



**Red Hat**

OpenShift

Container Platform

# OPENSHIFT CONTAINER PLATFORM TECHNICAL OVERVIEW

Red Hat



# AGENDA

- [Containers](#)
- [OpenShift Business Value](#)
- [OpenShift Application Concepts](#)
- [OpenShift Architecture Concepts](#)
- [Possible OpenShift Cluster Configurations](#)
- [OpenShift Features Deep Dive](#)
  - [Monitoring Application Health](#)
  - [Networking](#)
  - [Logging & Metrics](#)
  - [Security](#)
  - [Operator Framework](#)
  - [Container Image Build and Deploy Strategies](#)
- [OpenShift 4 Themes](#)
- [Reference Architectures](#)

# CONTAINERS



It takes weeks for an environment to get delivered.

The application behaves differently in production than it did in test.

I don't have enough environments to perform testing.

We have no idea what is the current state of machines.

Deployments are manual, painful, and infrequent.

Each environment has a different set of configurations to manage.

We have a proliferation of technologies we have to manage.

# THE PROBLEM

Applications require  
complicated installation and  
integration every time they are  
deployed.



# THE SOLUTION

Adopt a container strategy in order to allow applications to be easily shared and deployed.

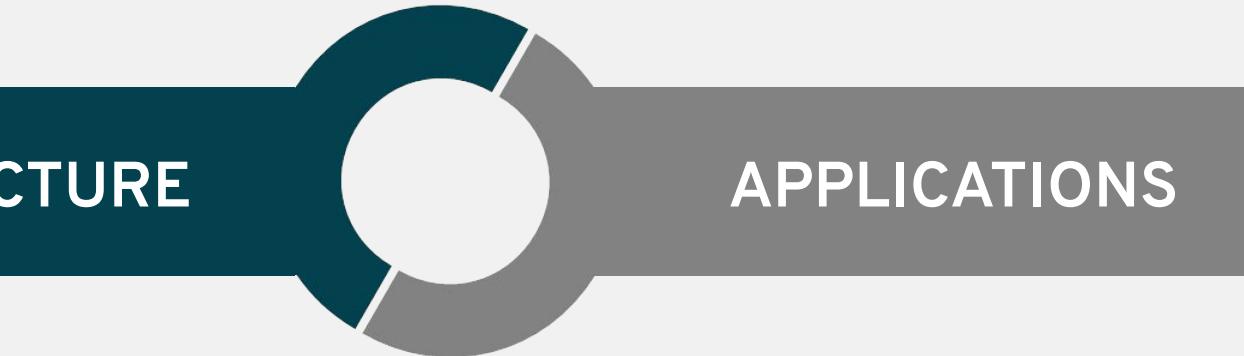


# WHAT ARE CONTAINERS?

It Depends Who You Ask

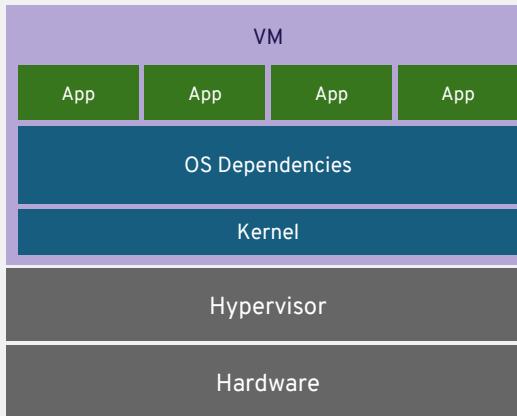
INFRASTRUCTURE

APPLICATIONS

- 
- Application processes on a shared kernel
  - Simpler, lighter, and denser than VMs
  - Portable across different environments
  - Package apps with all dependencies
  - Deploy to any environment in seconds
  - Easily accessed and shared

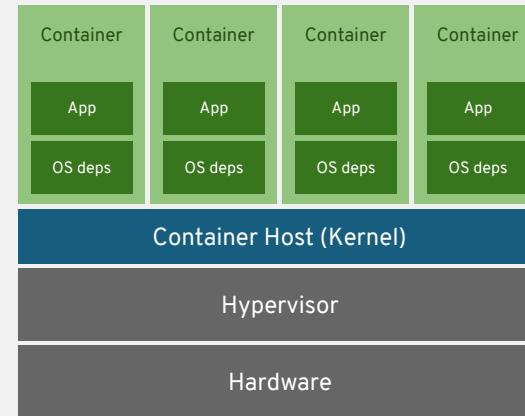
# CONTAINERS COMPLIMENT VIRTUAL MACHINES

VIRTUAL MACHINES



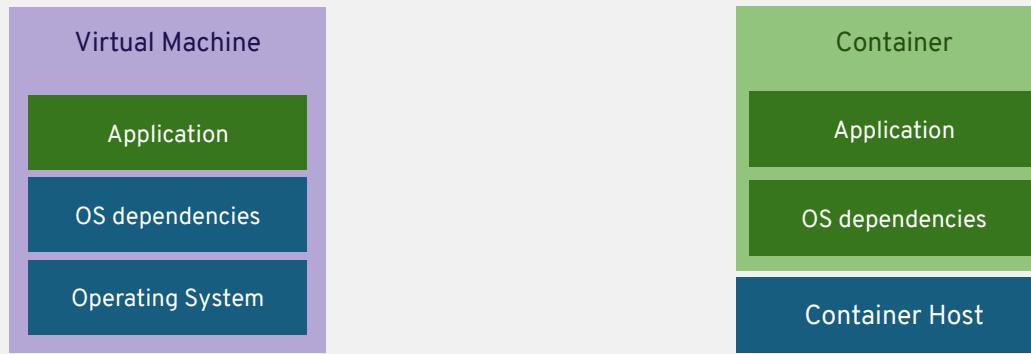
VM isolates the hardware

CONTAINERS



Container isolates the process

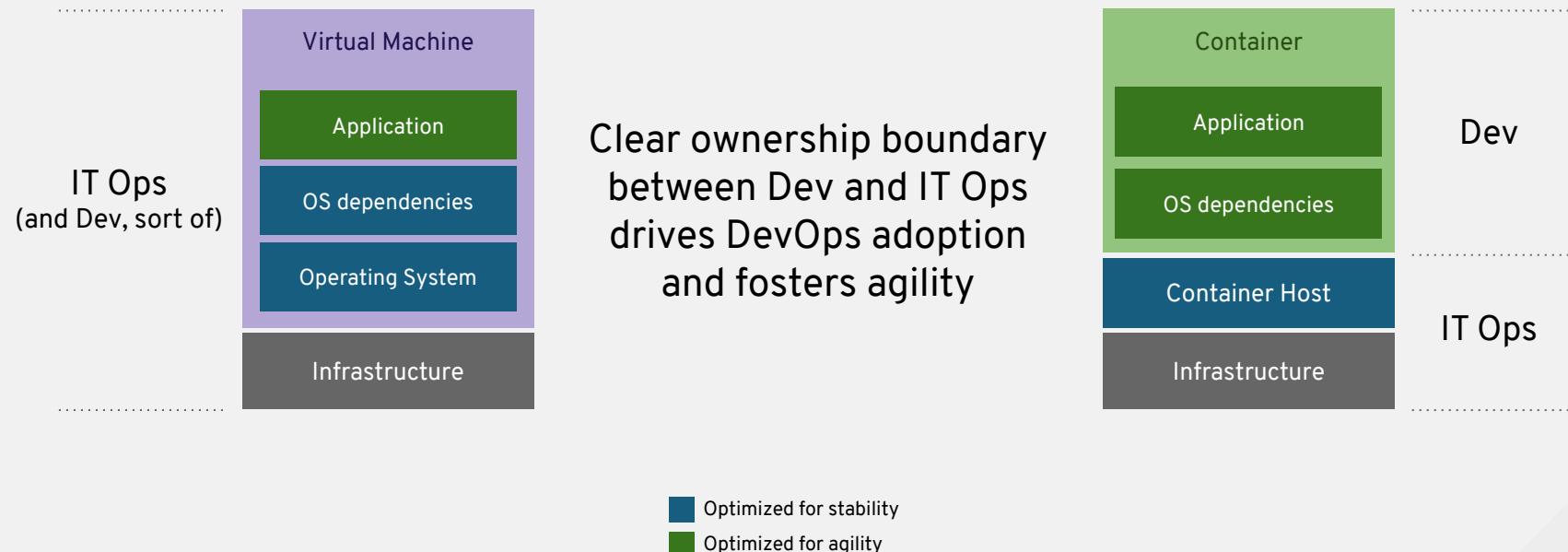
# COMPARING VIRTUAL MACHINES AND CONTAINERS



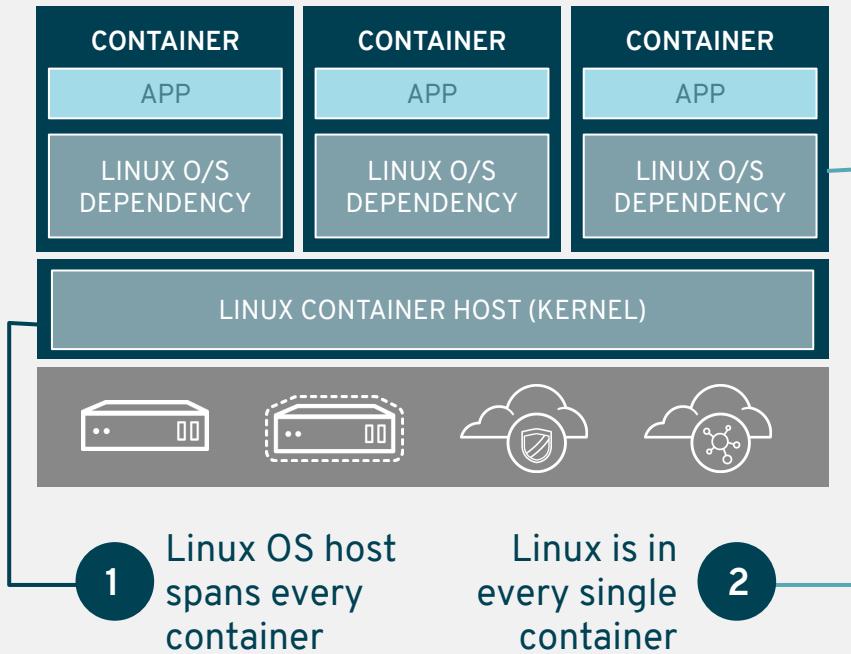
- + VM Isolation
- Complete OS
- Static Compute
- Static Memory
- High Resource Usage

