build Configs
Builds
Deployment Configs
Image Streams
Pods
frontend-1-2hc2g R
jee-sample-build-1-
mysql-1-8zryf Runni
Replication Controllers
Routes
route-edge jee-sam
Services
openshift
New
Show In
Delete Resource...
Import Application...
Pod Log...
Port Forwarding...
Refresh
Properties
Console
javaeehol\jee-sample-build-1-build log
140/178 KB 33/33 KB
144/178 KB 33/33 KB
Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/shared/maven-filtering/1.0-beta-2
148/178 KB
152/178 KB
156/178 KB
160/178 KB
/repo.maven.apache.org/maven2/org/codehaus/plexus/plexus-archiver/1.2/plexus-arc
bapp
ebapp [movieplex7] in [/opt/app-root/src/target/movieplex7-1.0-SNAPSHOT]
ar project
pp resources [/opt/app-root/src/src/main/webapp]
bled in [33 msecs]
[INFO] Building war: /opt/app-root/src/target/movieplex7-1.0-SNAPSHOT.war
[INFO] WEB-INF/web.xml already added, skipping
[INFO] --
[INFO] BUILD SUCCESS
[INFO] --
[INFO] Total time: 20.037 s
[INFO] Finished at: 2015-12-03T12:39:26+00:00
[INFO] Final Memory: 17M/122M
[INFO] --
[WARNING] The requested profile "openshift" could not be activated because it does not exist.
Copying built war files into /wildfly/standalone/deployments for later deployment...
Copying config files from project...
...done
I1203 12:39:39.696261 1 sti.go:213] Using provided push secret for pushing 172.30.236.154:500
I1203 12:39:39.696301 1 sti.go:217] Pushing 172.30.236.154:5000/javaeehol/jee-sample:latest i
I1203 12:39:54.976489 1 sti.go:233] Successfully pushed 172.30.236.154:5000/javaeehol/jee-sam
Docker ...
Projects
Packages
demo
swarm-sample


springboot-rest [C:\work\src\tmp\springboot-rest] - IntelliJ IDEA
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
springboot-rest
Add Configuration...
Project
springboot-rest C:\work\src\tmp\springboot-rest
External Libraries
Scratches and Consoles
Search Everywhere Double Shift
Go to File Ctrl+Maj+N
Recent Files Ctrl+E
Navigation Bar Alt+Origine
Drop files here to open
Ant Build
Bean Validation
CDI
Database
Event Log
Favorites
Java Enterprise
Maven
OpenShift
Project
SonarLint
Spring
Structure
Terminal
TODO
Web


File Edit Selection View Go Debug Terminal Help
EXPLORER
application.properties
QuarkusDemoResource.java
index.html
pom.xml
NativeQuarkusDemoR
My Workspace
WORKSPACE
User Runtimes
git
New terminal
quarkus-builder
New terminal
compile quarkus:dev
package -Pnative
package
quarkus-runner
New terminal
start native
Plugins
PREVIEW
http://serverzd7pwskc-theia-idebtb-server-1313...
Your new Cloud-Native application is ready!
Congratulations, you have created a new Quarkus application.
Why do you see this?
This page is served by Quarkus. The source is in src/main/resources/META-INF/resources/index.html.
/hello endpoint:
hello
Next steps
Setup your IDE
Getting started
Quarkus Web
Applica
GroupId: com.exam
ArtifactId: hello-quarkus
Version: 1.0-SNAPSHO
Quarkus Version: 0.14.0
package com.example;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;
@Path("/hello")
public class QuarkusDemoResource {
@GET
@Produces(MediaType.TEXT_PLAIN)
public String hello() {
return "hello";
}
}
concat(String str) : String
intern() : String
replace(char oldChar, char newChar) : String
replace(CharSequence target, CharSequence replacen
replaceAll(String regex, String replacement) : Str
replaceFirst(String regex, String replacement) : S
substring(int beginIndex) : String
substring(int beginIndex, int endIndex) : String
toLowerCase() : String
toLowerCase(Locale locale) : String
toString() : String
toUpperCase() : String
compile quarkus:dev
package -Pr
[hello-quarkus-1.0-SNAPSHOT-runner:1124] (compile): 72,994.25 ms
[hello-quarkus-1.0-SNAPSHOT-runner:1124] compile: 106,000.31 ms
[hello-quarkus-1.0-SNAPSHOT-runner:1124] image: 3,586.62 ms
[hello-quarkus-1.0-SNAPSHOT-runner:1124] write: 592.33 ms
[hello-quarkus-1.0-SNAPSHOT-runner:1124] [total]: 212,931.14 ms
[INFO] BUILD SUCCESS
[INFO] Total time: 04:02 min
[INFO] Finished at: 2019-07-30T14:52:13Z
git terminal 14
2019-07-30 14:54 +0000 Unknown o Unstaged changes
2019-07-30 14:54 +0000 Unknown o Staged changes
2019-07-30 13:57 +0000 Sun Tan o [master] [origin/maste
2019-07-23 19:10 +0200 Sun Seng David TAN o set HOME to avoid diff
2019-07-22 12:27 +0200 Sun Seng David TAN o do not override entryp
2019-07-22 12:18 +0200 Sun Seng David TAN o fix maven home default
2019-07-19 18:27 +0200 Sun Seng David TAN o try fix on ocp4
2019-07-19 17:25 +0200 Sun Seng David TAN o updating devfile switc
2019-07-19 09:41 +0200 Sun Seng David TAN o fix entrypoint
2019-07-15 20:31 +0200 Sun Seng David TAN o fixing build and devfi
[main] 15ad3a725fbd6210fafb1cdf0745401fa3faaaef - commit 1 of 237%
start native
2019-07-30 14:56:48,910 INFO [io.quarkus] (main) Quarkus 0.14.0 started in 0.045s. Listening on: http://0.0.0.0:8080
2019-07-30 14:56:48,910 INFO [io.quarkus] (main) Installed features: [cdi, resteasy]
master*+
Ln 14, Col 24
LF
Spaces: 4
Java

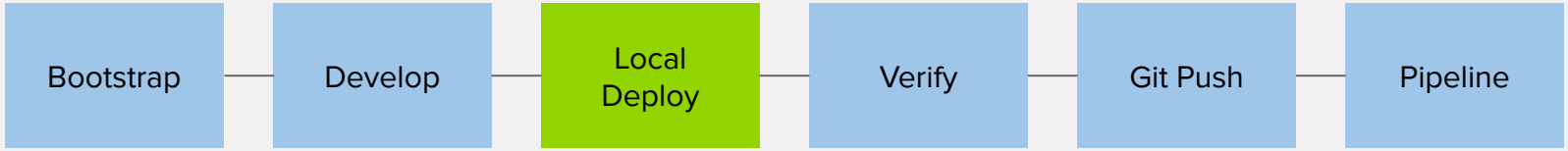
LOCAL DEVELOPMENT WORKFLOW



DEVELOP

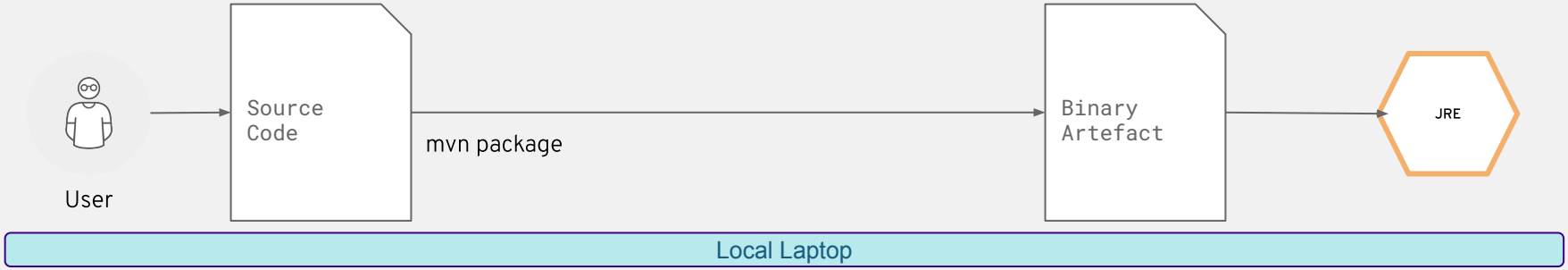
- Pick your framework of choice such as Java EE, Spring, Ruby on Rails, Django, Express, ...
- Develop your application code using your editor or IDE of choice
- Build and test your application code locally using your build tools
- Create or generate OpenShift templates or Kubernetes objects

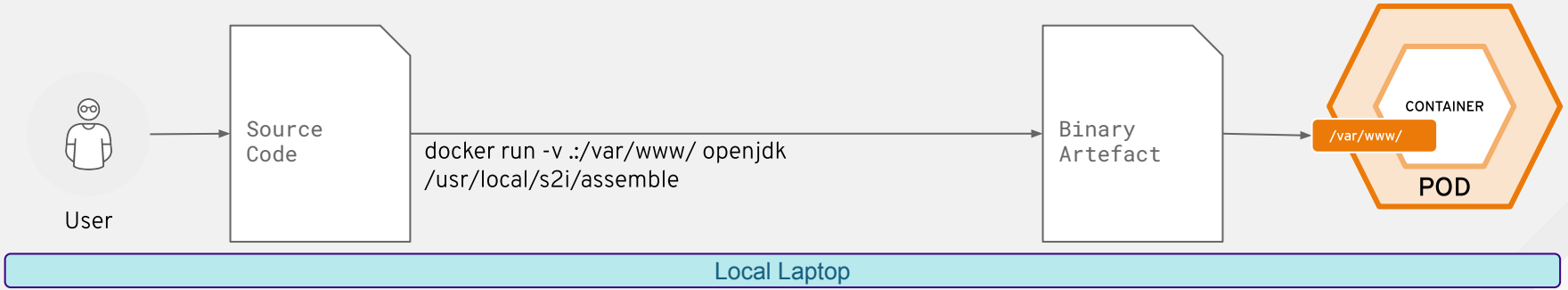
LOCAL DEVELOPMENT WORKFLOW



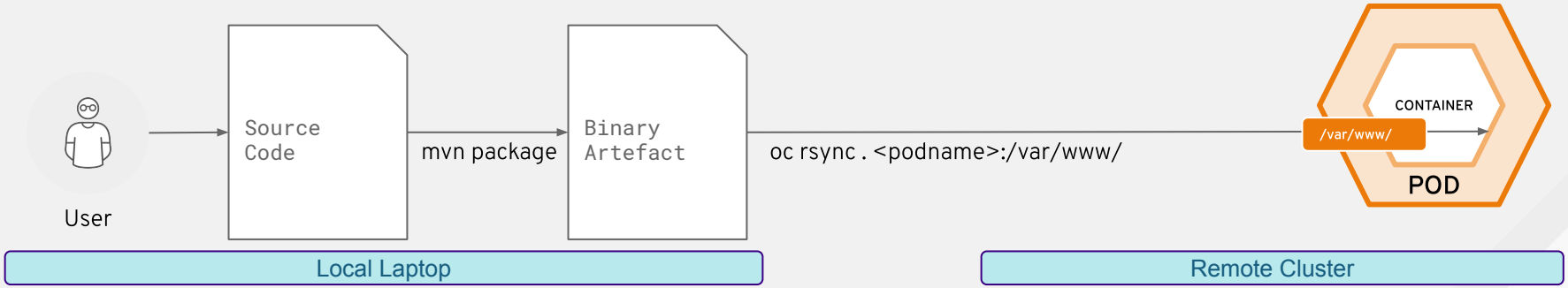
LOCAL DEPLOY

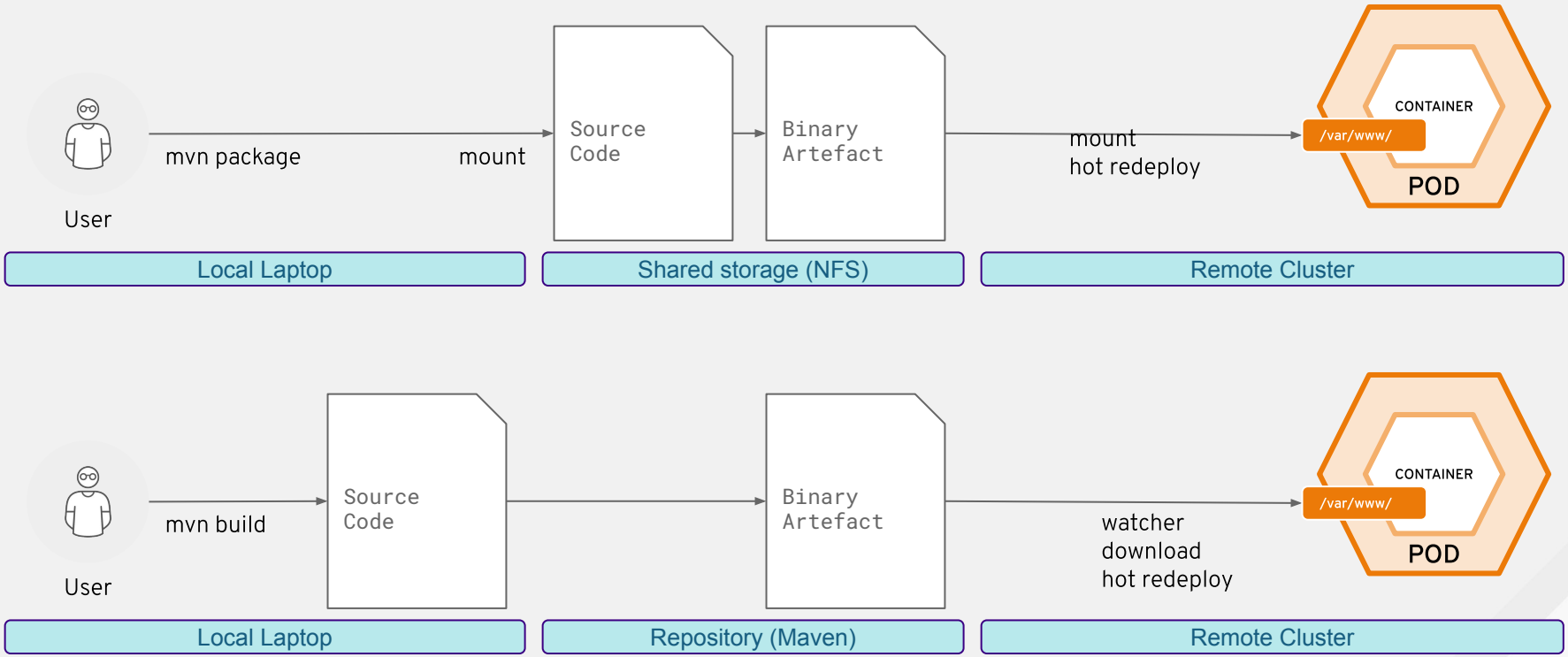
- Deploy your code on a local OpenShift cluster
  - Red Hat CodeReady
- Use binary deploy, maven or CLI rsync to push code or app binary directly into containers


User
Source Code
mvn package
Binary Artefact
JRE
Local Laptop


User
Source Code
docker run -v .:/var/www/ openjdk
/usr/local/s2i/assemble
Binary Artefact
CONTAINER
/var/www/
POD
Local Laptop


User
Source Code
inotify
oc rsync . <podname>:/var/www/
/usr/local/s2i/assemble
Binary Artefact
CONTAINER
/var/www/
POD
Local Laptop
Remote Cluster


User
Source Code
mvn package
Binary Artefact
oc rsync . <podname>:/var/www/
CONTAINER
/var/www/
POD
Local Laptop
Remote Cluster


User
mvn package
mount
Source Code
Binary Artefact
mount
hot redeploy
CONTAINER
/var/www/
POD
Local Laptop
Shared storage (NFS)
Remote Cluster
User
mvn build
Source Code
Binary Artefact
watcher
download
hot redeploy
CONTAINER
/var/www/
POD
Local Laptop
Repository (Maven)
Remote Cluster

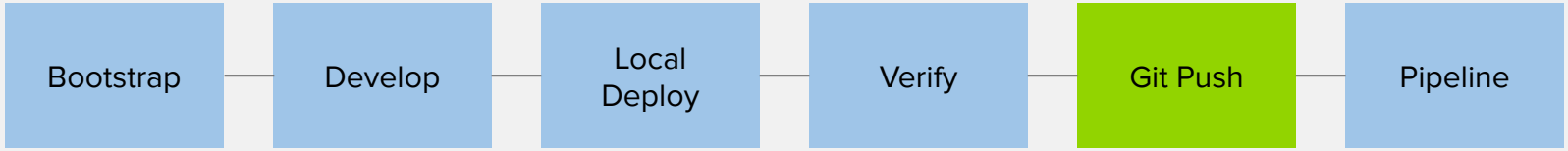
```
oc project dev-<vdiuser>

git clone https://bitbucket/mywebsite.git
oc new-app .
oc get is,bc,dc,svc,route

oc start-build --from-dir=. --follow

mvn package
oc rsync . <pod-name>:/var/www/html/

yum install nfs
vi /etc/exports
oc set volume
```

LOCAL DEVELOPMENT WORKFLOW

VERIFY

- Verify your code is working as expected
- Run any type of tests that are required with or without other components (database, etc)
- Based on the test results, change code, deploy, verify and repeat

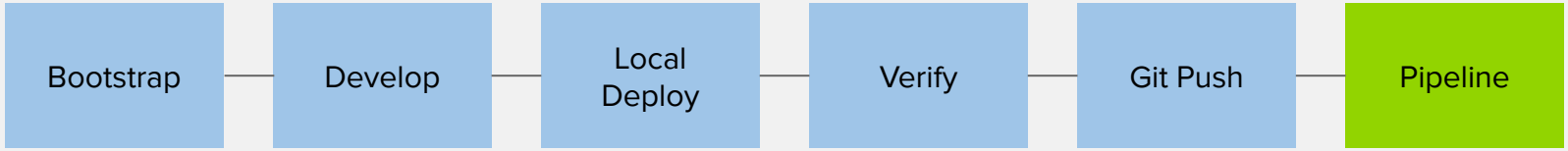
LOCAL DEVELOPMENT WORKFLOW



GIT PUSH

- Push the code and configuration to the Git repository
- If using Fork & Pull Request workflow, create a Pull Request
- If using code review workflow, participate in code review discussions

LOCAL DEVELOPMENT WORKFLOW



PIPELINE

- Pushing code to the Git repository triggers one or multiple deployment pipelines
- Design your pipelines based on your development workflow e.g. test the pull request
- Failure in the pipeline? Go back to the code and start again

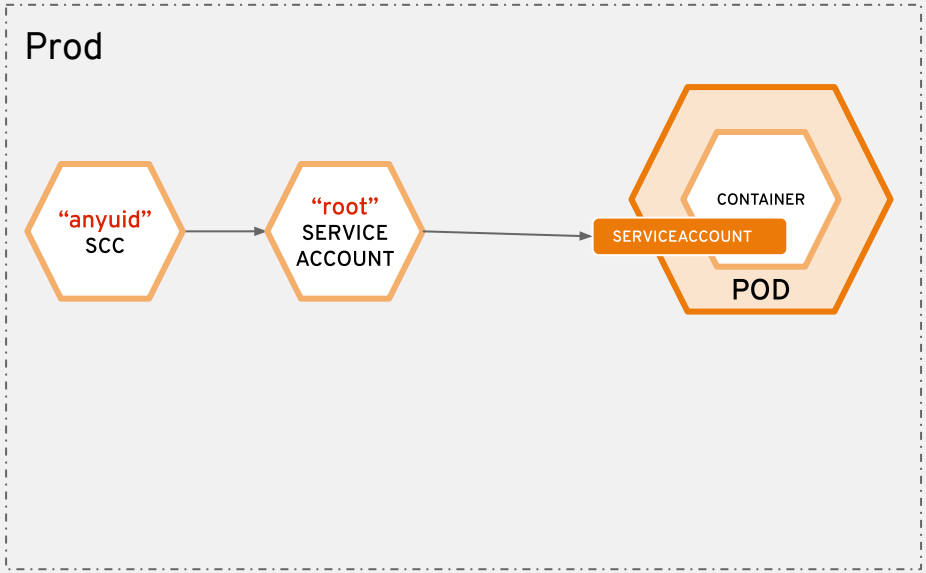
Image building

Promote & Deploy into

Production

automatically

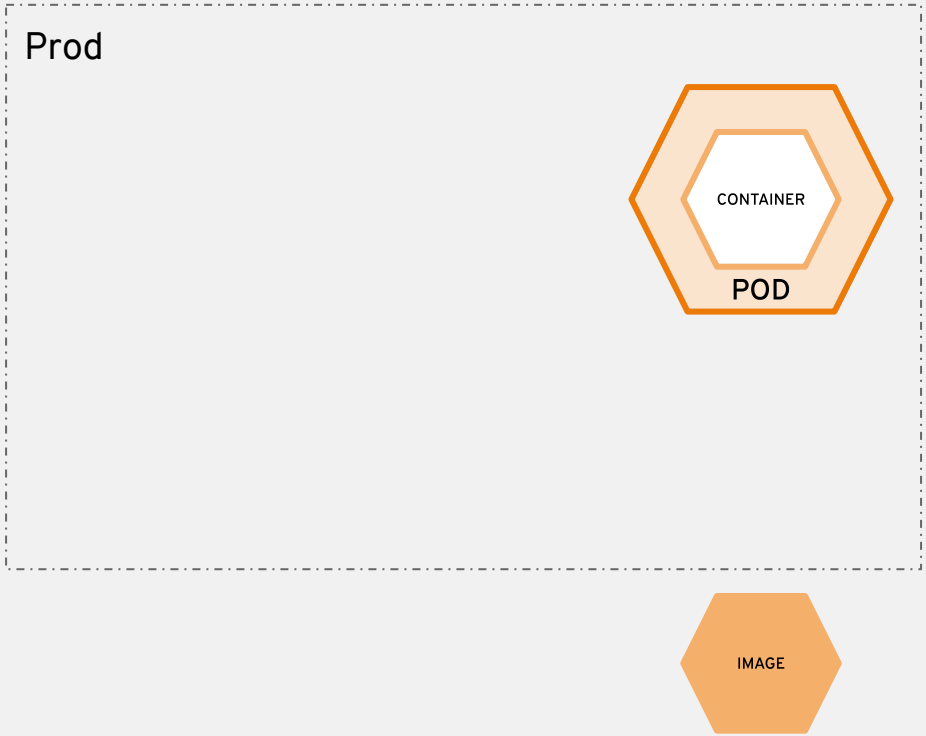
~~RunAsRoot~~




```
kind: DeploymentConfig
spec:
  template:
    spec:
      hostPID: true
      Containers:
        image: docker.io/httpd
        ports:
        - containerPort: 80
          protocol: TCP
        securityContext:
          privileged: true
          runAsUser: 0 #root
      serviceAccount: root
```

> oc adm policy add-scc-to-user “anyuid” -z “root”

RunAsRange

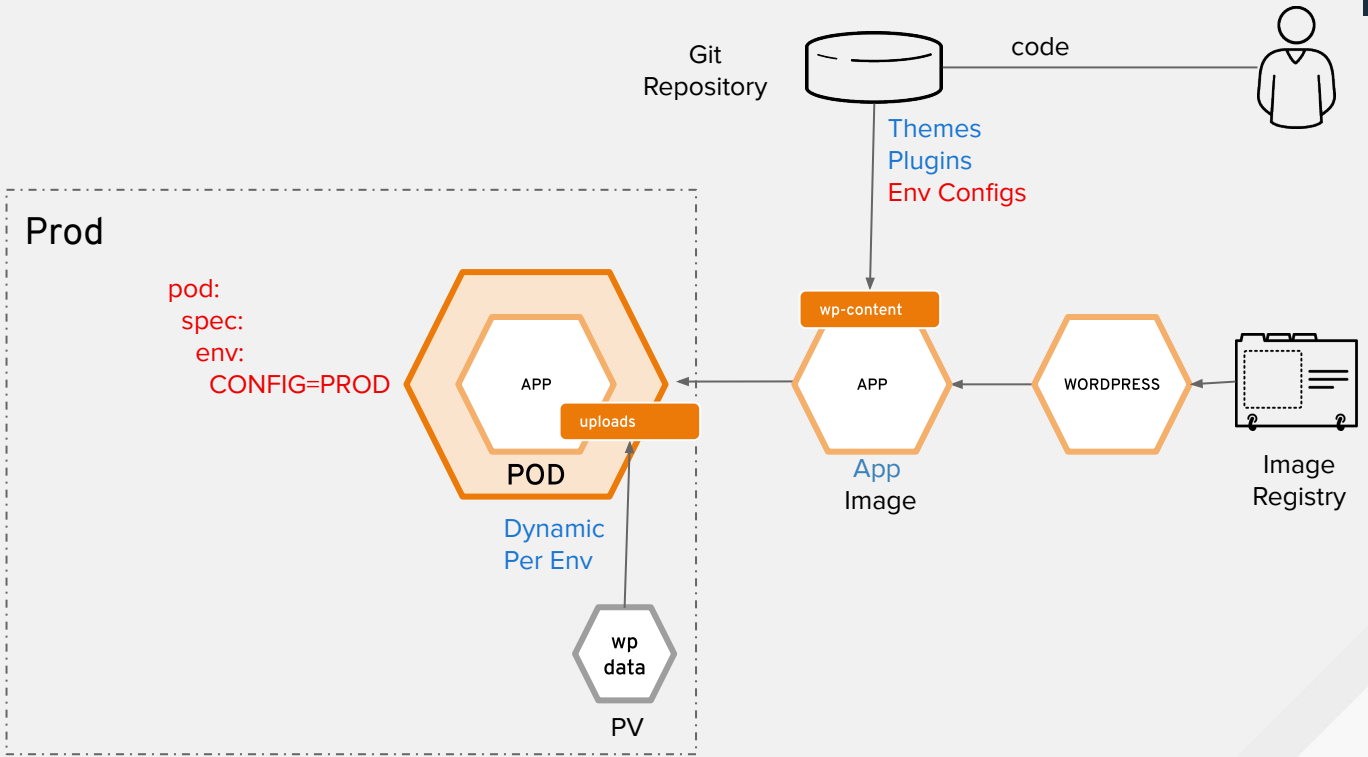



```
kind: DeploymentConfig
spec:
  template:
    spec:
      containers:
        image: redhat.io/httpd
        ports:
        - containerPort: 8080
          protocol: TCP
        securityContext:
          privileged: false
          runAsUser: random
      serviceAccount: default
```

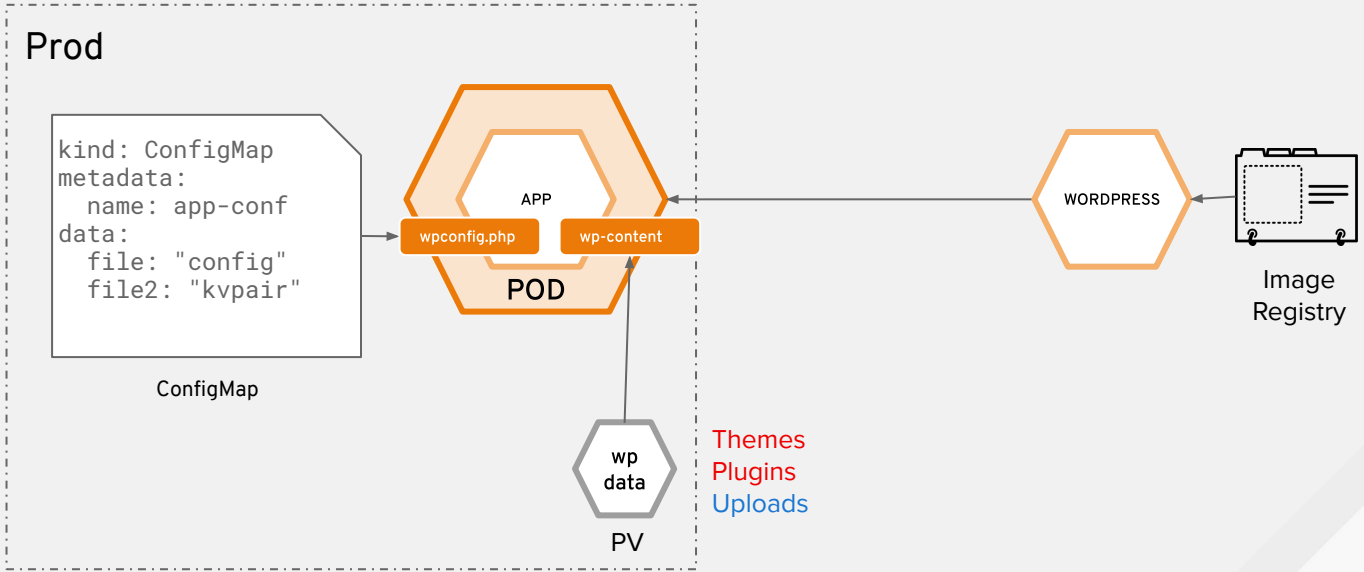
```
USER 10240000
RUN  chmod 777 /var/www
```

> oc adm policy add-scc-to-user “anyuid” -z “root”