- + Container Isolation
- + Shared Kernel
- + Burstable Compute
- + Burstable Memory
- + Low Resource Usage

# OWNERSHIP COMPARISON: VIRTUAL MACHINES AND CONTAINERS



# LINUX AND CONTAINER INFRASTRUCTURE

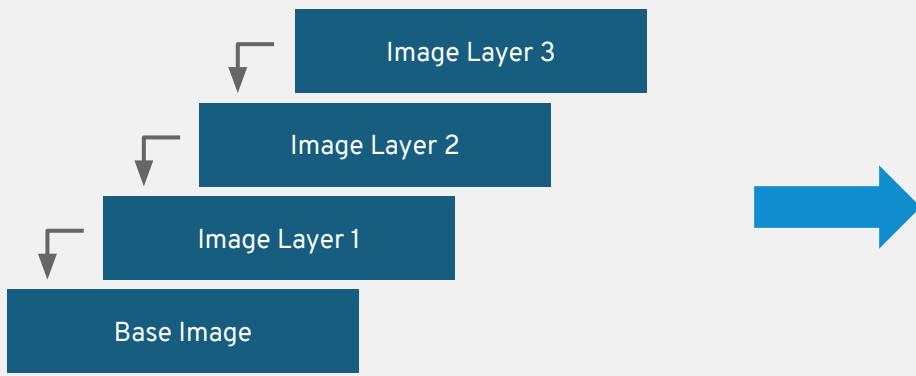


## CONTAINERS ARE LINUX

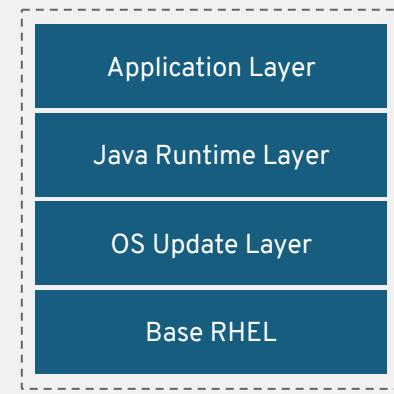
Red Hat  
Enterprise Linux  
is a leader in paid  
Linux

70%  
CY2016 paid  
Linux share

# RAPID SECURITY PATCHING USING CONTAINER IMAGE LAYERING



Container Image Layers



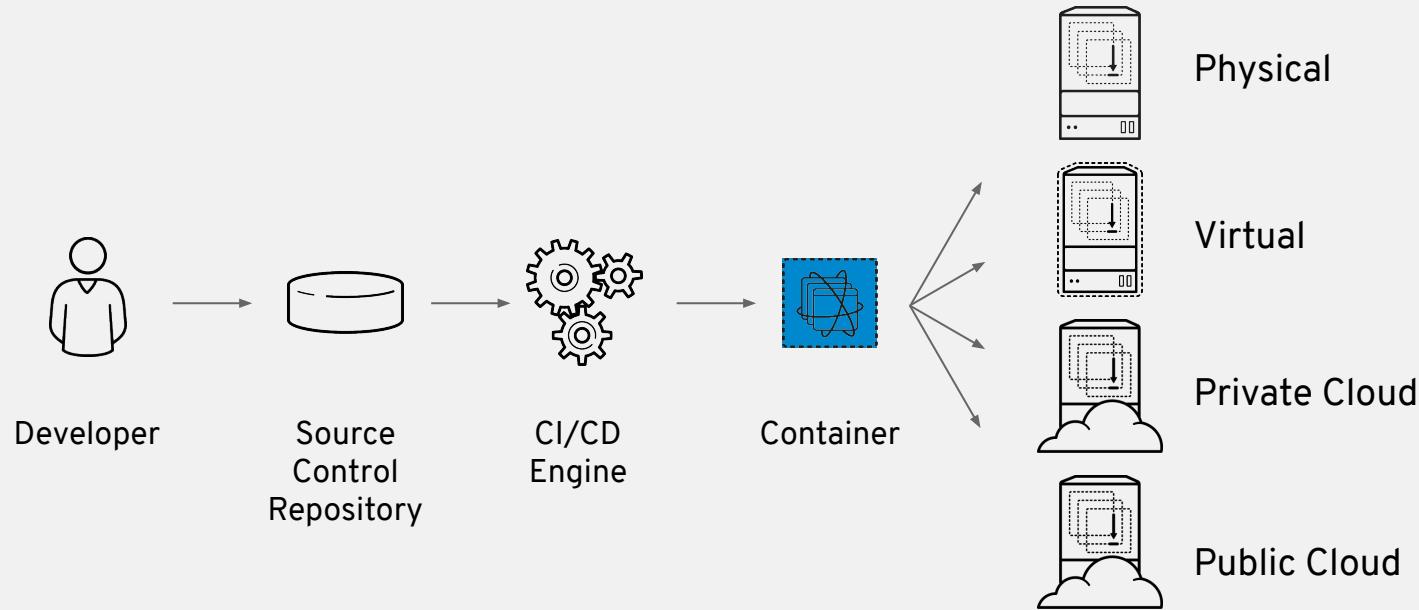
Example Container Image

The background of the slide features a large, modern cable-stayed bridge with multiple towers and cables stretching across a body of water. The sky is overcast with heavy clouds.