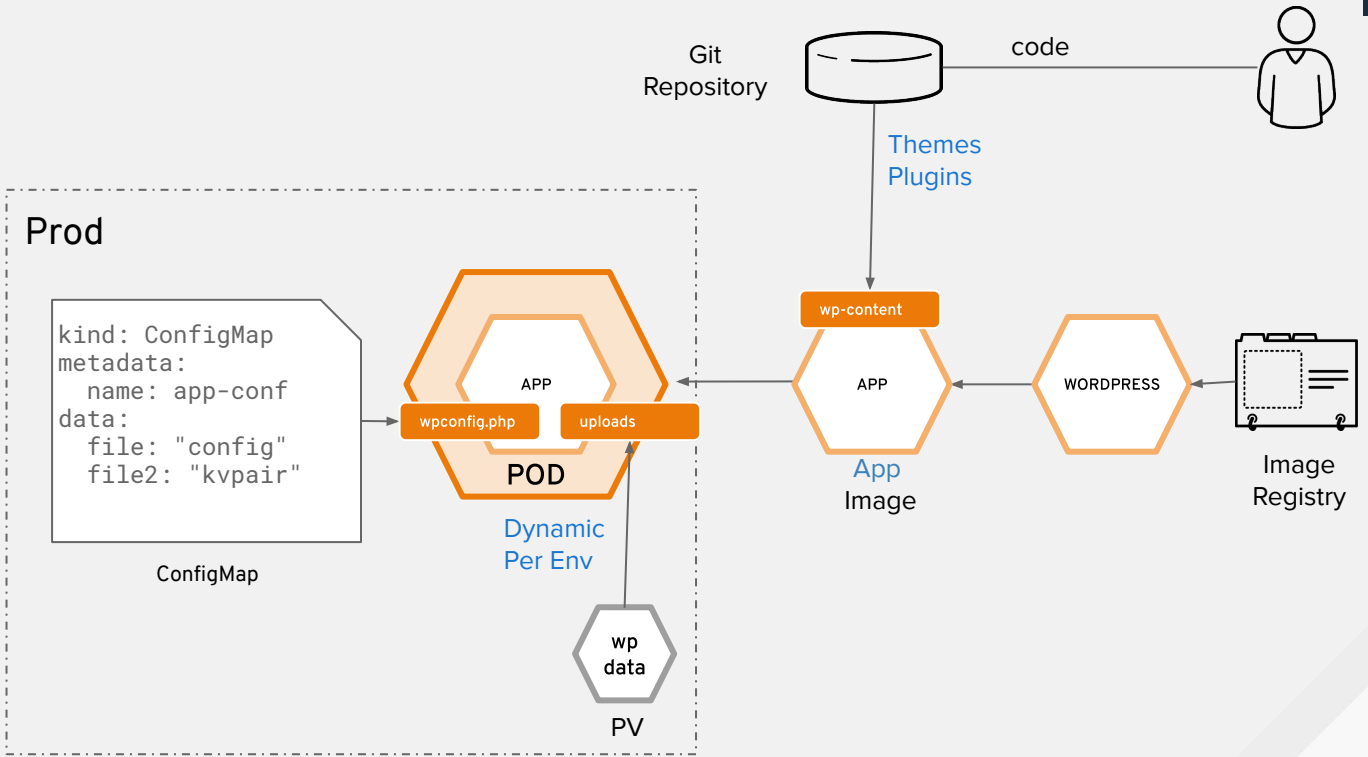
~~ENVIRONMENT Config~~



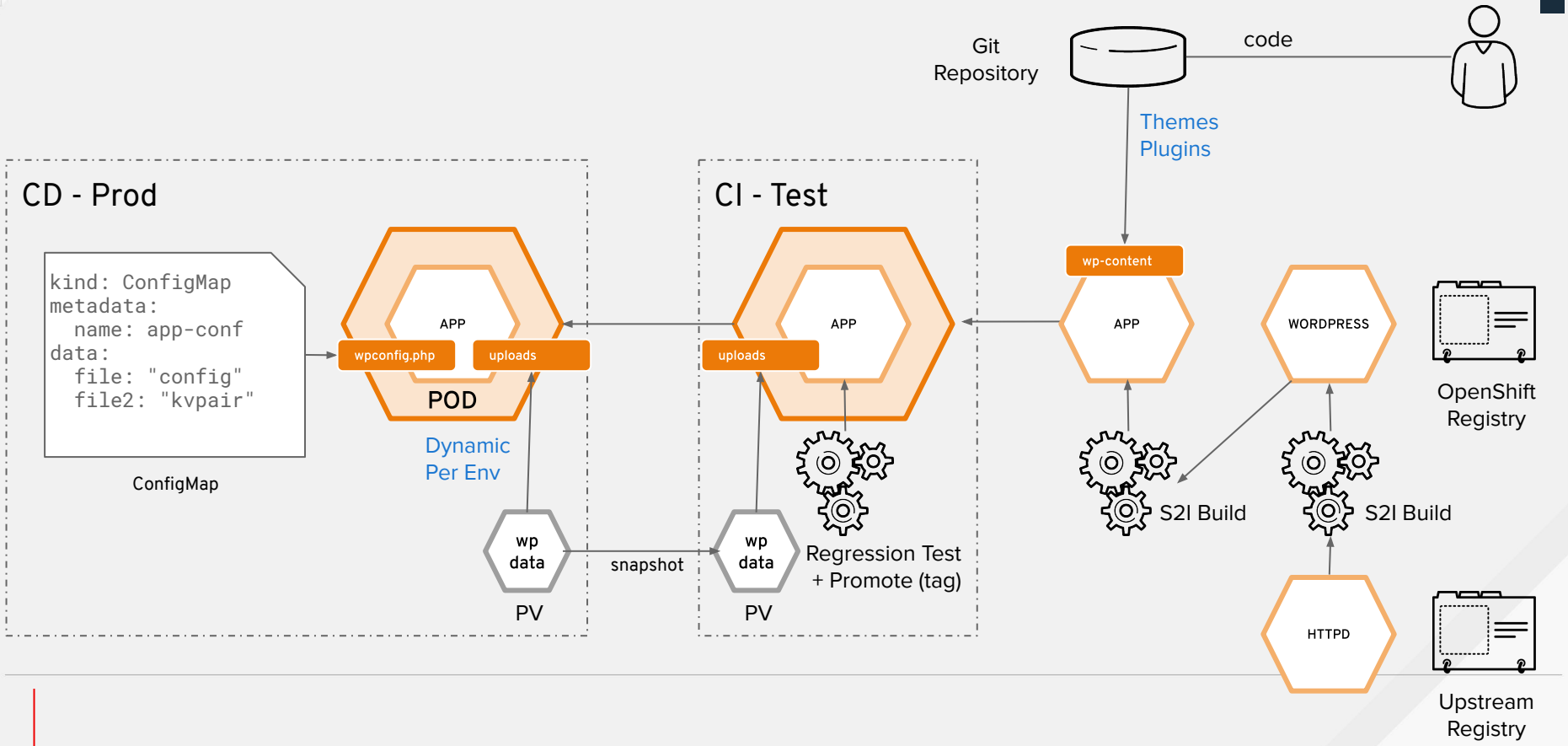
~~STATIC DATA~~


Prod
kind: ConfigMap
metadata:
name: app-conf
data:
file: "config"
file2: "kvpair"
ConfigMap
APP
wpconfig.php
wp-content
POD
WORDPRESS
Image
Registry
wp
data
PV
Themes
Plugins
Uploads

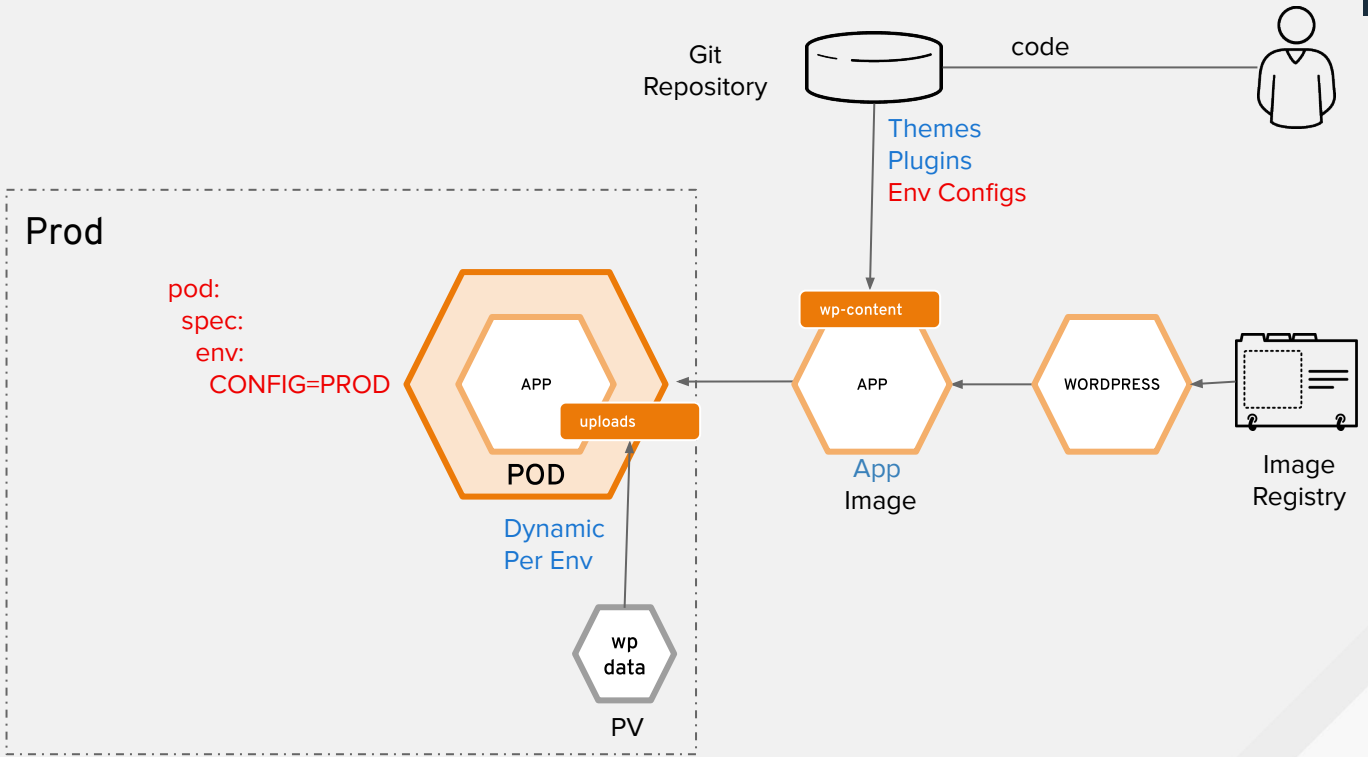
Code vs Data vs Config



LifeCycle Management of static content

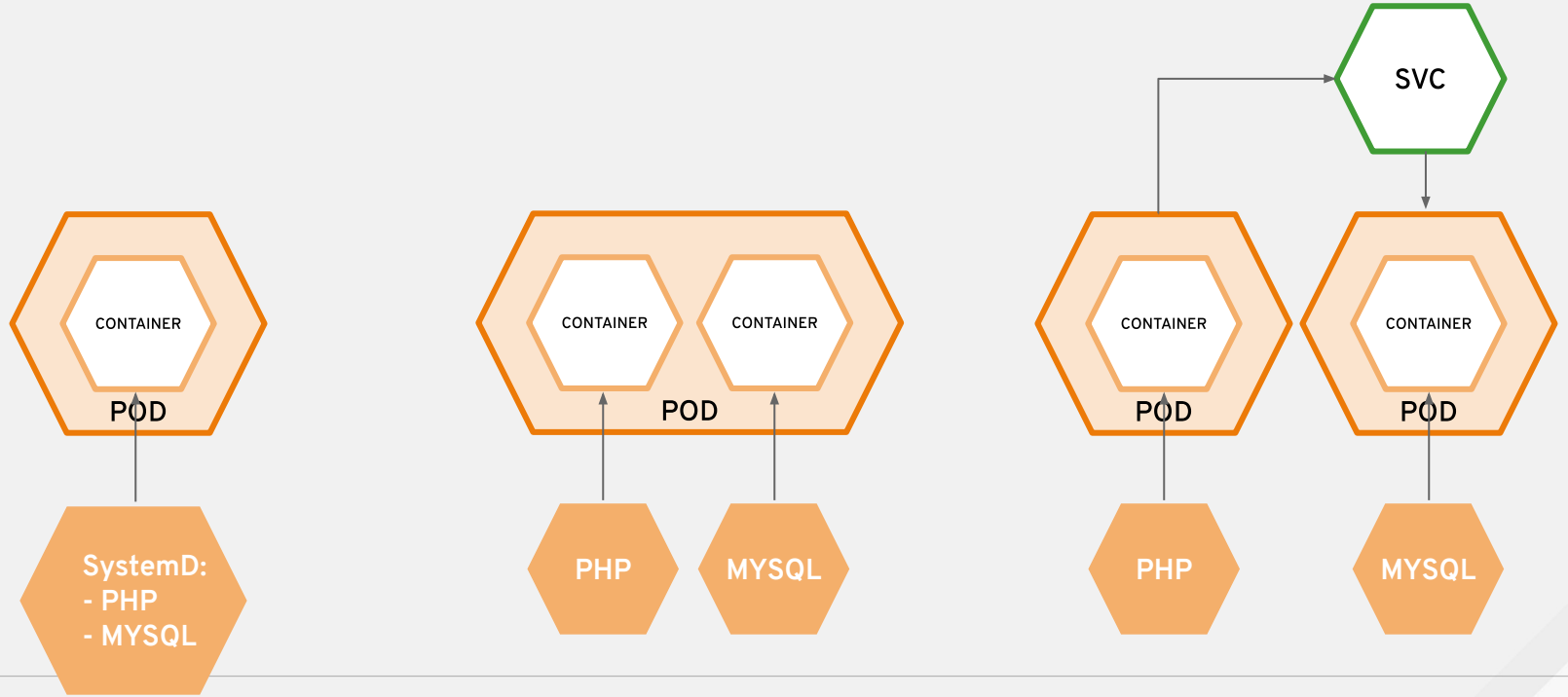


ENVIRONMENT Config



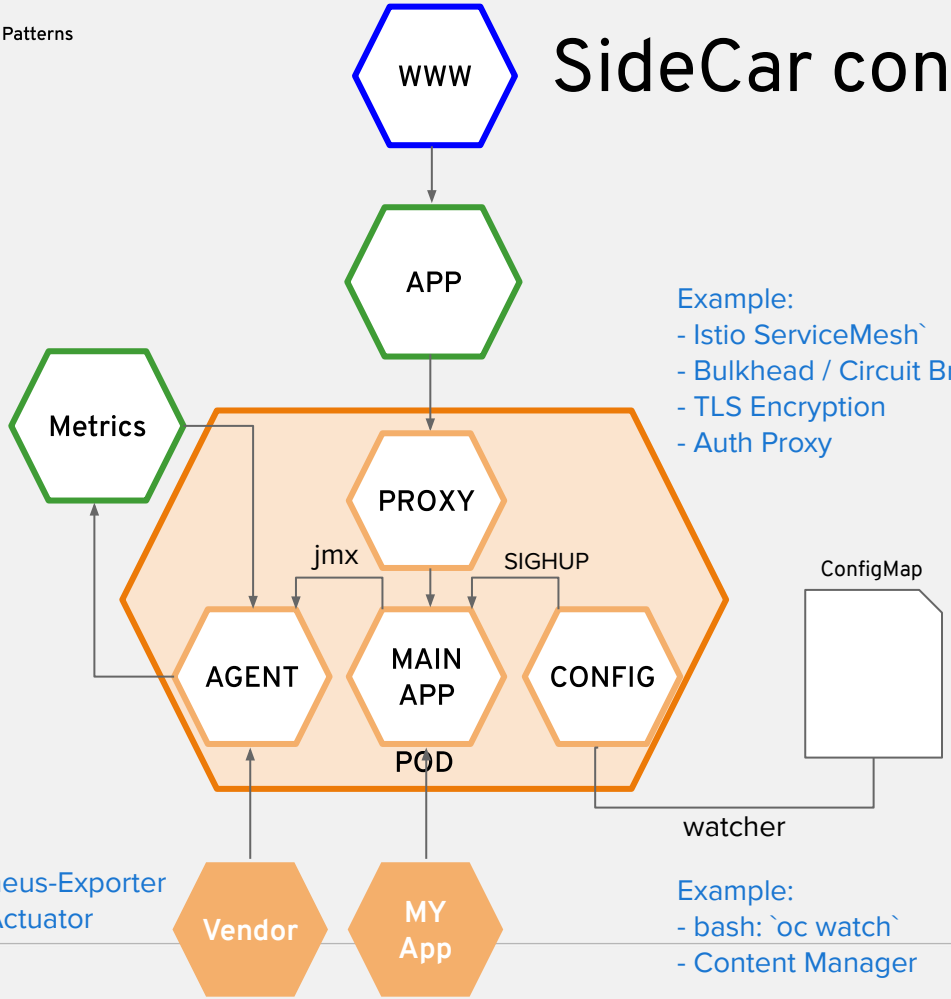
Atomic Unit

- Deployed and Scaled as One
- 1:1 relation
- LivenessProbe kills Pod



SideCar containers

- Same Namespace
- Tightly coupled
- Monitoring
- Config reload



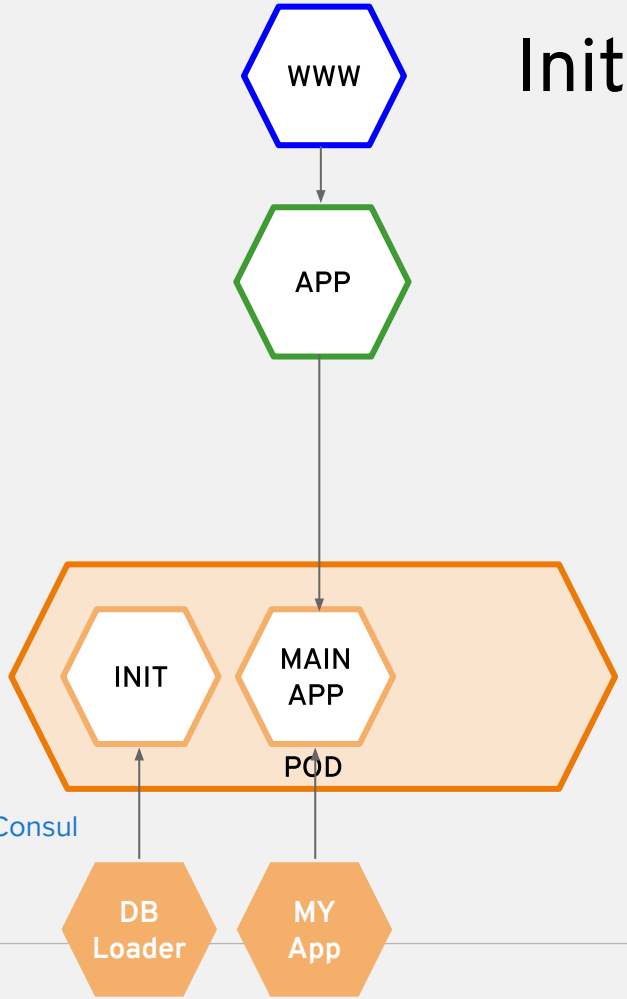
Example:
- Istio ServiceMesh`
- Bulkhead / Circuit Breaker
- TLS Encryption
- Auth Proxy

Example:
- Jolokia
- Prometheus-Exporter
- Spring Actuator
- ~~Backup~~
- ~~Nagios~~

Example:
- bash: `oc watch`
- Content Manager

Init containers

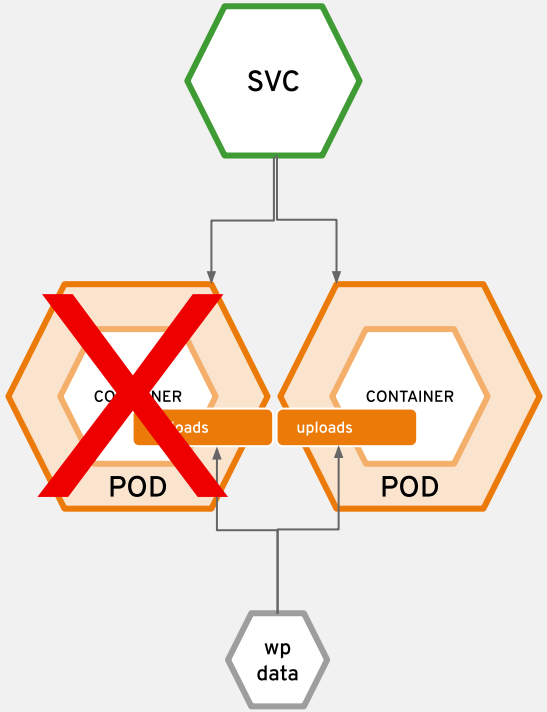
- Must complete successful



Example:
- Cluster Quorum
- Get node id
- Get Licence
- Fetch config from Zookeeper/Consul
- Liquibase
- Flyway

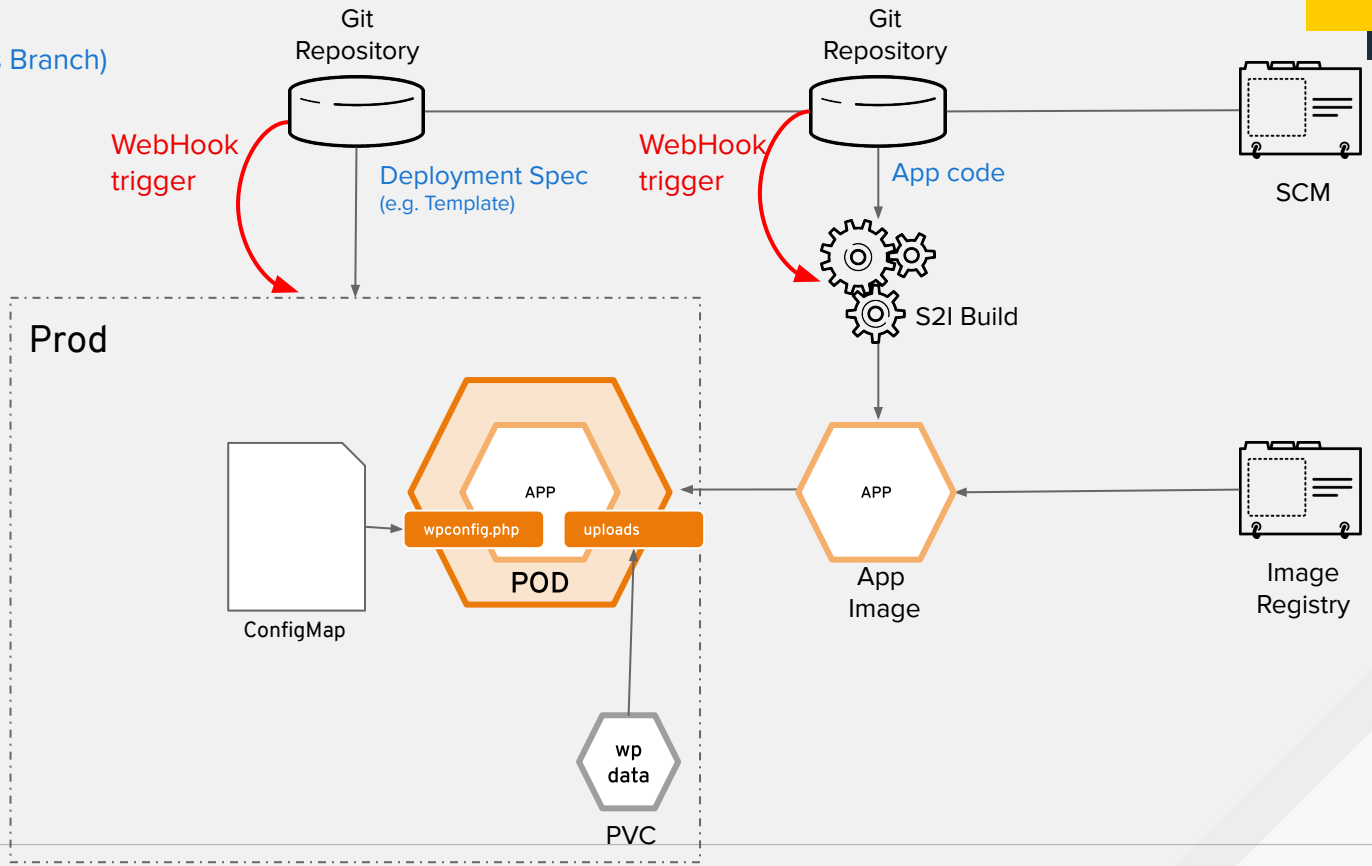
The Cloud-Native agreement

- Built for Failure
- Allow for Node Maintenance
- Stateless (Session data shared/externalized)
- (Difficult to Debug)
- VMware HA vs Container Failover



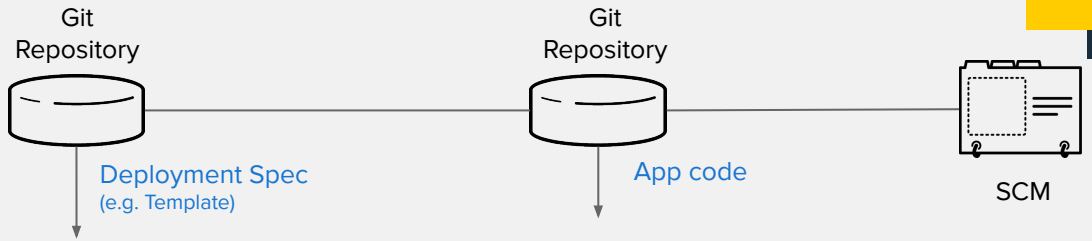
GitOps model

- Branching Strategy (Repo vs Branch)
- Template vs List



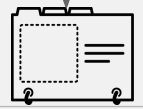
GitOps model

- No Branch Merging
- Versioned Stack Templates
- Prod-like envs



BRANCH **PROD**	prod.params: - stack_version: v1	/src/code.java /resources/k8s/template.json	BRANCH **MASTER**
BRANCH **DEV**	dev.params - stack_version: latest	/src/code.java /resources/k8s/template.json	BRANCH **DEVELOP**

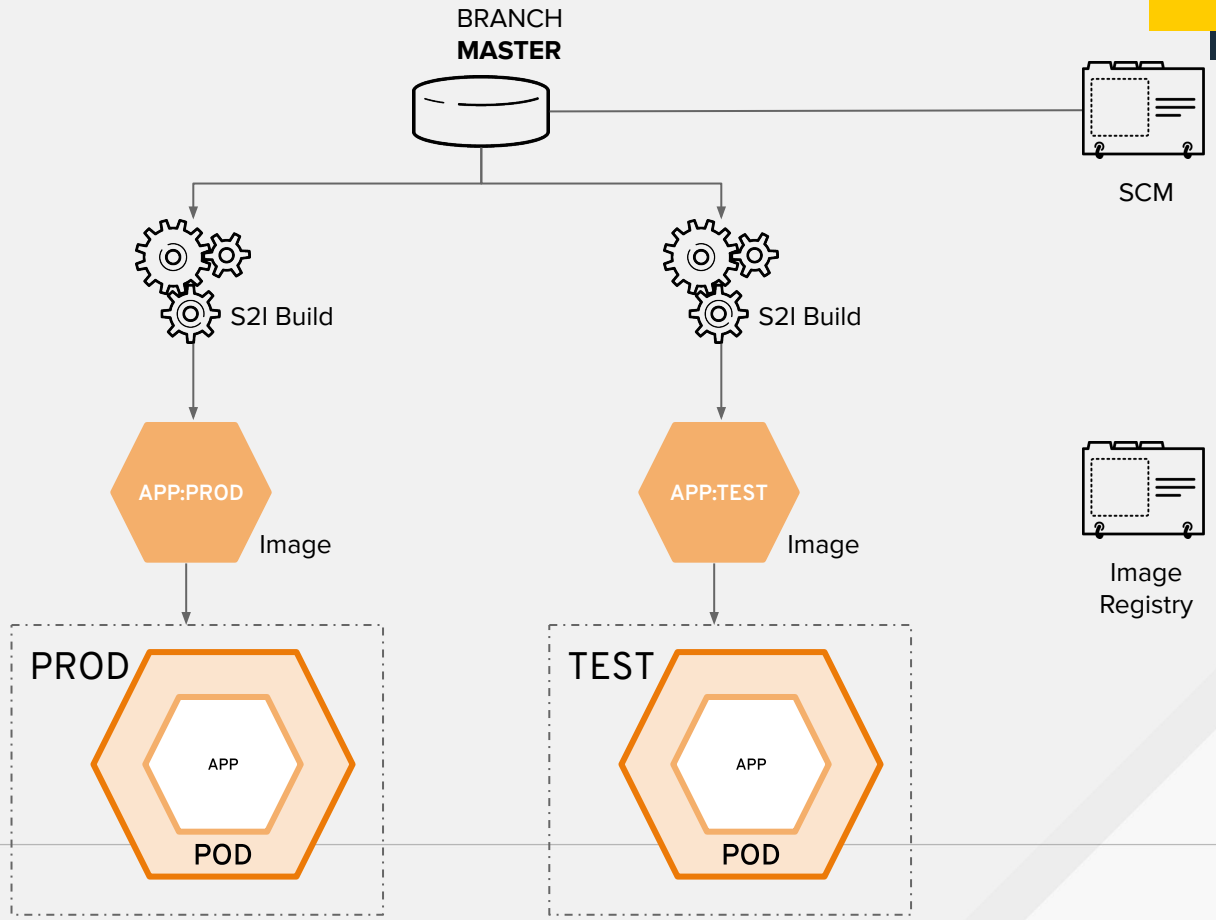
BRANCH **PROD**	/resources/k8s/list.json - image_version: v1	/src/code.java /resources/k8s/template.json	BRANCH **MASTER**
BRANCH **DEV**	/resources/k8s/list.json - image_version: latest	/src/code.java /resources/k8s/template.json	BRANCH **DEVELOP**



Service
Catalog

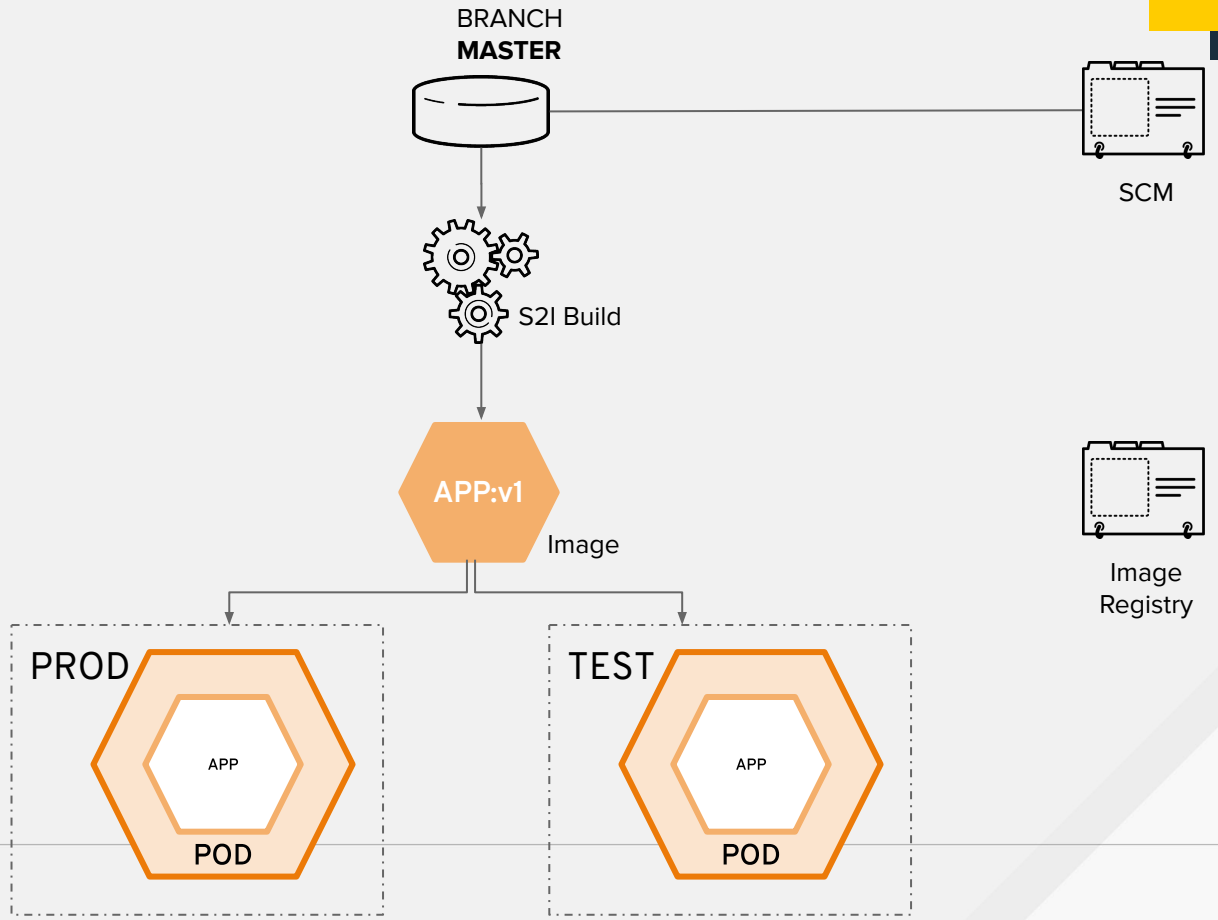
~~BUILD EVERYWHERE~~

- Branching Strategy (Repo vs Branch)
- Template vs List



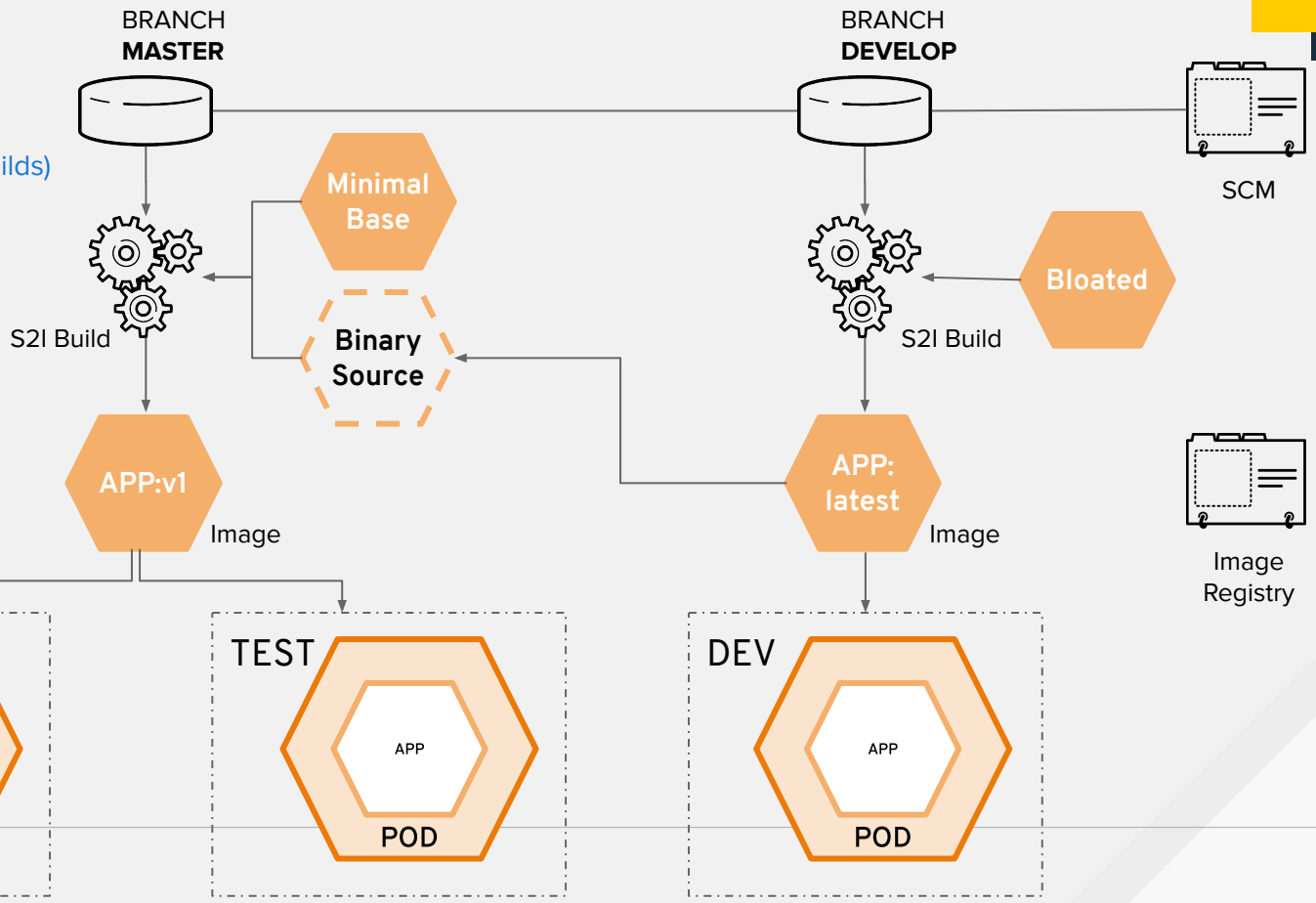
BUILD ONCE, DEPLOY MANY

- Same Image
- Tested / Certified



BUILD ONCE, DEPLOY MANY

- Debug Tools
- Dev != CI/CD Pipeline
- Test == certification for PROD
- Build Chaining (Multi-Stage builds)