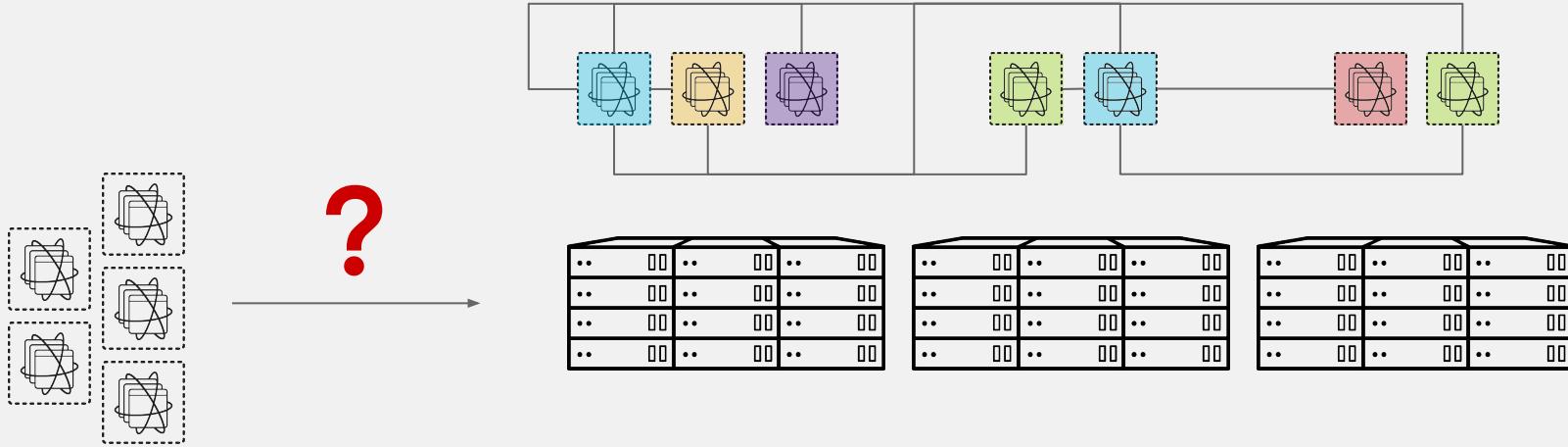
# DEVOPS AND CONTAINERS



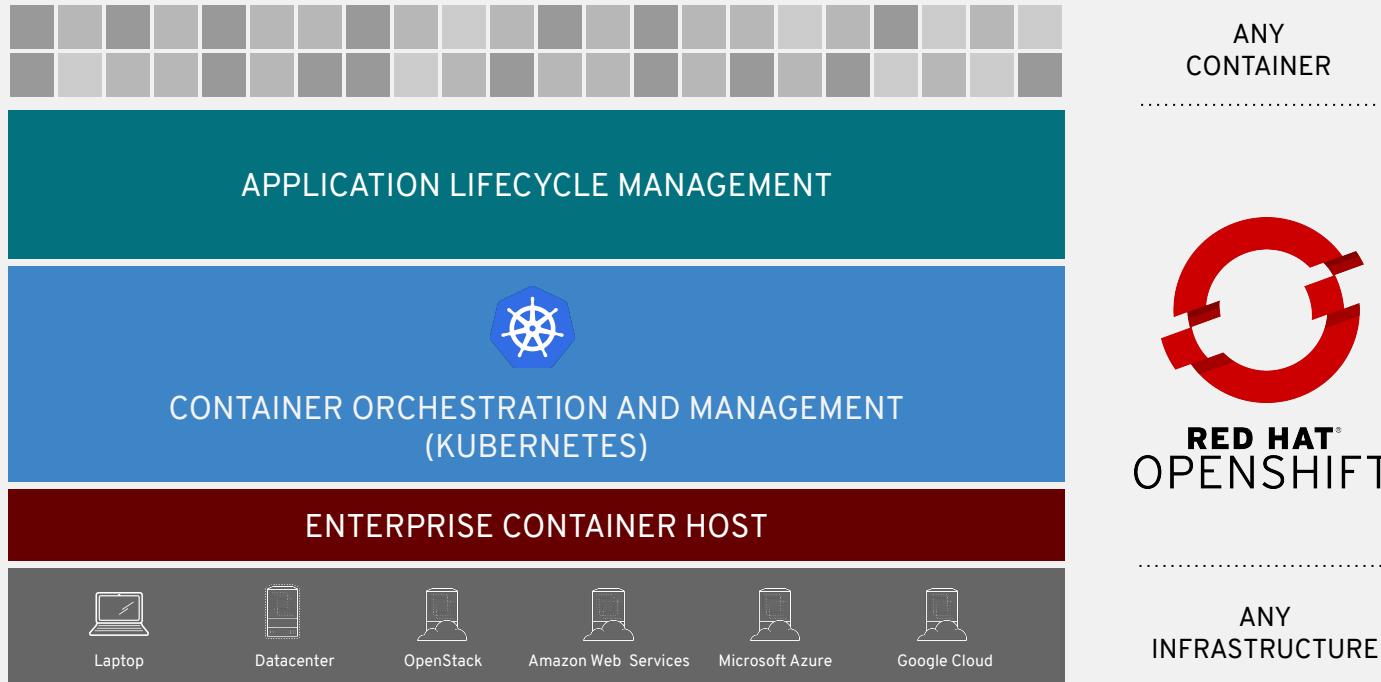
# DEVOPS WITH A CONTAINER = EASY



# DEVOPS WITH MANY CONTAINERS = HARD



# OPENShift CONTAINER PLATFORM

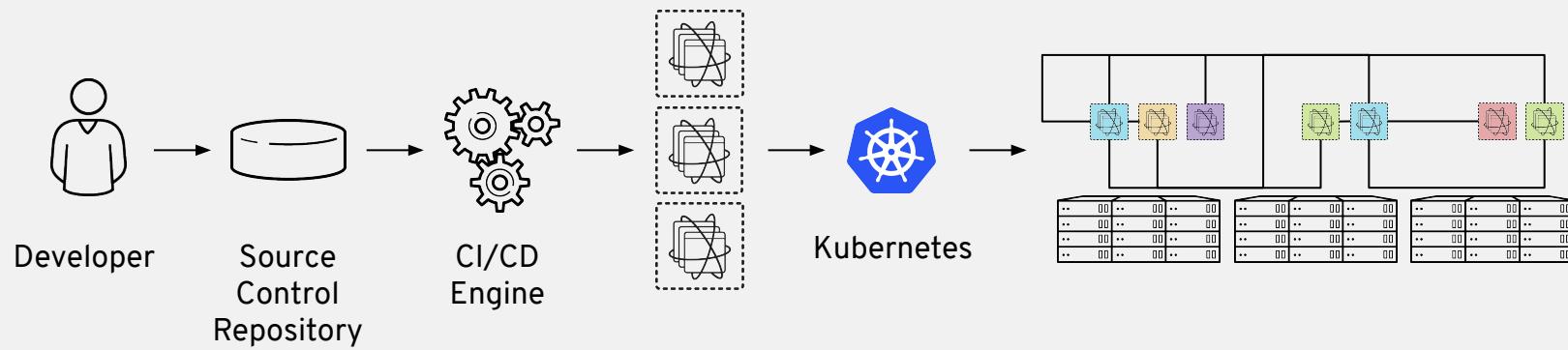


Kubernetes is an open-source system for automating deployment, operations, and scaling of containerized applications across multiple hosts.



# Kubernetes

# DEVOPS WITH KUBERNETES



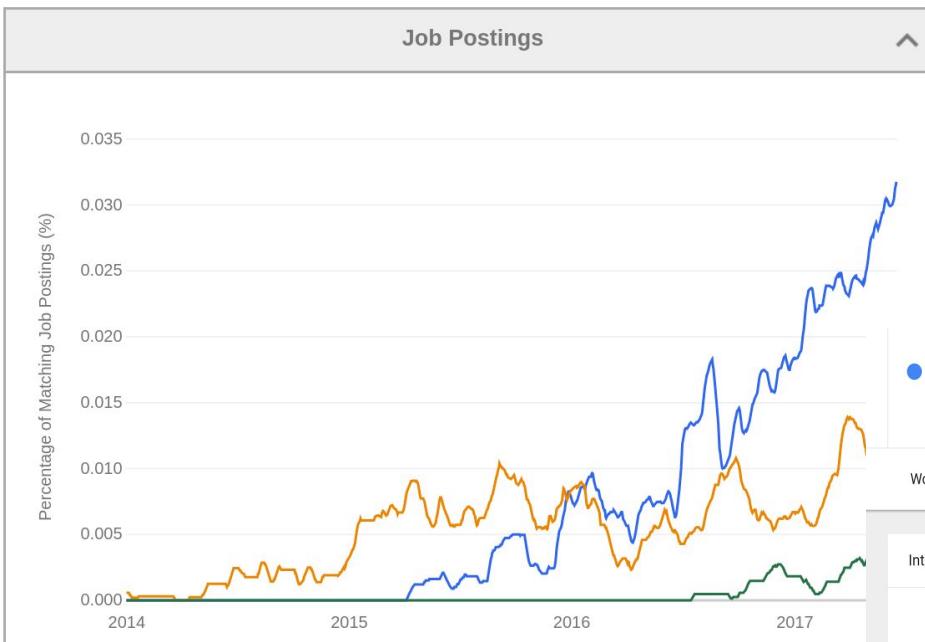
Kubernetes

Cloud Foundry

Docker Swarm

+ Add Term

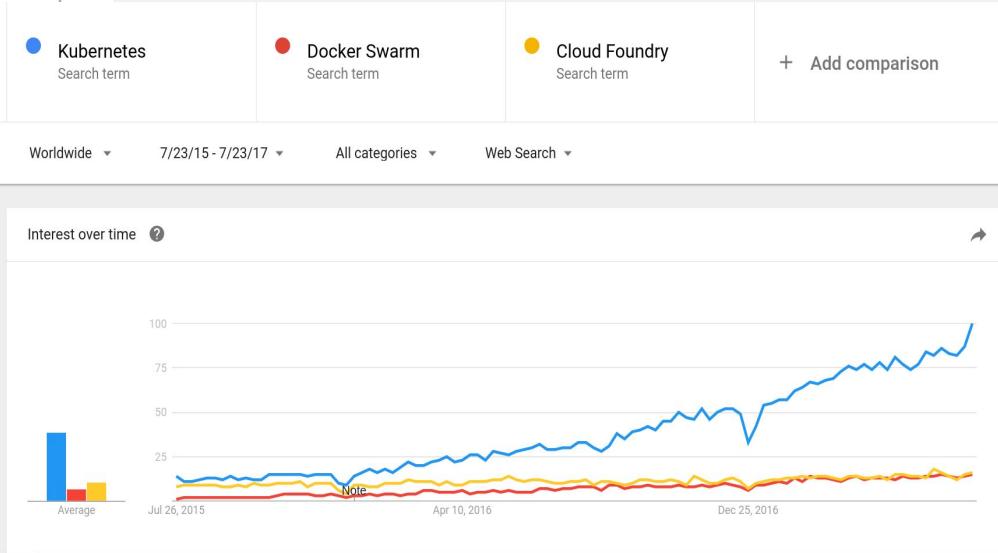
Find Trends



Job Postings

## Most active project on GitHub

- #1 Most commented
- #2 Issues Open + Closed
- #1 Comments + Issues



Google Trends

GENERAL DISTRIBUTION

# KUBERNETES DONE RIGHT IS HARD

## INSTALL

- Templating
- Validation
- OS Setup

## DEPLOY

- Identity & Security Access
- App Monitoring & Alerts
- Storage & Persistence
- Egress, Ingress & Integration
- Host Container Images
- Build/Deploy Methodology

## HARDEN

- Platform Monitoring & Alerts
- Metering & Chargeback
- Platform Security Hardening
- Image Hardening
- Security Certifications
- Network Policy
- Disaster Recovery
- Resource Segmentation

## OPERATE

- OS Upgrade & Patch
- Platform Upgrade & Patch
- Image Upgrade & Patch
- App Upgrade & Patch
- Security Patches
- Continuous Security Scanning
- Multi-environment Rollout
- Enterprise Container Registry
- Cluster & App Elasticity
- Monitor, Alert, Remediate
- Log Aggregation

 75%

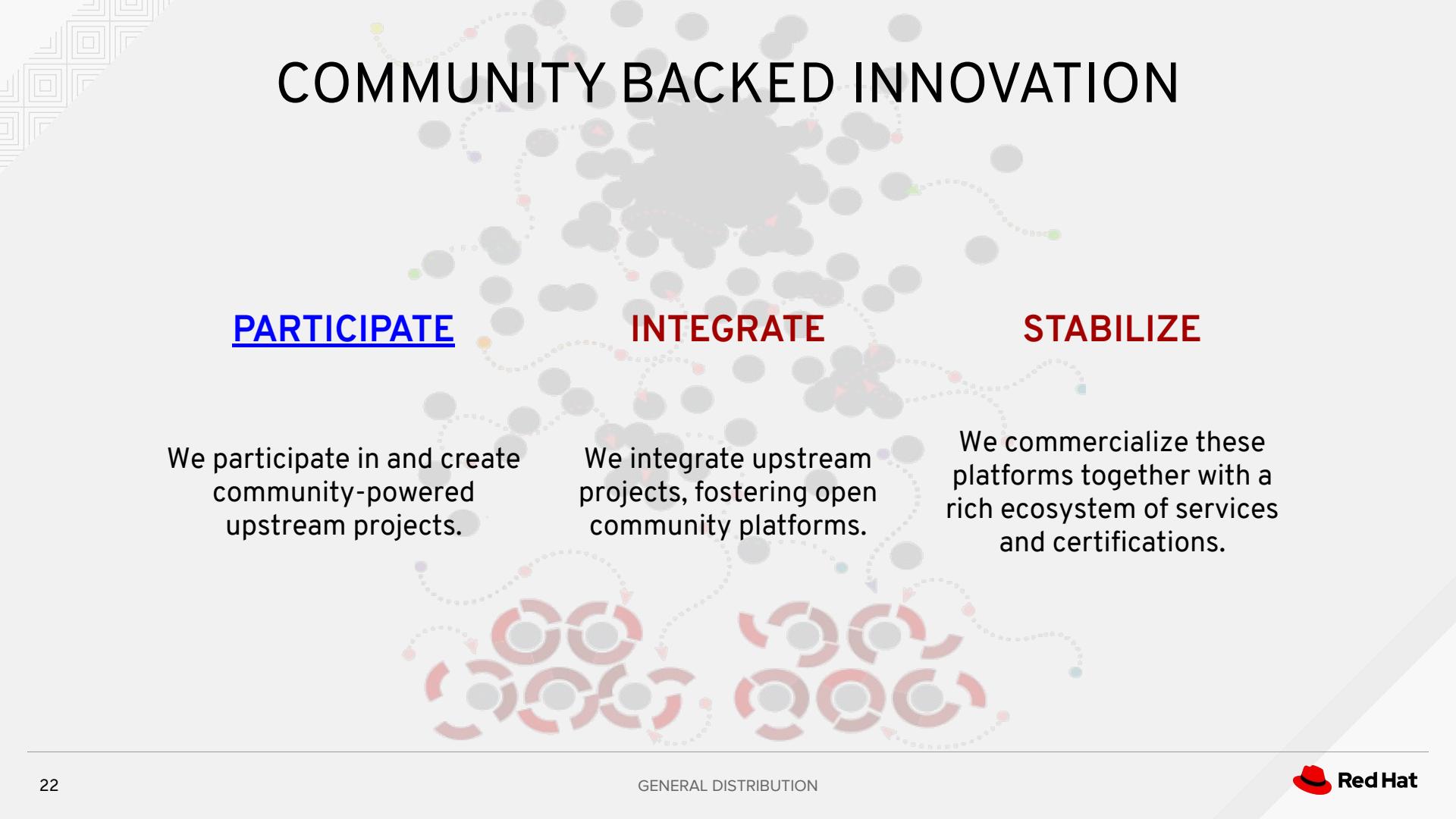
of enterprise users identify complexity of implementation and operations as the top blocker to adoption

Source: The New Stack, The State of the Kubernetes Ecosystem, August 2017

# ENTERPRISE IT DEMANDS MORE

- Standard operating environment
- Application services
- Metrics and logging
- Infrastructure management
- Self service portal
- Persistent storage
- Etc.