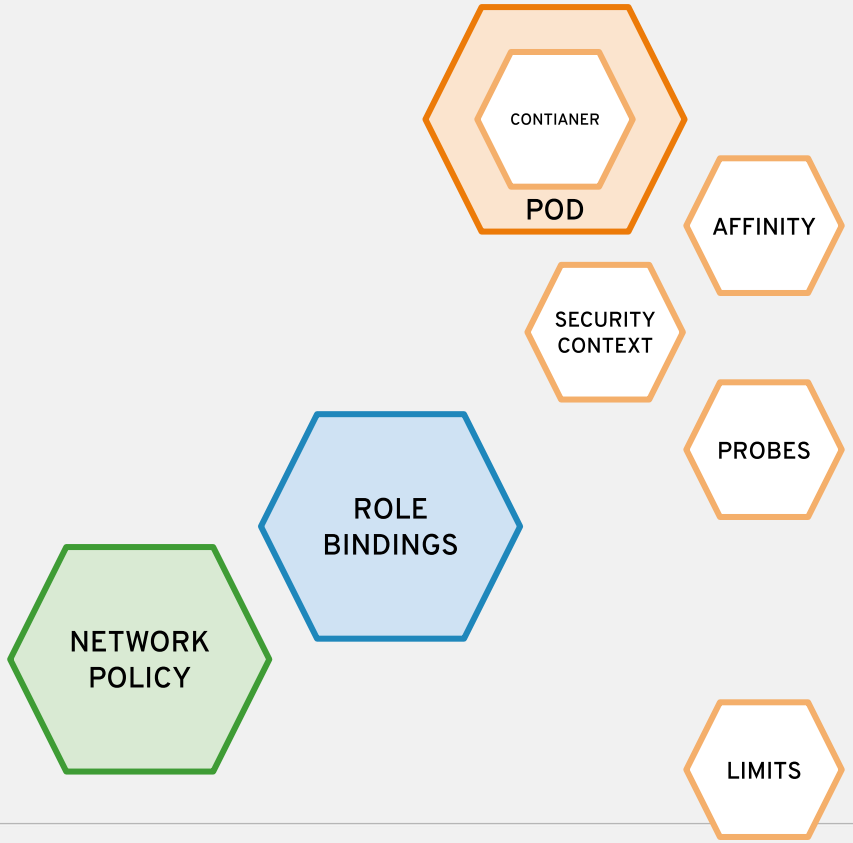


BUILD CHAINING

- ...

```
apiVersion: v1
kind: BuildConfig
metadata:
  name: image-build
spec:
  output:
    to:
      kind: ImageStreamTag
      name: image-build:latest
  source:
    dockerfile: |-
      FROM jee-runtime:latest
      COPY ROOT.war /deployments/ROOT.war
    images:
    - from:
        kind: ImageStreamTag
        name: artifact-image:latest
      paths:
      - sourcePath: /wildfly/standalone/deployments/ROOT.war
        destinationDir: "."
  strategy:
    dockerStrategy:
      from:
        kind: ImageStreamTag
        name: jee-runtime:latest
  triggers:
  - imageChange: {}
    type: ImageChange
```

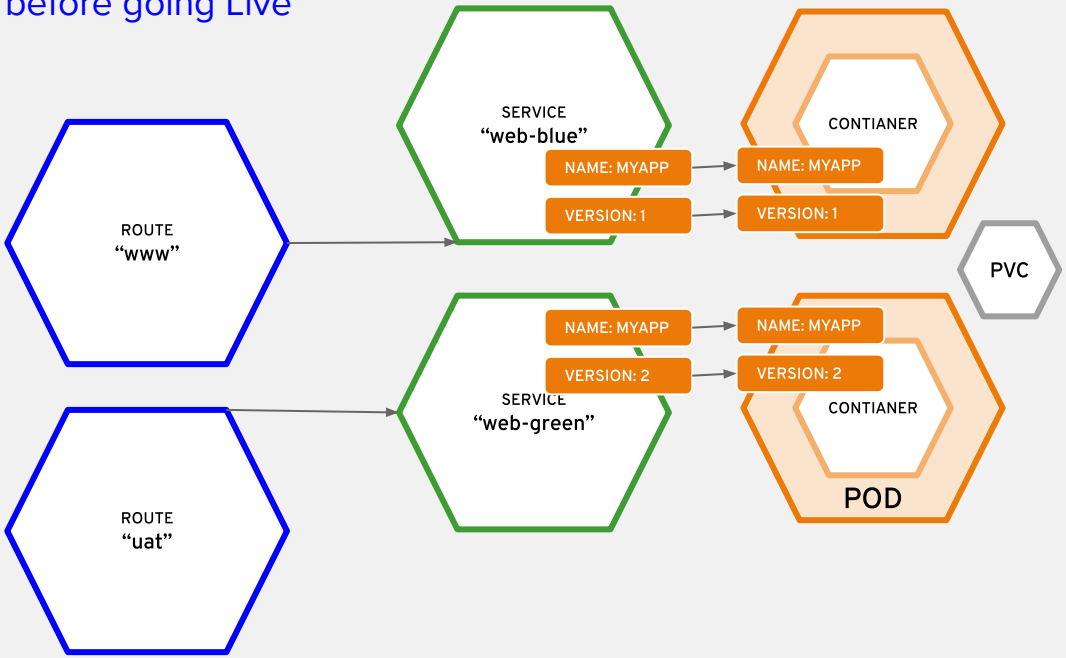
DEPLOY CHECKLIST




```yaml
apiVersion: v1
kind: DeploymentConfig
metadata:
  name: httpd
spec:
  affinity:
    podAntiAffinity:
      preferredDuringSchedulingIgnoredDuringExecution:
      - topologyKey: kubernetes.io/hostname
  containers:
  - name: httpd
    image: docker.io/library/httpd
    livenessProbe:
      tcpSocket:
        port: 8080
    readinessProbe:
      httpGet:
        path: /healthz
        port: 8080
        scheme: HTTP
    resources:
      limits:
        cpu: 200m
        memory: 512Mi
      requests:
        cpu: 100m
```

Blue / Green update strategy

- Test before going Live




```
apiVersion: route.openshift.io/v1
kind: Route
  metadata:
  name: www
spec:
  host: www.belastingdienst.nl
  to:
    kind: Service
    name: web-blue
    weight: 100
```

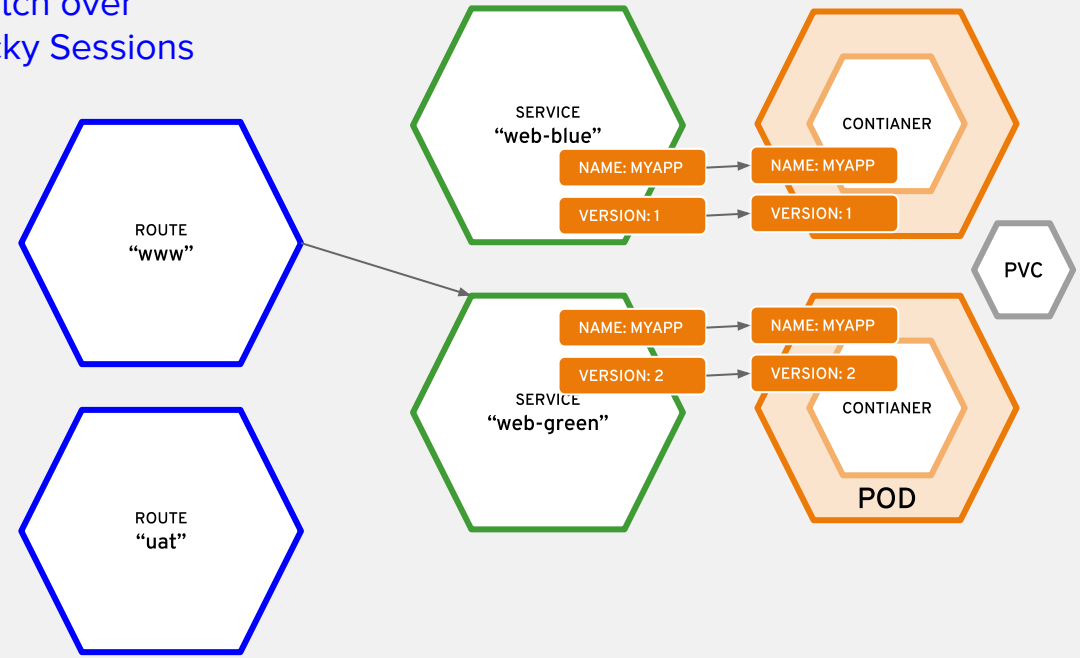
```
apiVersion: v1
kind: Service
  metadata:
  name: web-blue
spec:
  selector:
    name: myapp
    version: 1
```



```
> oc patch route/www -p '{"spec":{"to":{"name":"web-green"}}}'
> oc patch svc/web-blue -p '{"spec":{"selector":{"version":"3"}}}'
```

Blue / Green update strategy

- Switch over
- Sticky Sessions




```
apiVersion: route.openshift.io/v1
kind: Route
  metadata:
  name: www
spec:
  host: www.belastingdienst.nl
  to:
    kind: Service
    name: web-green
    weight: 100
```

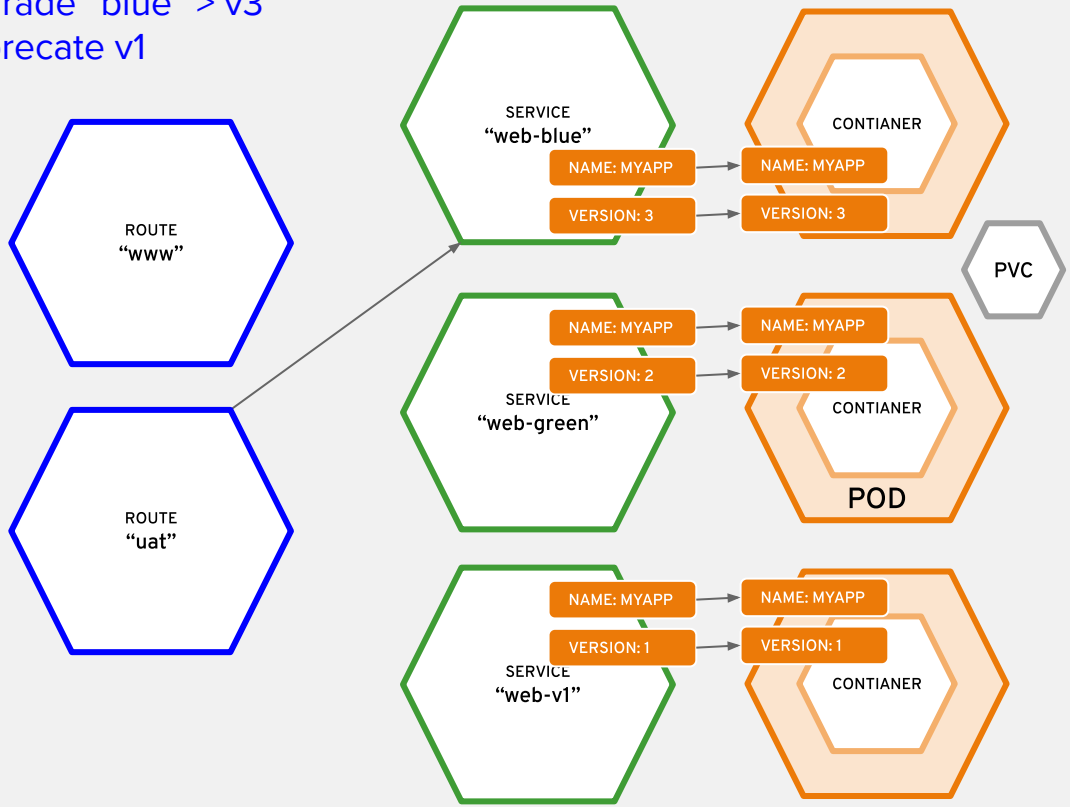
```
apiVersion: v1
kind: Service
  metadata:
  name: web-blue
spec:
  selector:
    name: myapp
    version: 1
```



```
> oc patch route/www -p '{"spec":{"to":{"name":"web-green"}}}'
> oc patch svc/web-blue -p '{"spec":{"selector":{"version":"3"}}}'
```

Blue / Green update strategy

- Upgrade “blue” > v3
- Deprecate v1




```
apiVersion: route.openshift.io/v1
kind: Route
  metadata:
  name: uat
spec:
  host: uat.belastingdienst.nl
  to:
    kind: Service
    name: web-blue
    weight: 100
```

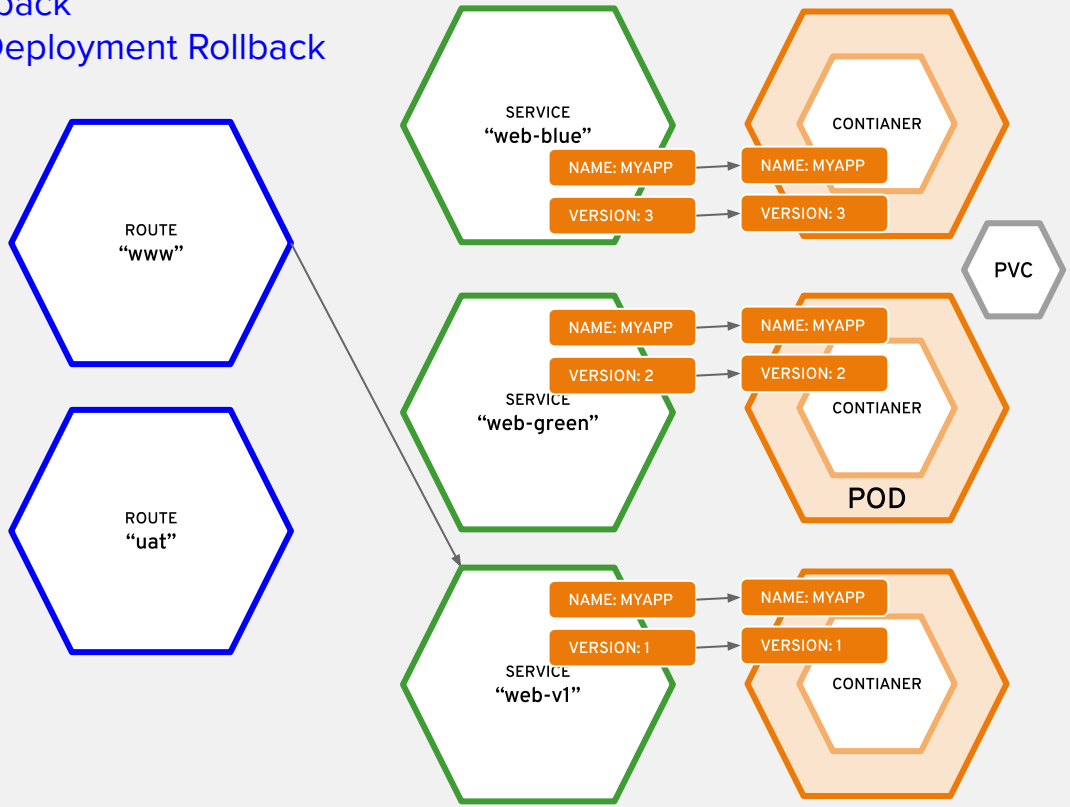
```
apiVersion: v1
kind: Service
  metadata:
  name: web-blue
spec:
  selector:
    name: myapp
    version: 3
```



```
> oc patch route/www -p '{"spec":{"to":{"name":"web-green"}}}'
> oc patch svc/web-blue -p '{"spec":{"selector":{"version":"3"}}}'
```