# COMMUNITY BACKED INNOVATION



## PARTICIPATE

We participate in and create community-powered upstream projects.

## INTEGRATE

We integrate upstream projects, fostering open community platforms.

## STABILIZE

We commercialize these platforms together with a rich ecosystem of services and certifications.

# RED HAT SUBSCRIPTION & YOUR BUSINESS

## TECHNICAL SUPPORT

- 24 HOURS / 7 DAYS A WEEK
- UNLIMITED INCIDENTS
- MULTI-LINGUAL
- MULTI-VENDOR CASE OWNERSHIP
- MULTI-CHANNEL

## ONGOING DELIVERY

- STABILITY WITH A PRODUCT LIFE CYCLE OF UP TO 10 YEARS
- PATCHES
- UPDATES
- UPGRADES
- SECURITY RESPONSE TEAM

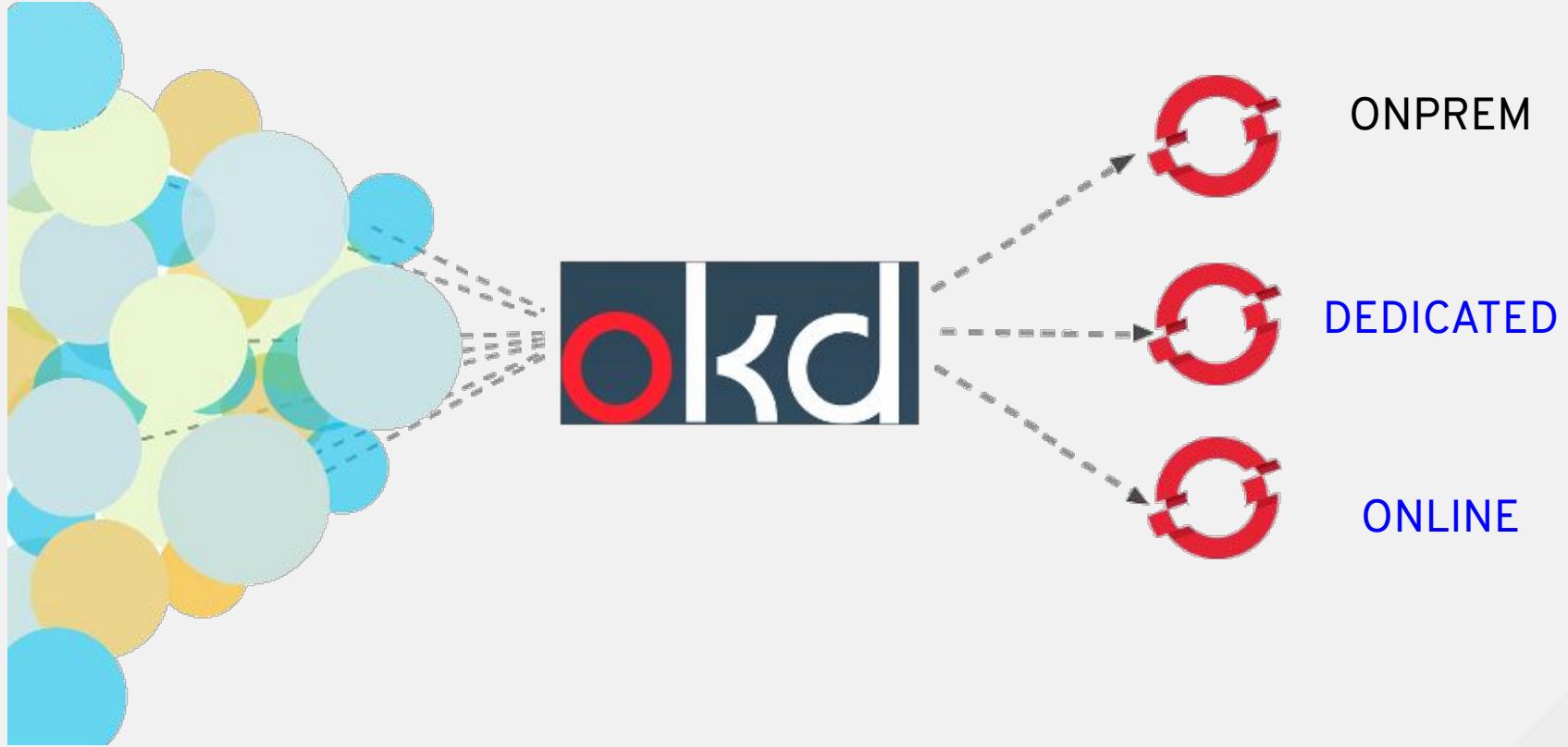
## EXPERTISE

- CUSTOMER PORTAL & FORUMS
- KNOWLEDGEBASE
- ACCESS LABS
- TRAINING CURRICULA

## COMMITMENTS

- HARDWARE CERTIFICATION
- SOFTWARE CERTIFICATION
- CLOUD PROVIDER CERTIFICATION

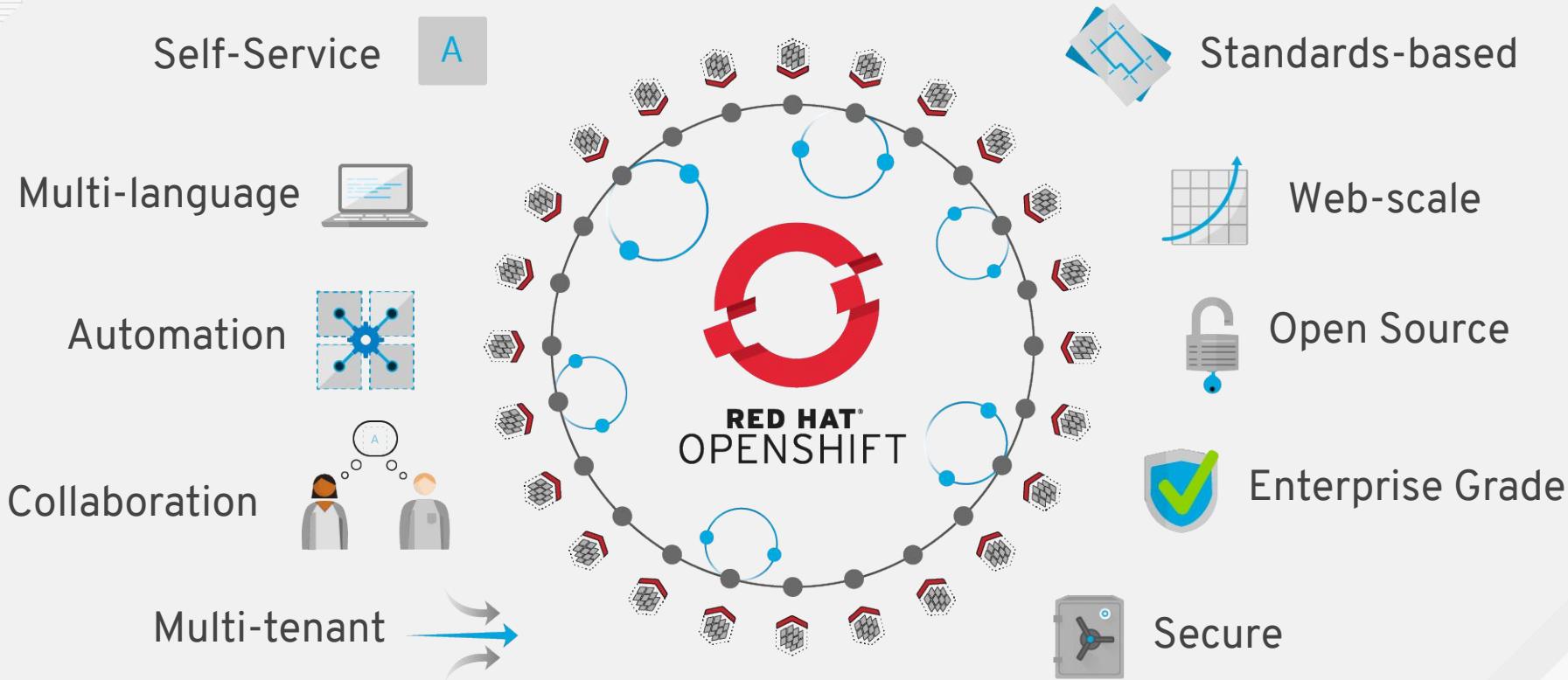
# OPENSHIFT CONTAINER PLATFORM





# OPENShift BUSINESS VALUE



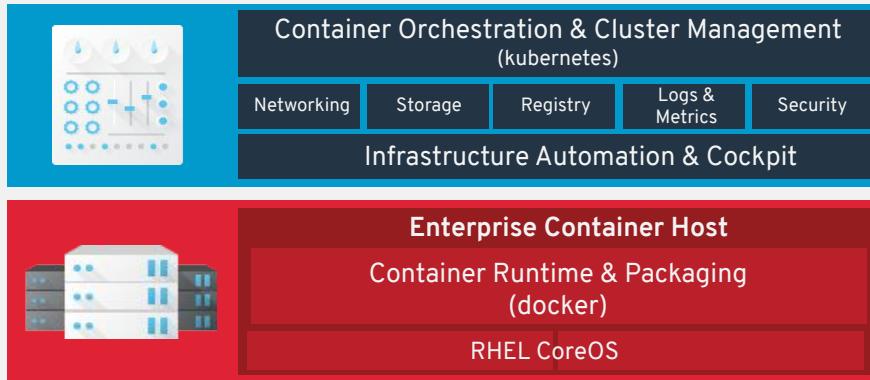


# OPENSHIFT CONTAINER PLATFORM



Trusted by Fortune Global 500 companies

# OPENSHIFT CONTAINER PLATFORM



Enterprise Kubernetes++  
container orchestration

Trusted by Fortune Global 500  
companies

# OPENSHIFT IS KUBERNETES FOR THE ENTERPRISE

Kubernetes  
Release



1-3 months  
hardening

OpenShift  
Release

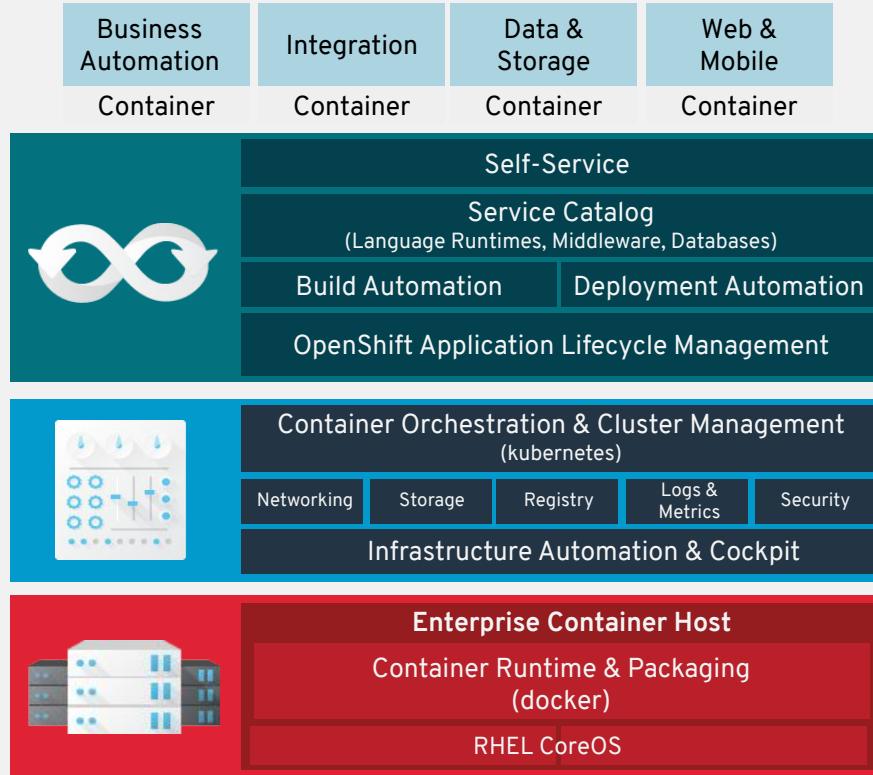


200+ validated integrations  
100s of defect and performance fixes  
9 year enterprise lifecycle management  
Security fixes  
Middleware integration  
(container images, storage, networking, cloud services, etc)  
Certified Kubernetes

	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](#)

# OPENSHIFT CONTAINER PLATFORM



Traditional, stateful, and cloud-native apps

Developer Experience

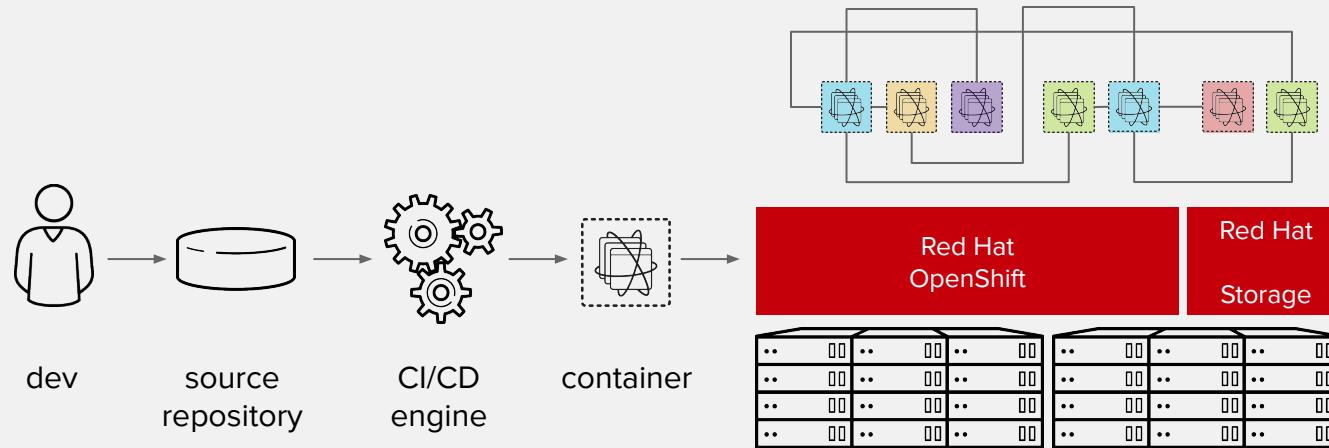
Enterprise Kubernetes++

Trusted by Fortune Global 500 companies

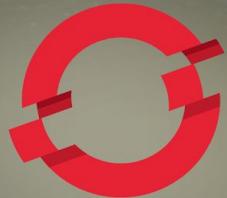
# POLYGLOT PLATFORM

LANGUAGES	Java	NodeJS	Python	PHP	Perl	Ruby	.NET Core	Third-party Language Runtimes	<i>CRUNCHYDATA</i>
DATABASES	MySQL	PostgreSQL	MongoDB	Redis	MS SQL	...and virtually any container image!			<i>GITLAB</i>
WEB SERVERS	Apache HTTP Server	nginx	Varnish	Phusion Passenger	Tomcat				<i>IRON.IO</i>
MIDDLEWARE	Spring Boot	Wildfly Swarm	.NET	JBoss Web Server	JBoss EAP	JBoss A-MQ	JBoss Fuse	Third-party Middleware	<i>COUCHBASE</i>
	3SCALE API mgmt	JBoss BRMS	JBoss BPMS	JBoss Data Virt	JBoss Data Grid	RH Mobile	RH SSO	Third-party Middleware	<i>SONATYPE</i>

# DEPLOYING CONTAINERS WITH RED HAT



# WHO ELSE IS DOING THIS?



RED HAT®  
OPENSHIFT

<https://openshift.com/customers>