Blue / Green update strategy

- Rollback
- vs Deployment Rollback



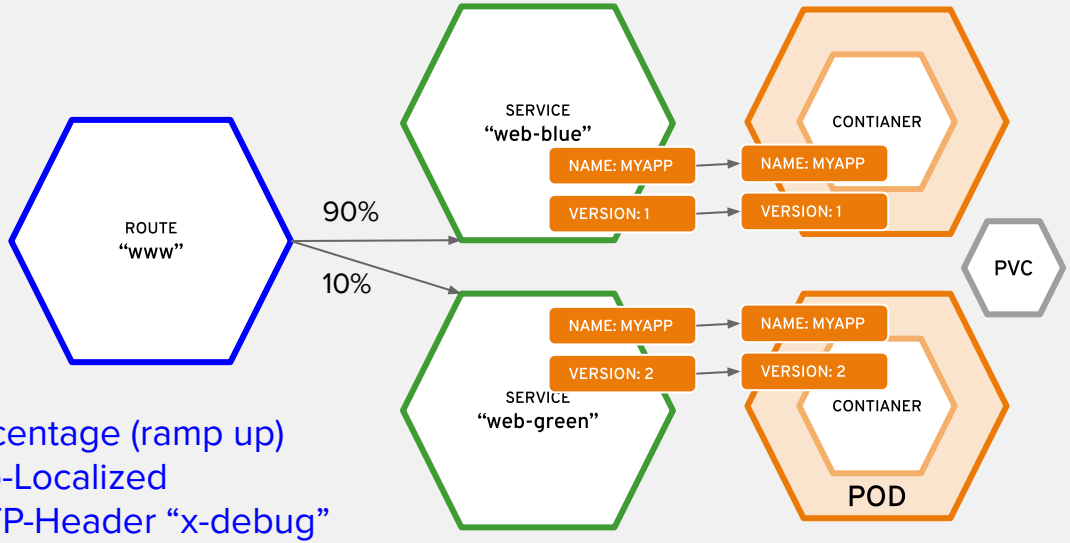

```
apiVersion: route.openshift.io/v1
kind: Route
  metadata:
  name: uat
spec:
  host: uat.belastingdienst.nl
  to:
    kind: Service
    name: web-blue
    weight: 100
```

```
apiVersion: v1
kind: Service
  metadata:
  name: web-blue
spec:
  selector:
    name: myapp
    version: 3
```



```
> oc patch route/www -p '{"spec":{"to":{"name":"web-v1"}}}'
```

A / B update strategy



- Percentage (ramp up)
- Geo-Localized
- HTTP-Header “x-debug”
- Feedback button enabled

```
apiVersion: route.openshift.io/v1
kind: Route
  metadata:
  name: uat
spec:
  host: uat.belastingdienst.nl
  to:
    kind: Service
    name: web-blue
    weight: 90
  alternativeBackends:
    kind: Service
    name: web-green
    weight: 10
```

```
apiVersion: v1
kind: Service
  metadata:
  name: web-blue
spec:
  selector:
    name: myapp
    version: 1
```



```
> oc patch route/www -p '{"spec":{"to":{"name":"web-v1"}}}'
```

STAY K8S COMPATIBLE

	OpenShift	Vanilla Kubernetes	Cloud
Deploy	DeploymentConfig Deployment	Deployment	-
Build	BuildConfig	-	Google Tekton AWS CodeBuild Azure Pipelines
Ingress	Route Ingress	Ingress	ELB Service
Security	SCC PSP	PSP	-
Network	NetworkPolicy	NetworkPolicy	SecurityGroups
Storage	PVC	PVC	PVC
Monitoring	EFK / Prometheus	-	CloudWatch

Reference Architectures

See what is recommended from the vendors

REFERENCE ARCHITECTURES

OpenShift on VMware vCenter
https://access.redhat.com/articles/2745171

OpenShift on Red Hat OpenStack Platform
https://access.redhat.com/articles/2743631

OpenShift on Amazon Web Services
https://access.redhat.com/articles/2623521

OpenShift on Google Cloud Platform
https://access.redhat.com/articles/2751521

OpenShift on Microsoft Azure
https://access.redhat.com/articles/3030691

Deploying an OpenShift Distributed Architecture
https://access.redhat.com/articles/1609803

OpenShift Architecture and Deployment Guide
https://access.redhat.com/articles/1755133

OpenShift Scaling, Performance, and Capacity Planning
https://access.redhat.com/articles/2191731

Application Release Strategies with OpenShift
https://access.redhat.com/articles/2897391

Building Polyglot Microservices on OpenShift
https://access.redhat.com/articles/2893381

Building JBoss EAP 6 Microservices on OpenShift
https://access.redhat.com/articles/2094731

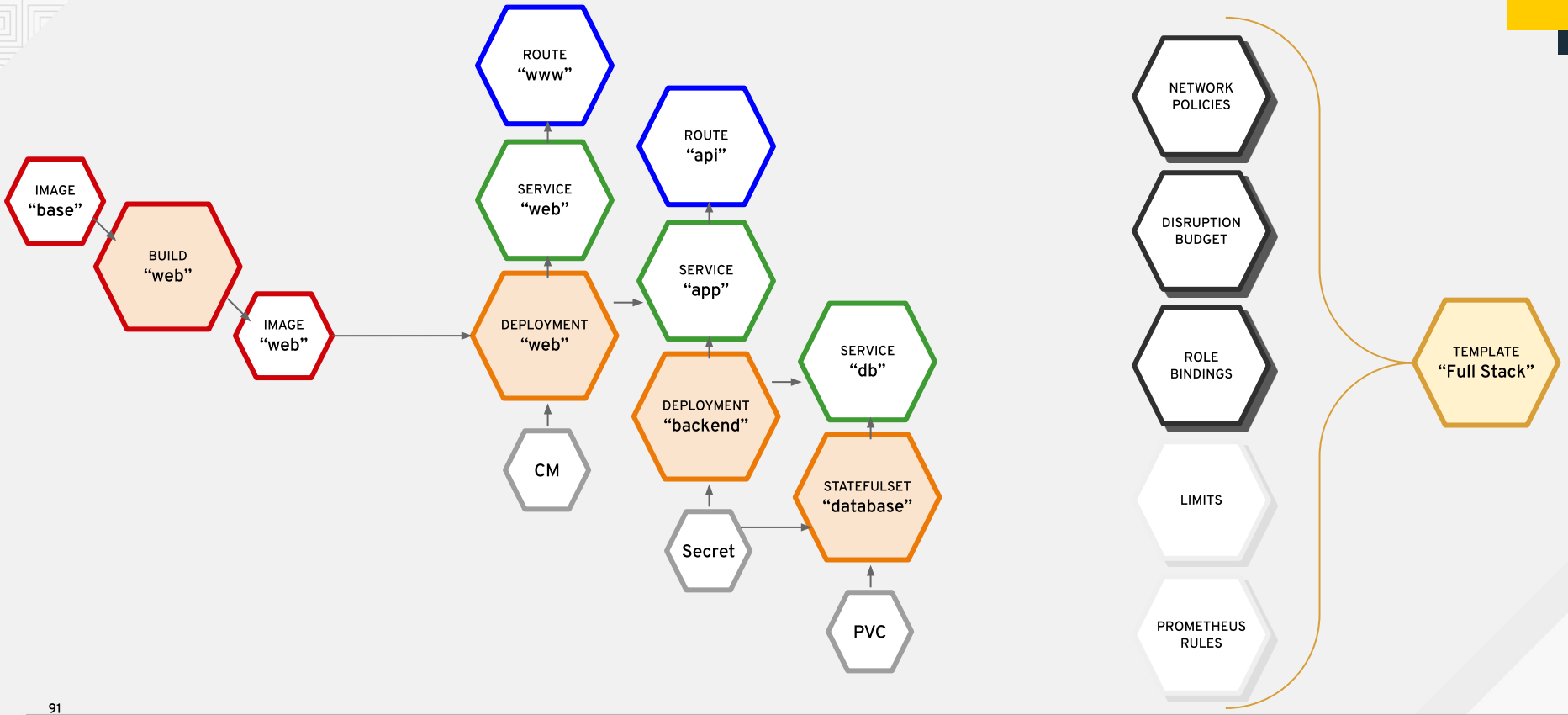
Building JBoss EAP 7 Microservices on OpenShift
https://access.redhat.com/articles/2407801

Business Process Management with JBoss BPMS on OpenShift
https://access.redhat.com/articles/2893421

Build and Deployment of Java Applications on OpenShift
https://access.redhat.com/articles/3016691

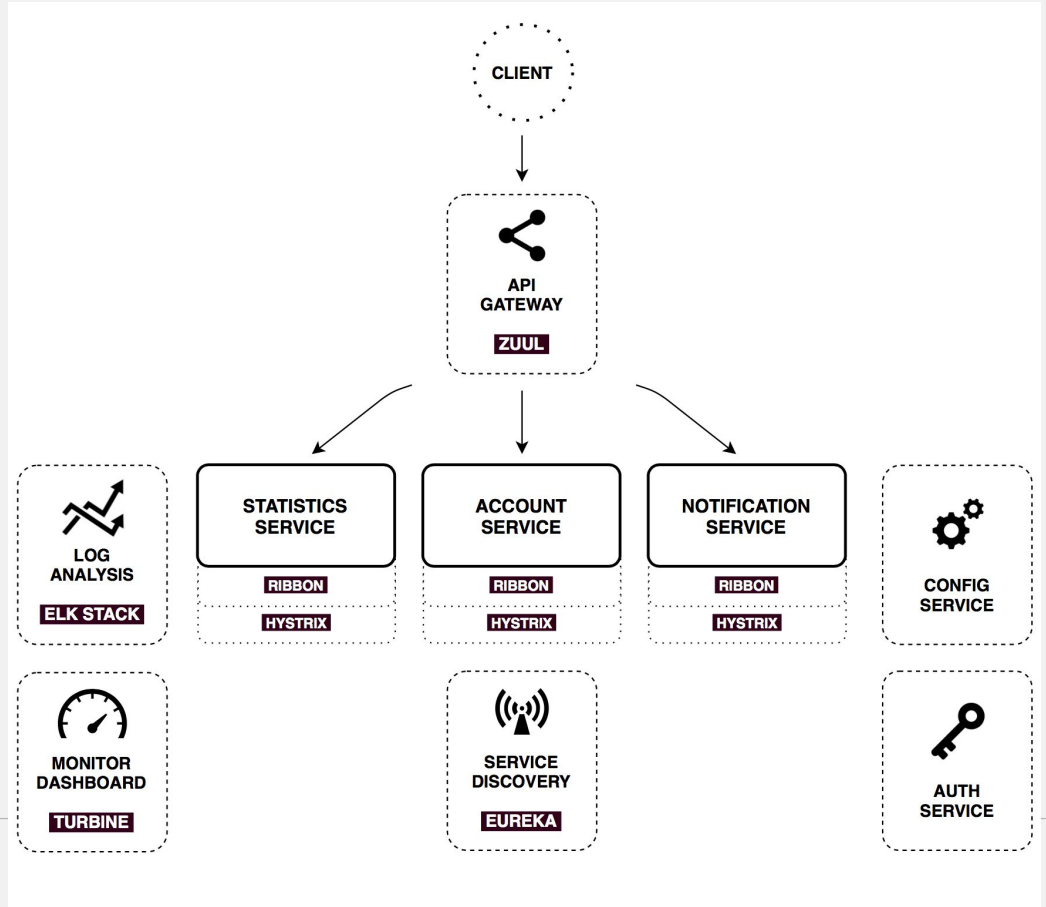
JFrog Artifactory on OpenShift Container Platform
https://access.redhat.com/articles/3049611

JEE Java Stack



> oc patch route/www -p '{"spec":{"to":{"name":"web-v1"}}}'

Spring Cloud - Java Stack



Application Onboarding

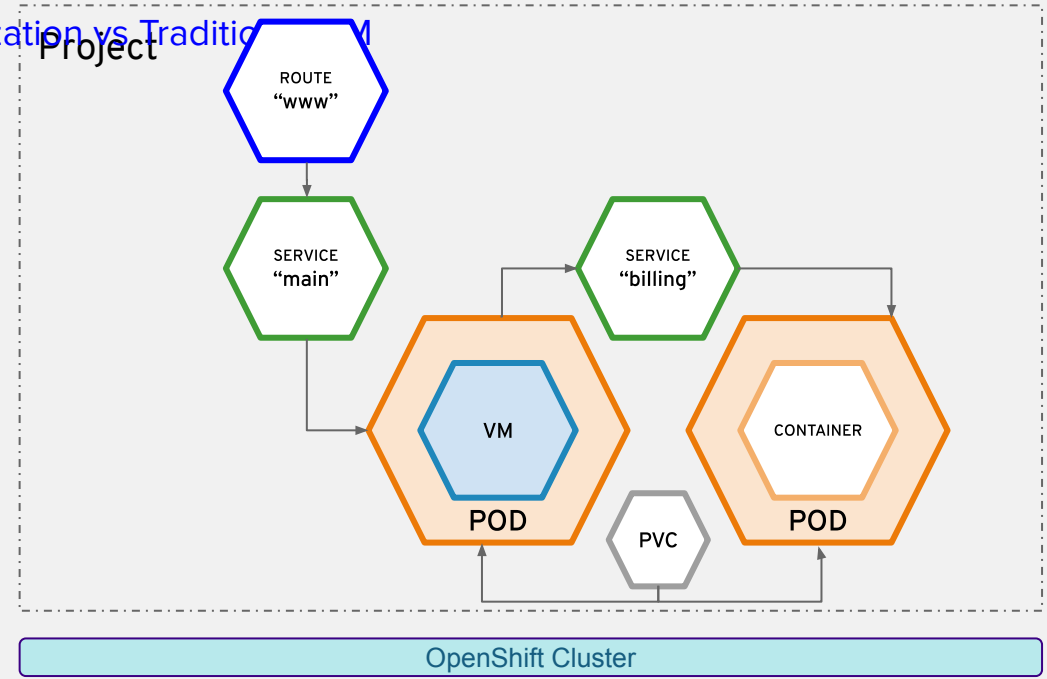
Promote & Deploy into

Production

automatically

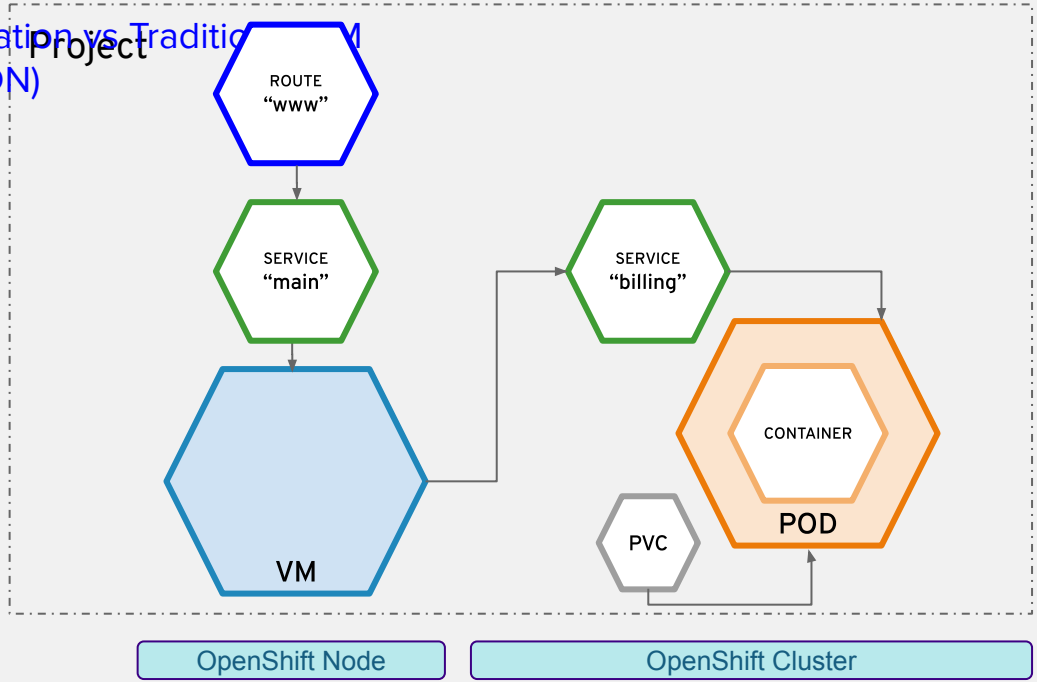
Lift & Shift

- Container-Native Virtualization vs Traditional VM
- Service Discovery (DNS)
- KVM based
- Strangler pattern



Lift & Shift

- Container-Native Virtualization vs Traditional VM
- Ramp Up node (VPN-2-SDN)
- Service Discovery (DNS)



- Label node

Greenfield / S2I

- Lots of Base Images
- Easy to recompile
- Java == Java
- Write your own

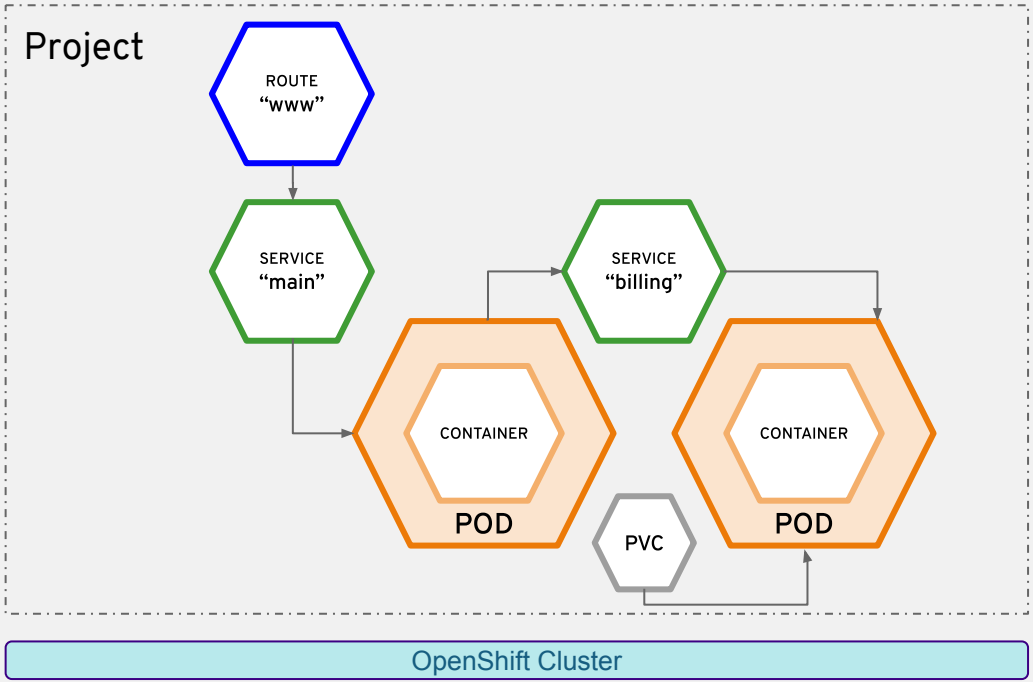


Image selection

80%

Existing Builder Image?

oc new-app <git-url>

- Red Hat products
- Common languages

70%

Existing Red Hat Image?