# A LEADING HEALTH INSURANCE PROVIDER RE-INVENTS ITSELF WITH DEVOPS



## INSURANCE SERVICES

## SOFTWARE AND SERVICES

Red Hat Consulting  
Red Hat OpenShift  
Red Hat Fuse

### CHALLENGE

- At risk of missing ACA-mandated deadlines due long delivery cycles
- Seeking new revenue streams by selling data on a subscription basis

### SOLUTION

- Delivered architecture for building, testing, and delivering microservices
- Built out a DevOps methodology for application delivery
- Circuit breakers and switches for zero-downtime deployments
- Automatic scale-up and scale-down of services via OpenShift

### BENEFITS

- Reduce production delivery cycle from **9+ months** to **3 weeks**
- Reduced time-to-market from idea to delivery, which leads to greater experimentation with new ideas
- On-demand infrastructure utilization increases efficiency and reduces cost

# WHY IS RED HAT THE BEST CHOICE?

## CODE

Kubernetes commits

Category	Percentage
Google	46%
Red Hat	19%
Independent	18%
Others	17%

## CUSTOMERS

## CLOUD

## COMPREHENSIVE

Category	Container Type
Business Automation & API Mgmt	CONTAINER
Data & Storage	CONTAINER
Web & Mobile	CONTAINER
3rd party frameworks	CONTAINER

Layer	Product
APPLICATION LIFECYCLE AUTOMATION	Red Hat Registry
CONTAINER MANAGEMENT	Developer Studio
CONTAINER INFRASTRUCTURE	CDK
ENTERPRISE-GRADE CONTAINER OS	CloudForms
Physical Infrastructure	Ansible
Virtual Infrastructure	Satellite
Private Infrastructure	
Public Infrastructure	

Red Hat is a leading Kubernetes developer & contributor with Google<sup>1</sup>.

We make container development easy, reliable, & more secure.

Most reference customers running in production.

We have years of experience running OpenShift Online & OpenShift Dedicated services.

Strong partnerships with cloud providers, ISVs, CCSPs.

We have an extensive container catalog of certified partner images.

Our comprehensive portfolio of container products and services includes developer tools, security, application services, storage, & management.

# Why It Matters



**531%**  
5-year ROI

**66%**

Faster development  
life cycle

**36%**

More applications  
per year

**8 MONTHS**

Payback  
period

**US\$1.29M**

Average annual  
benefits per  
100 developers

The Business Value of Red Hat OpenShift, IDC #US41845816, October 2017,  
<https://www.redhat.com/en/resources/The-Business-Value-of-Red-Hat-OpenShift>.



**10x**

Increased application development throughput from 20 to 200 changes a day

**OpenShift on AWS & private cloud**

The Hilton logo, featuring the word "Hilton" in a large, bold, serif font inside a black rectangular border.