Don't need S2I
Trusted
Compatible
Supported
Up-to-date

- Red Hat products

40%

Existing Vendor Image?

Don't need S2I
Trusted
Compatible
Supported
Up-to-date

- COTS Software

10%

Existing Community Image?

Manage / Support yourself
Quickstart example
Untrusted!

Dockerfile
ADD .s2i/assemble

- Community

10%

Build from Scratch

Dockerfile
RUN yum install jdk weblogic
ADD /entrypoint.sh
ENV param1=value1
CMD /entrypoint.sh

Deployment Selection

Externalize ENV Config

60%

ENV vars

- Few parameters to drive direction
- Abstracts complex config
- Spring Boot

50%

ConfigMap

- Extensive parameters
- Multiple configurations
- Full control over config

20%

Secrets

- Sensitive data
- RBAC protected

5%

Database

- Traditional support
- Externally Managed (CMS)
- Scalable / Flexible

5%

Persistent Volume

- Dynamic config
- Managed by CMS

5%

ConfigServer

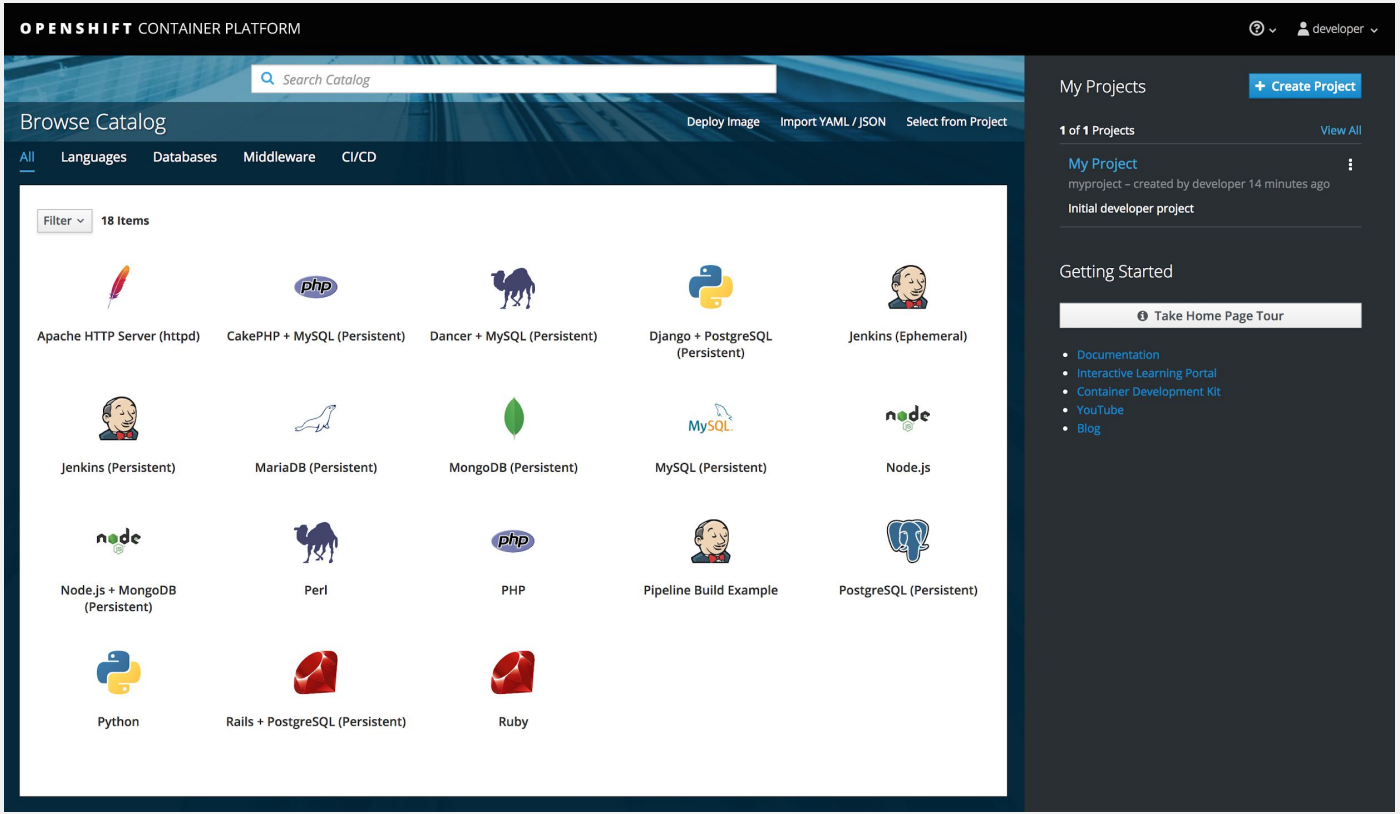
- Zookeeper / Consul
- Service Discovery
- Host Profile
- COTS Compatibility
- Central Management / Push

- Component Dependency

Entrypoint


15%
InitContainer
Database versioning
Fetch Config (Zookeeper)
Synchronizer
Cache Warmup
Slave registration
Tooling Image
• Keeps main image clean
10%
SideCar Container
Peer discovery
Reload Config
Proxy (Auth,TLS)
Management / Monitoring
•
90%
/Entrypoint.sh
Parse Parameters (ENV)
Generate Config
•

ALL RED HAT PRODUCTS CONTAINERIZED

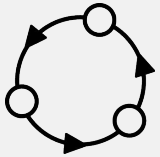


OPENSHIFT DEVELOPER CATALOG

Appendix: OpenShift vs. “Vanilla” Kubernetes Myths

THE VANILLA KUBERNETES MYTHS

Why IT shops swoon over “Vanilla” Kubernetes and its perceived value



Ultimate portability across Kubernetes Clusters

No “vendor lock-in”

Always on latest version

THE VANILLA KUBERNETES REALITY

"Vanilla" Kubernetes is not really vanilla at all

Every vendor configures their Kubernetes distribution differently

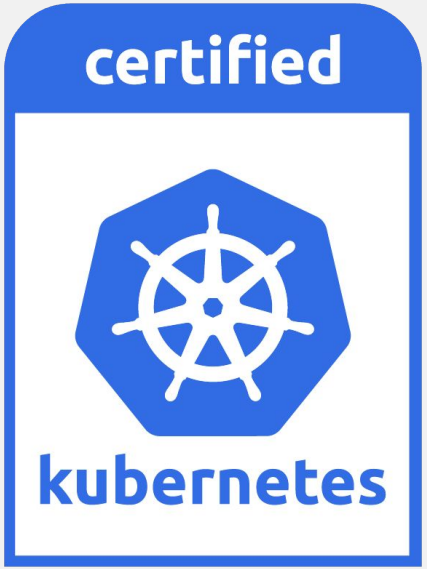
Every vendor operates Kubernetes differently; this matters

No vendor is in lockstep with the latest upstream

* https://medium.com/@jzelinskie/youre-not-running-vanilla-kubernetes-2f2359666bf9

KUBERNETES CONFORMANCE

Interoperability at the API



"The new Certified Kubernetes Conformance Program gives enterprise organizations the confidence that workloads that run on any Certified Kubernetes Distribution or Platform will work correctly on any other version," said Dan Kohn, Executive Director, Cloud Native Computing Foundation. **"The interoperability that this program ensures is essential to Kubernetes meeting its promise of offering a single open source software project supported by many vendors that can deploy on any public, private or hybrid cloud."**

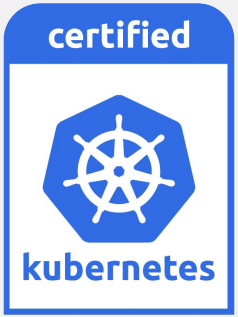
One of the goals of the project has always been **consistency and portability**. Kubernetes sits on top of the infrastructure and enables you to **describe your workload in a common format**. Kubernetes **makes it easy to move workloads from one place to another**, or combine disjointed environments with a shared control plane.

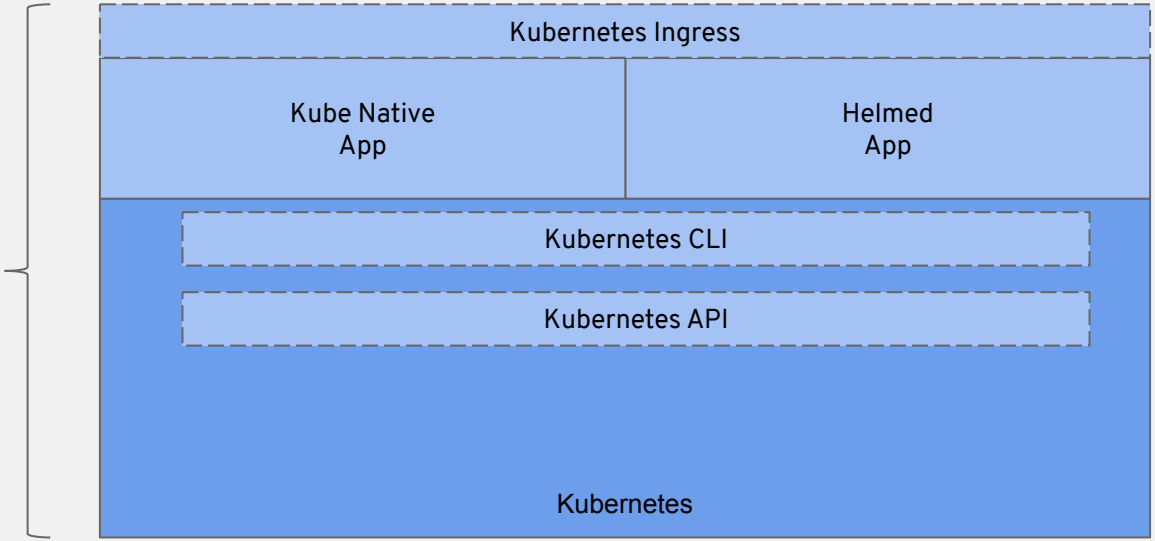
This **program gives end users the confidence** that when they use a **Certified Kubernetes** product they **can rely on a high level of common functionality**. It gives Independent Software Vendors (ISVs) **confidence that if their customer is using a Certified Kubernetes platform that their software will behave as expected**.

* https://github.com/cncf/k8s-conformance

UPSTREAM KUBERNETES

Upstream is closest to “Vanilla”

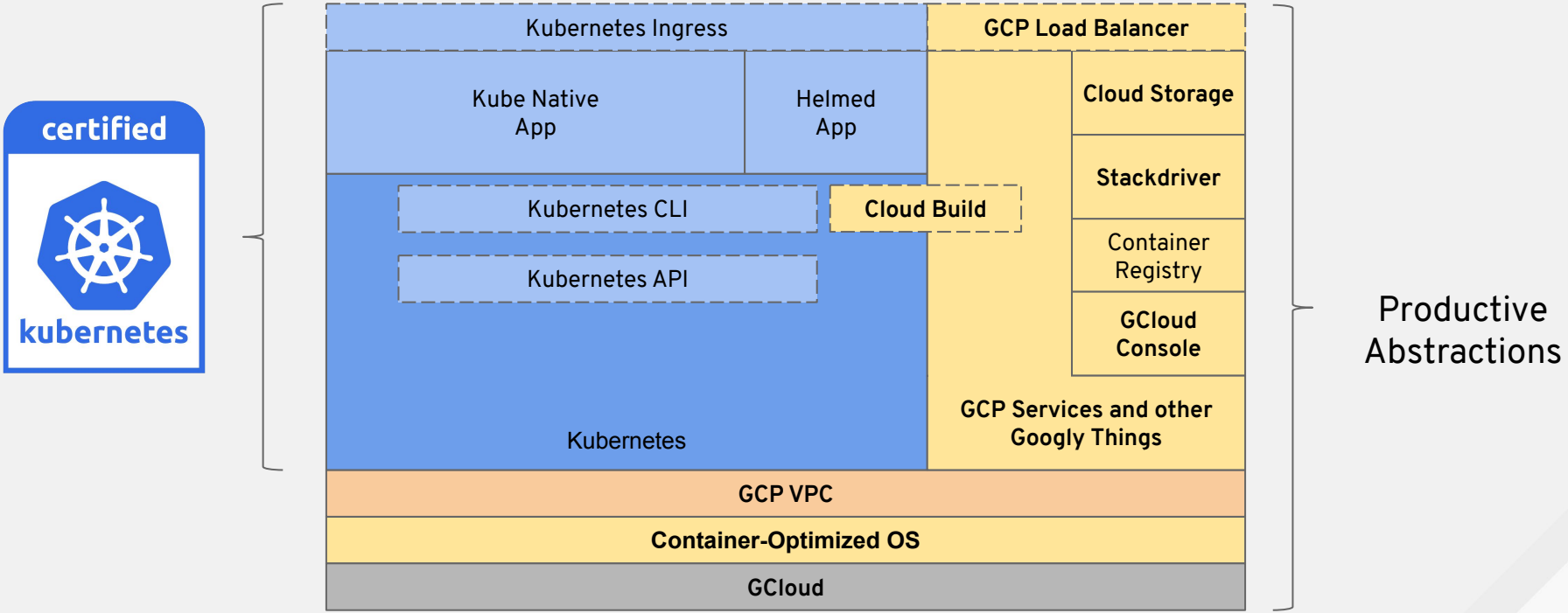




* Not comprehensive. Not even close.

GKE

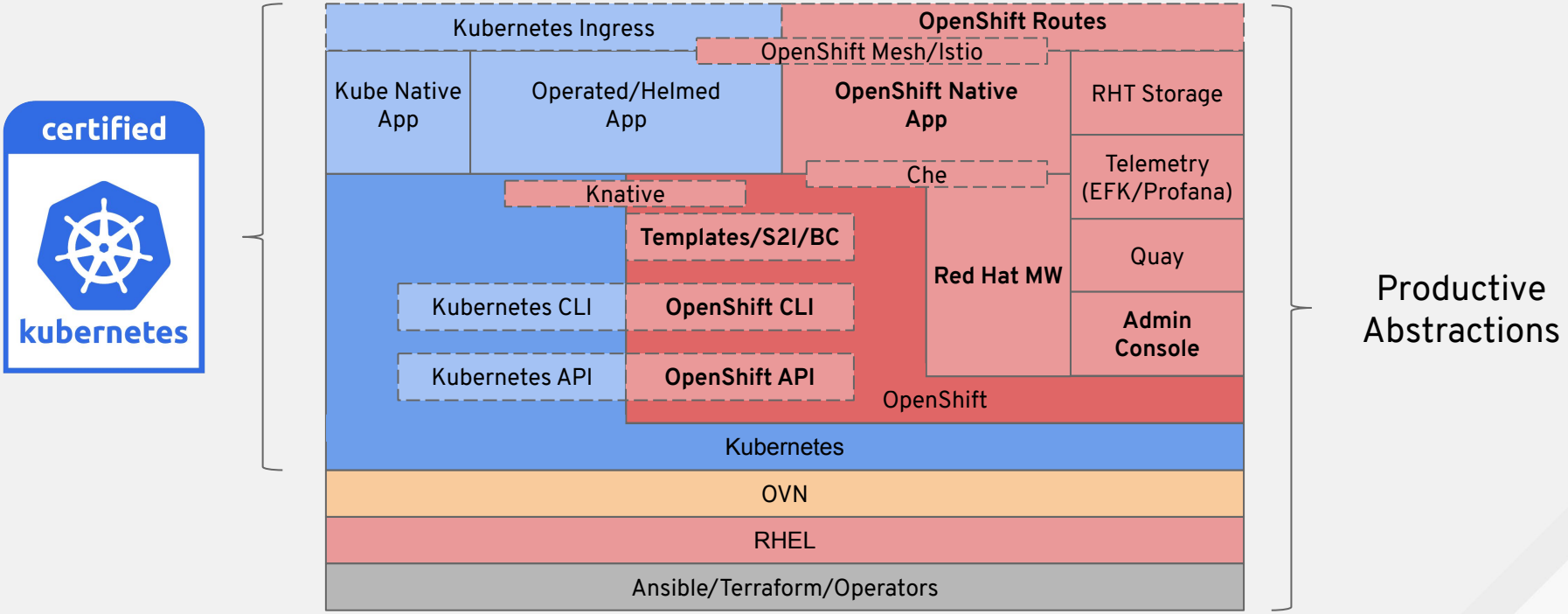
Even one of the Kube founders is not “Vanilla”



* Not comprehensive. Not even close. GCP only APIs in **bold**.

OPENSHIFT

Certified “Pure” Kubernetes and productive abstractions



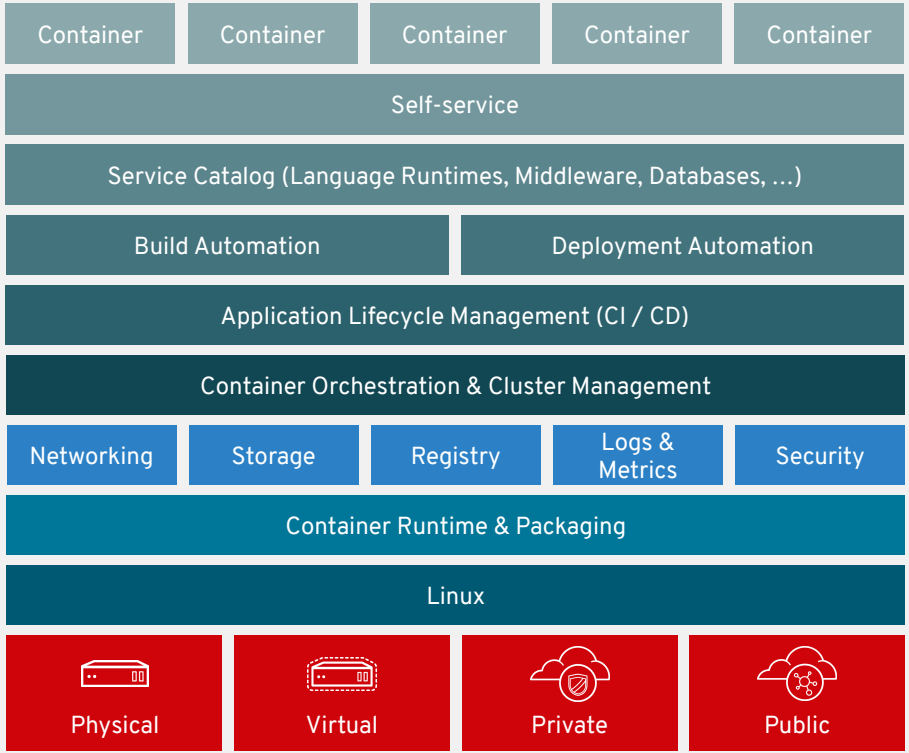
* Not comprehensive. Not even close. Red Hat or OpenShift only APIs in **bold**.

Appendix: Community projects vs enterprise software products

DIY CONTAINER STACK CHALLENGES

Bring your own middleware, data & other services. Build out a service catalog / interface to enable self-service deployment.

Pull Kubernetes or other orchestration (Mesos, Swarm) from rapidly moving upstream & support / maintain yourself. Do all the work required to integrate it into your enterprise IT environment (networking, storage, registry, security, logging, metrics, etc.)



Take existing application build/CI & deployment tools and evolve to add container image build & mgt., continuous deployment, etc.

Pull Docker container runtime from rapidly moving upstream and support, secure and maintain it yourself.

Support and manage your own Linux community distro or build on existing RHEL or 3rd party commercial Linux offerings.

CONTAINER INFRASTRUCTURE AND MANAGEMENT

	Kubernetes	OKD*	OpenShift
Multi-host container scheduling	✔	✔	✔
Self-service provisioning	✔	✔	✔
Service discovery	✔	✔	✔
Enterprise Linux operating system			✔
Image registry		✔	✔
Validated storage plugins		✔	✔
Networking and validated networking plugins		✔	✔
Log aggregation and monitoring		✔	✔
Multi-tenancy		✔	✔
Metering and chargeback			✔

* OKD is the open source project formerly known as OpenShift Origin

DEVELOPER EXPERIENCE

	Kubernetes	OKD*	OpenShift
Automated image builds	No developer or application services	✔	✔
CI/CD workflows and pipelines		✔	✔
Certified application services			✔
Certified middleware			✔
Certified databases			✔
200+ certified ISV solutions			✔

* OKD is the open source project formerly known as OpenShift Origin

ENTERPRISE SUPPORT AND COMMUNITY

	Kubernetes	OKD	OpenShift
Community forums and resources	✔	✔	✔
Zero downtime patching and upgrades			✔
Enterprise 24/7 support			✔
9 year support lifecycle			✔
Security response team			✔

External review: [10 most important differences between OpenShift and Kubernetes]

Appendix: Docker Support in OpenShift 4

IS DOCKER THE BEST AVAILABLE CONTAINER ENGINE?

Potential limitations surrounding Docker

- Build requires a “big fat” daemon on every host
- Regression for integration with container platforms Kubernetes/OpenShift
- Build has secret handling issues
- Root/privileged concerns at runtime
- Root/privileged concerns with daemon
- Build requires a running container

CONTAINER INNOVATION CONTINUES ....

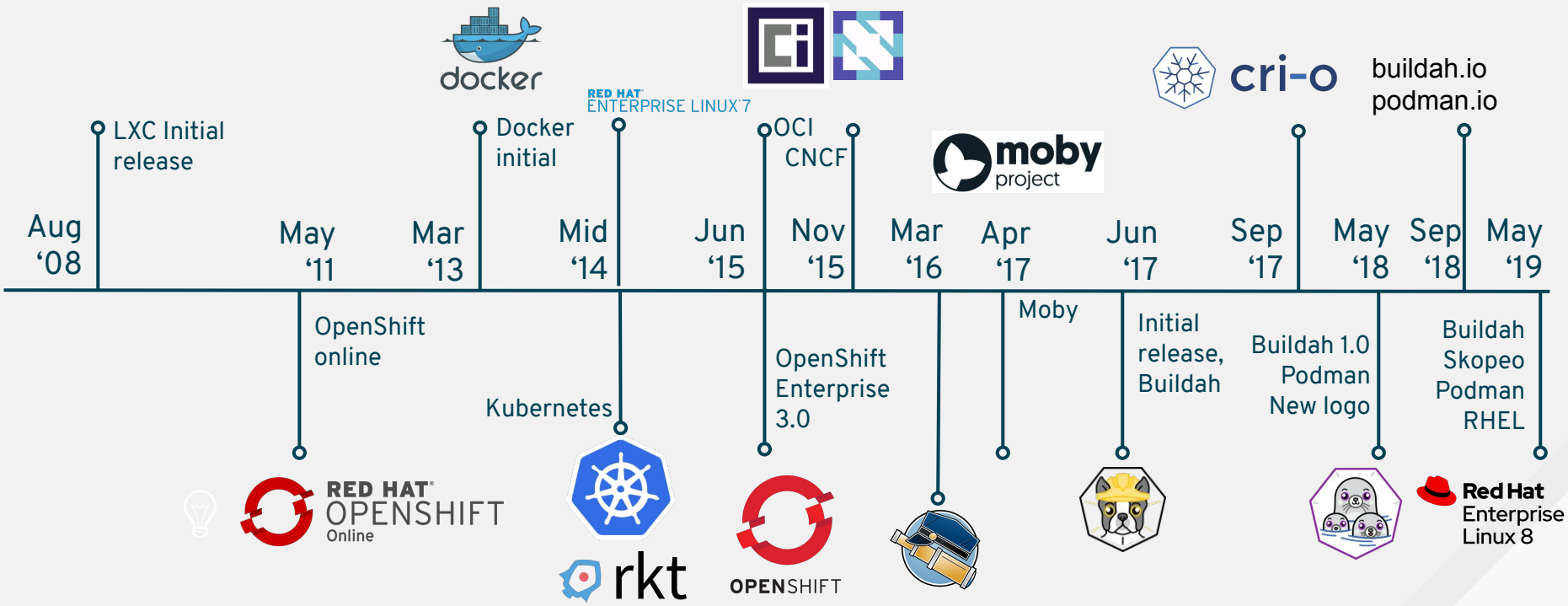
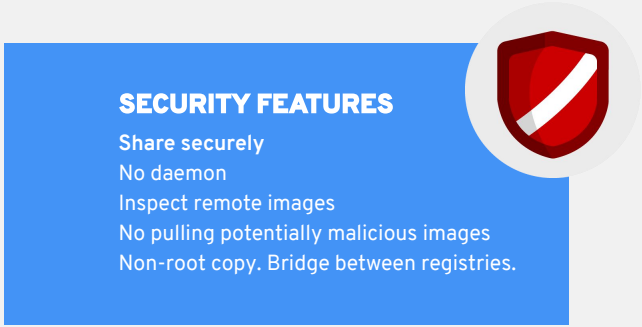
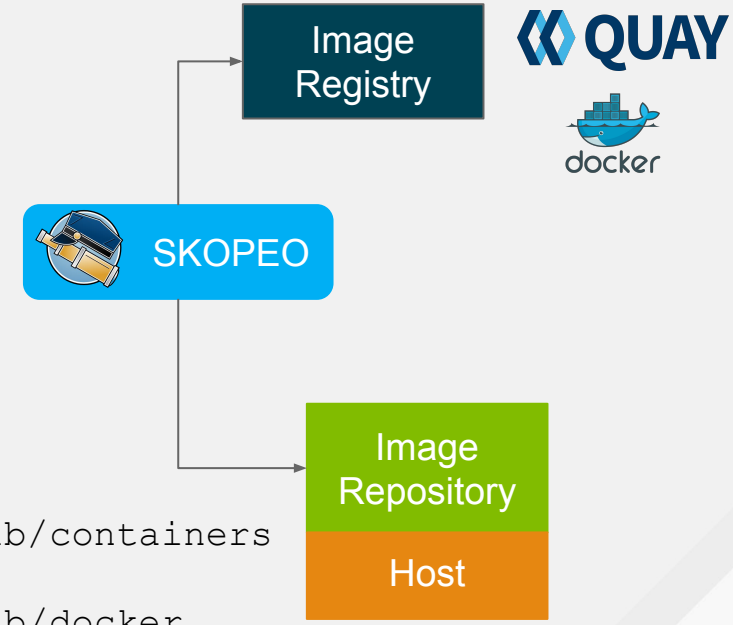


IMAGE COPY WITH SKOPEO

- Built for interfacing with Docker registry
- CLI for images and image registries
- Rejected by upstream Docker ¯_(ツ)_/¯
- Allows remote inspection of image meta-data - no downloading
- Can copy from one storage to another

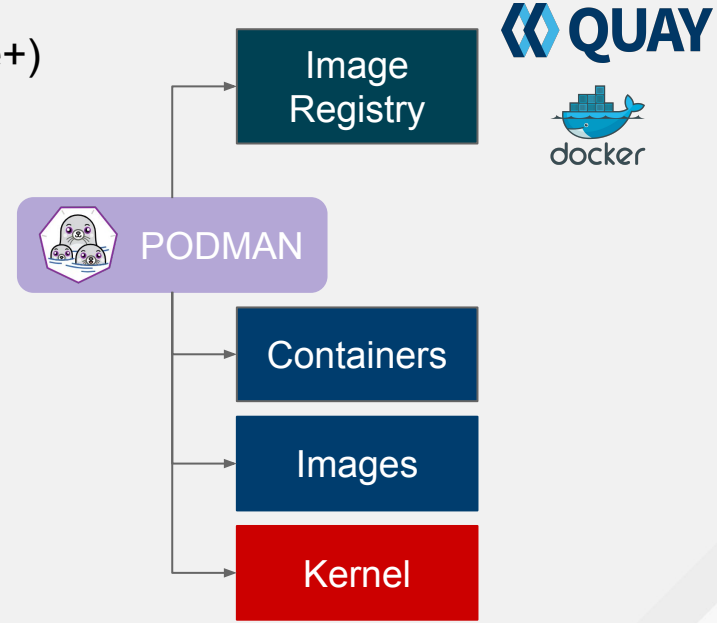


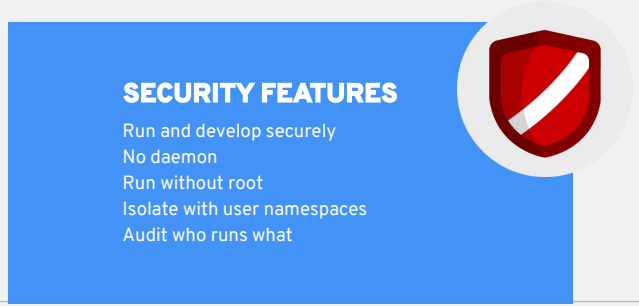


The new container CLI

podman

- @ podman.io
- Client only tool, based on the Docker CLI. (same+)
- No daemon!
- Storage for
  - Images - `containers/image`
  - Containers - `containers/storage`
- Runtime - `runc`
- Shares state with CRI-O and with Buildah!

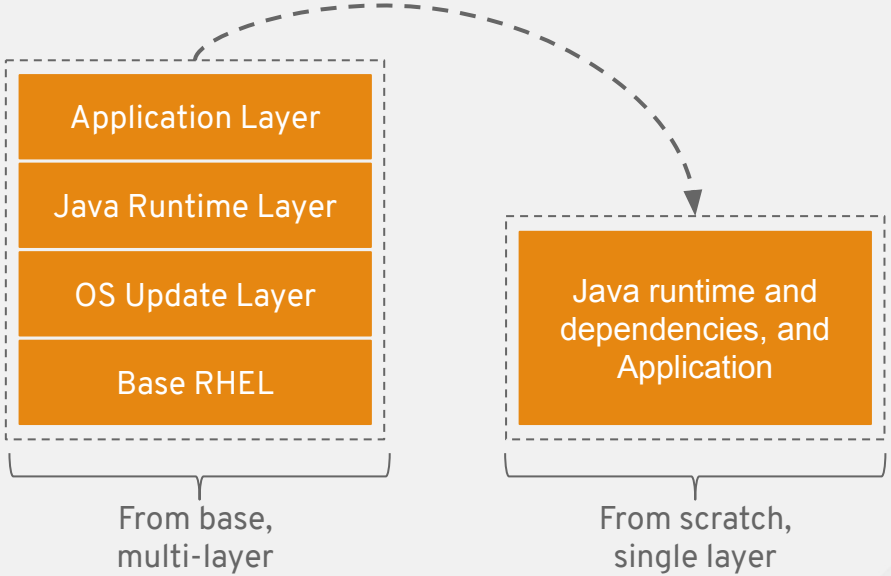




Why use Buildah?

buildah

- Now buildah.io
- Builds OCI compliant images
- No daemon - no “docker socket”
- Does not require a running container
- Can use the host’s user’s secrets.
- Single layer, from scratch images are made easy and it ensures limited manifest.
- If needed you can still maintain Dockerfile based workflow



SECURITY FEATURES

Build securely
No daemon
Shrink the attack surface
Fine-grained control of the layers
Run builds isolated
Better secret management