**Months → Days**

Improved time to market by accelerating development time

**OpenShift on AWS**

**50%**

Reduction in development time for new services and APIs. Launched a new cloud platform in 10 days

**OpenShift on AWS, Azure, & private cloud**



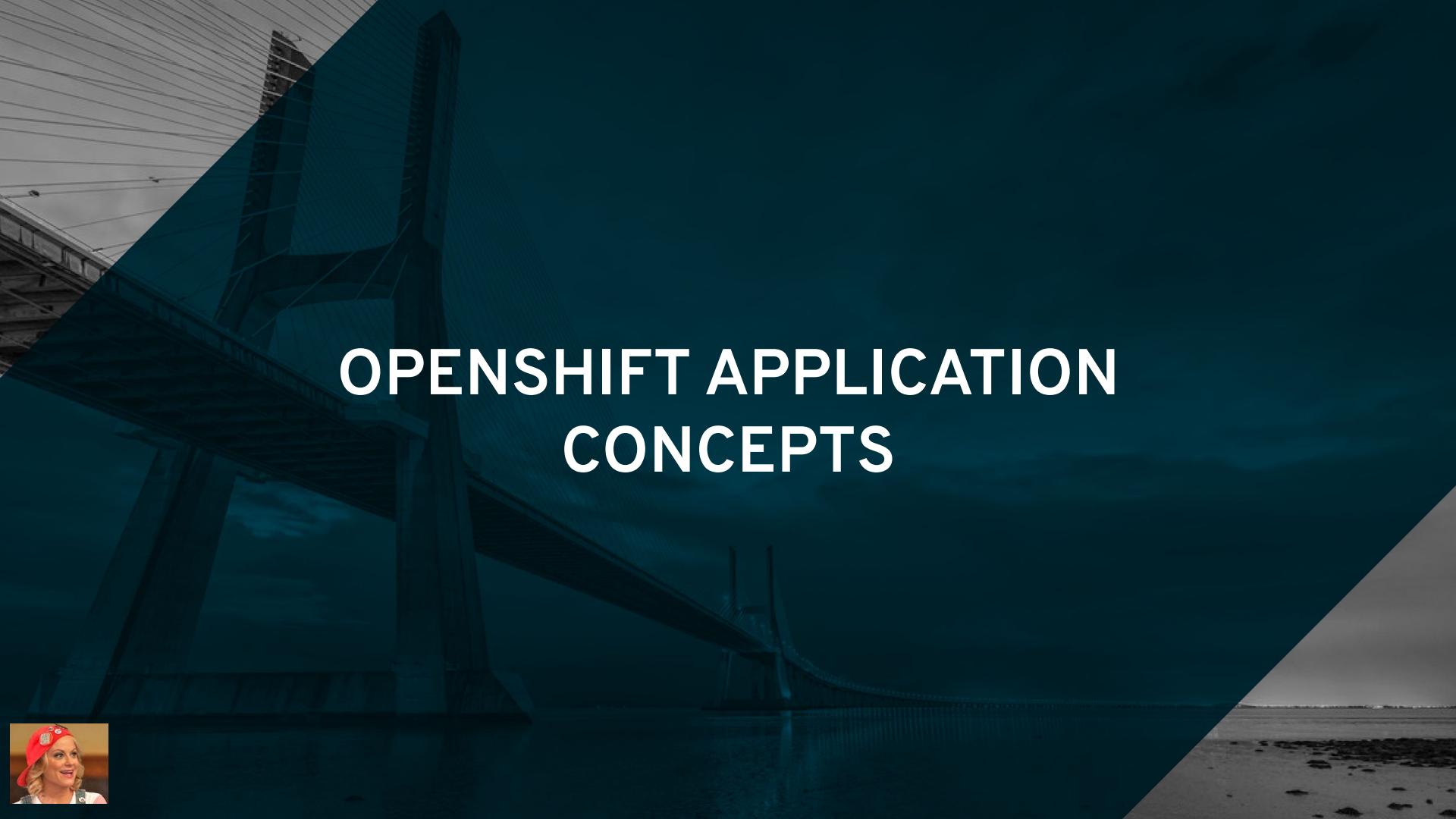
Source:

Cathay Pacific: Red Hat press release, [Cathay Pacific Takes Customer Experiences to New Heights with Red Hat's Hybrid Cloud Technologies](#), May 2018.

Hilton: Red Hat case study, [Hilton enhances digital guest experience with Red Hat container and automation technology](#), October 2018.

Schiphol: Red Hat case study, [Amsterdam Airport Schiphol builds agile cloud with Red Hat](#), August 2017.





# OPENSHIFT APPLICATION CONCEPTS



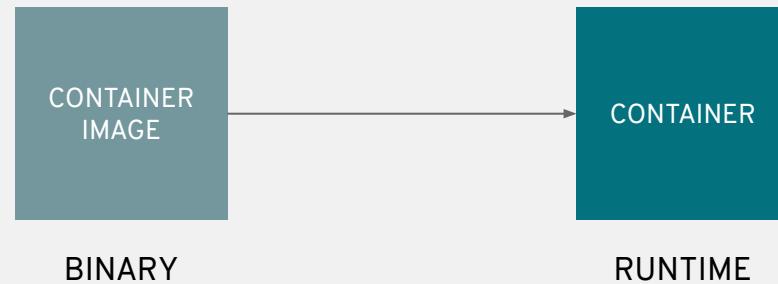


A **container** is the smallest compute unit

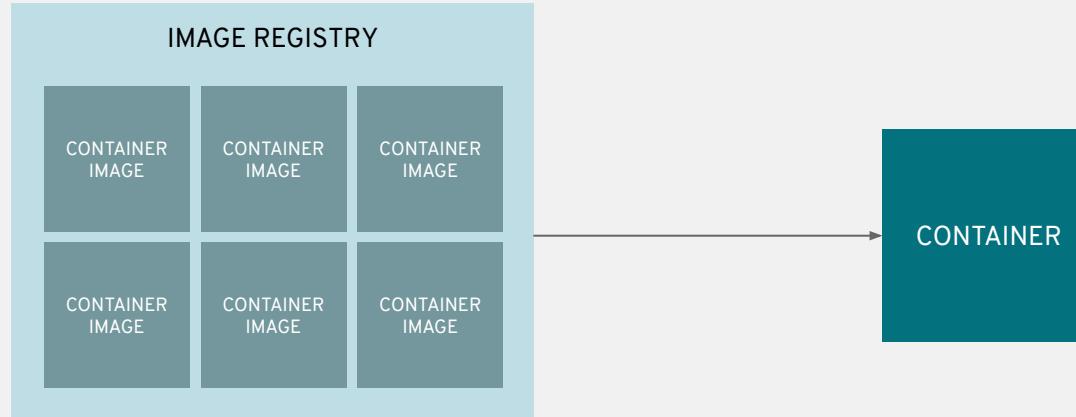




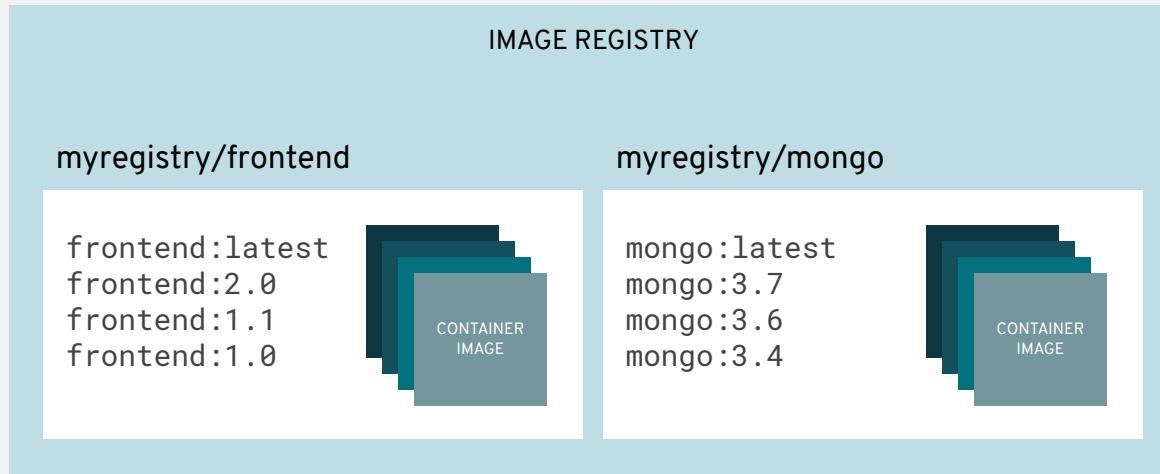
containers are created from  
container **images**



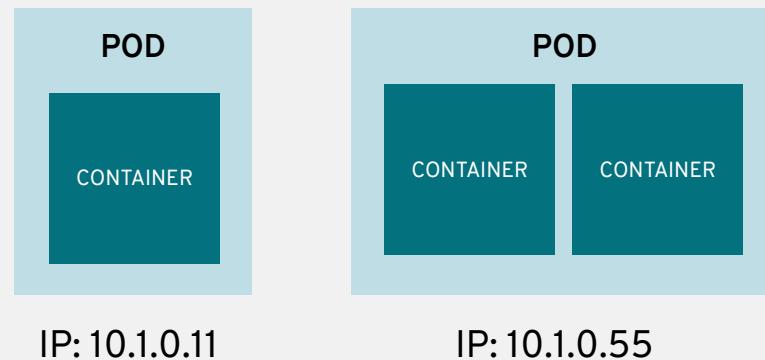
# container images are stored in an **image registry**



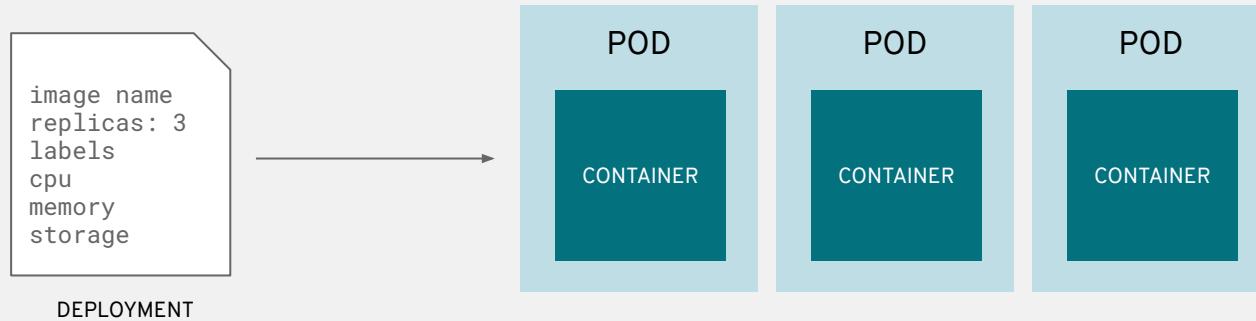
the image registry contains all versions (within default policy) of an image



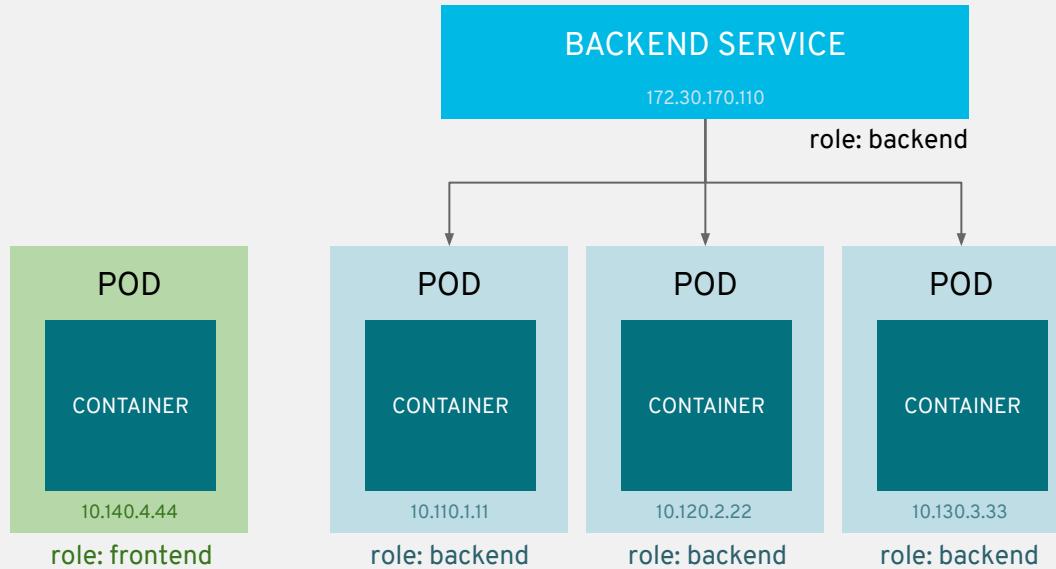
containers are wrapped in **pods** which are  
*units of deployment and management*



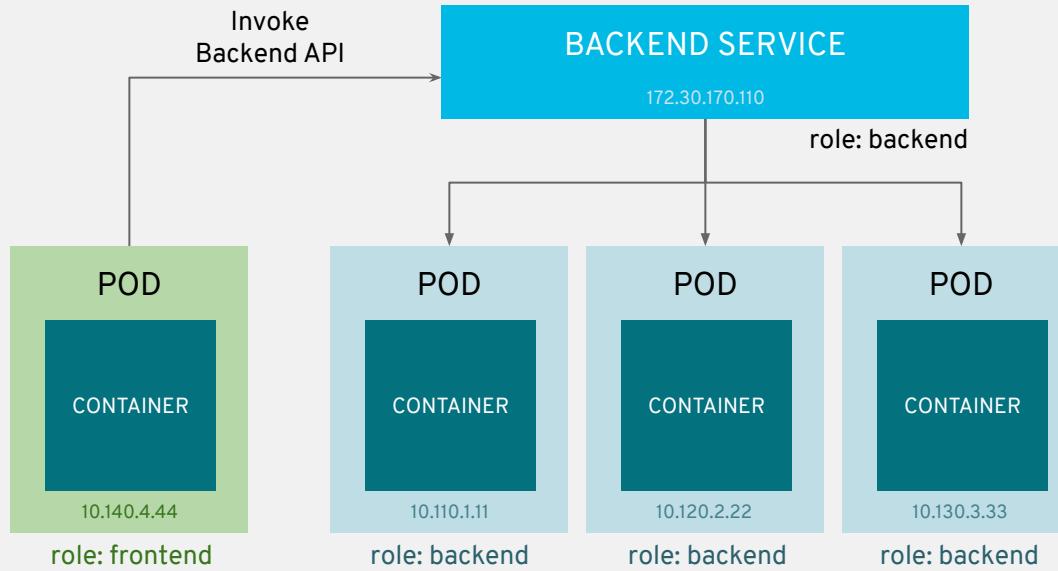
# pod configuration is defined in a **deployment config (DC)**



**services** provide internal load-balancing and service discovery across pods



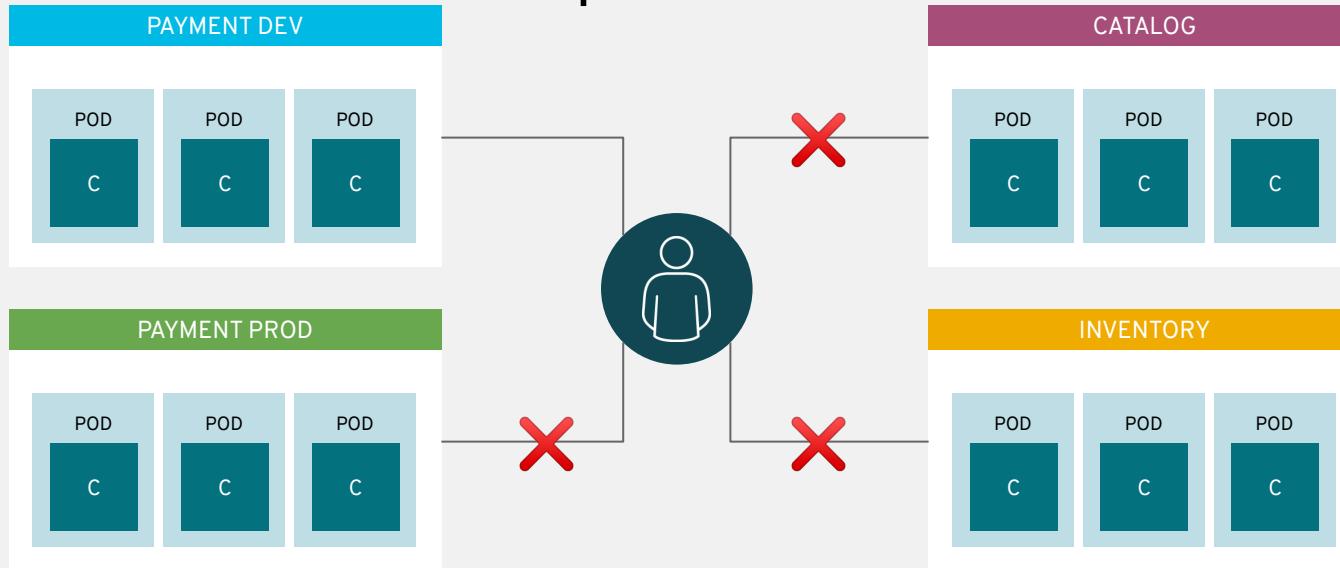
# apps can talk to each other via services

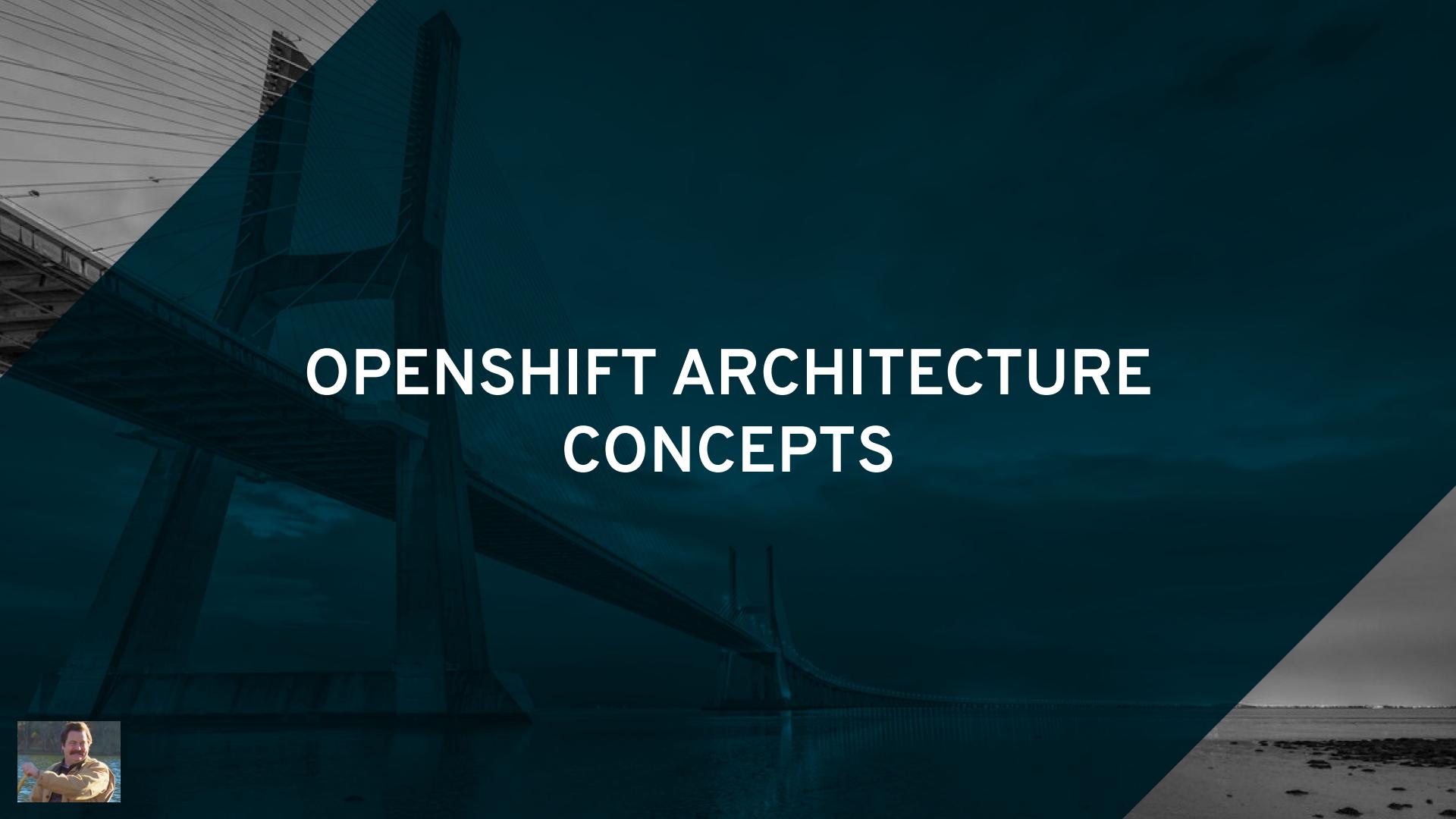


**routes** open an external door to services, adding them to the external load balancer and providing readable URLs for the app



**projects** provide logical buckets (and isolation!) in which to contain apps - across environments, teams, groups and departments



The background of the slide features a large, modern cable-stayed bridge at night. The bridge's towers are brightly lit, casting a reflection on the water below. The cables are visible against the dark sky. The overall atmosphere is architectural and industrial.

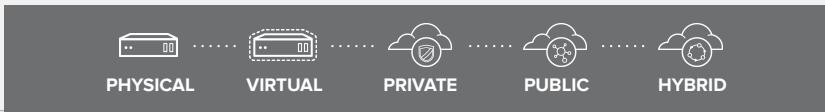
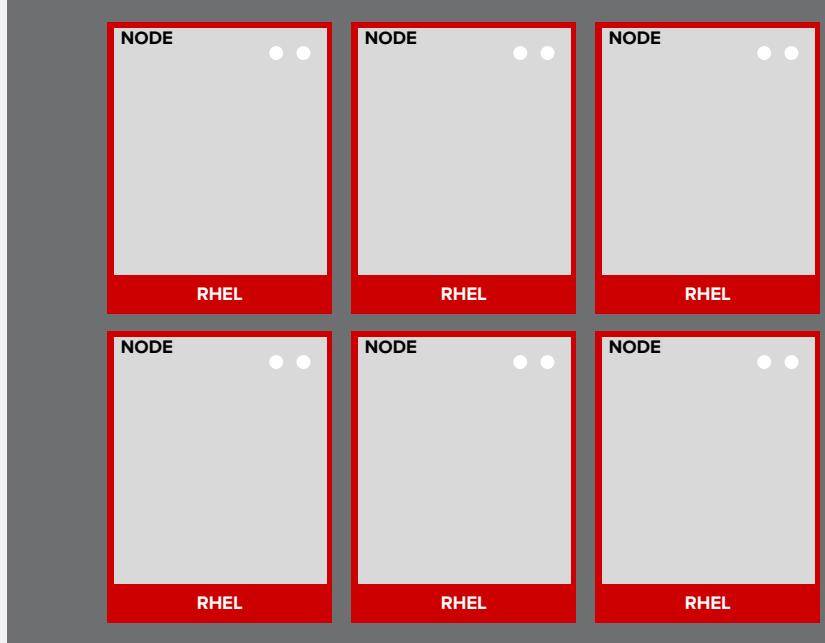
# OPENShift ARCHITECTURE CONCEPTS



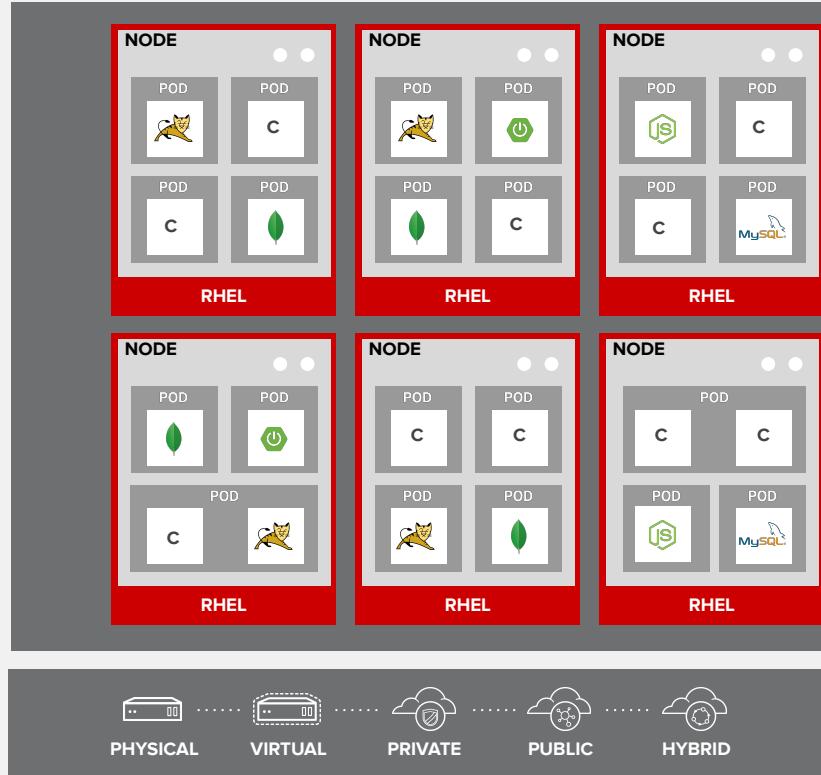
# YOUR CHOICE OF INFRASTRUCTURE



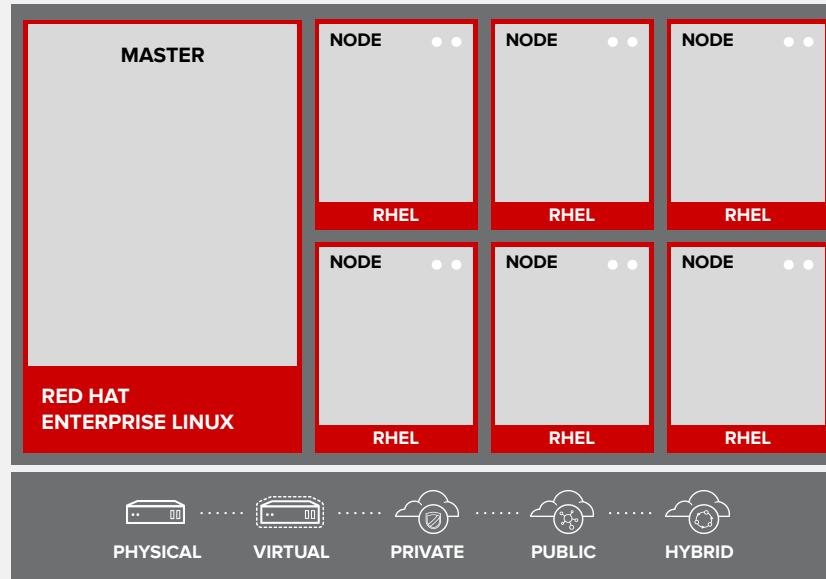
# NODES: RHEL INSTANCES WHERE...



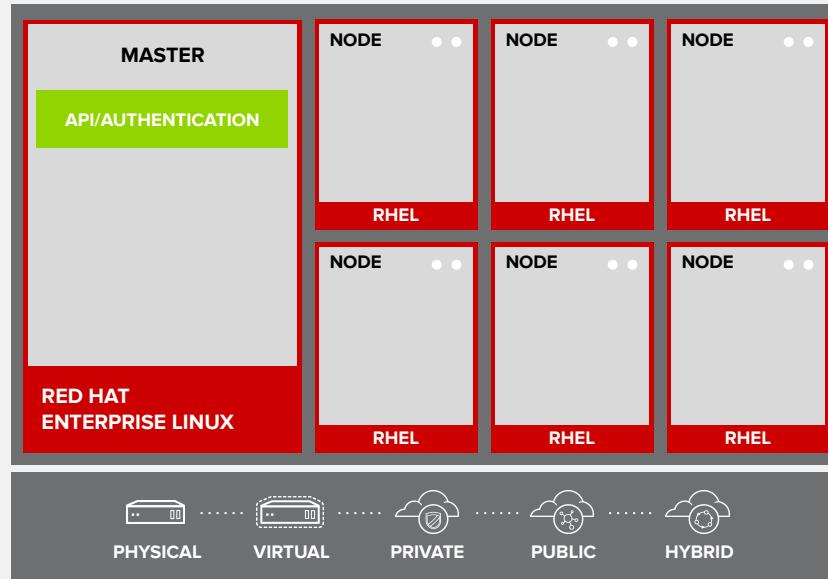
# NODES: RHEL INSTANCES WHERE PODS RUN



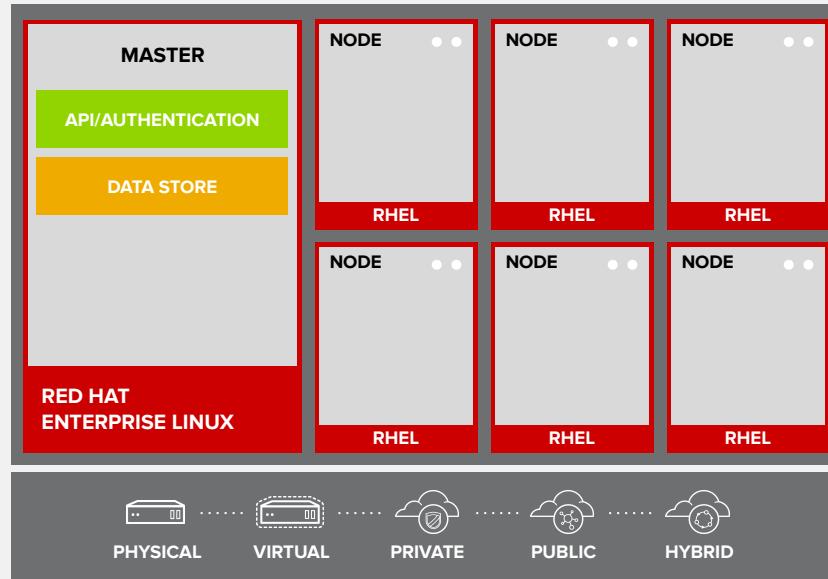
# MASTERS ARE THE CONTROL PLANE. THEY HANDLE THINGS LIKE...



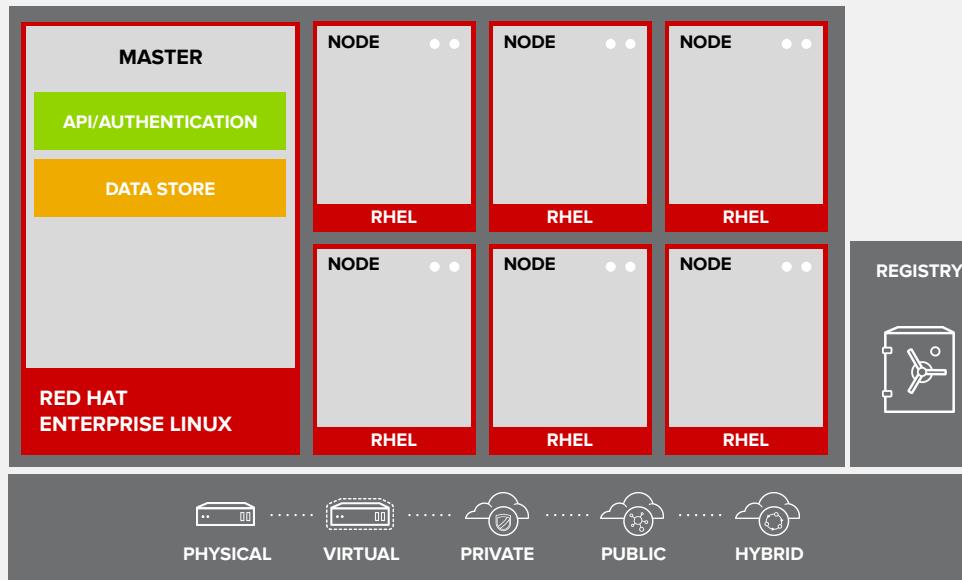
# API AND AUTHENTICATION



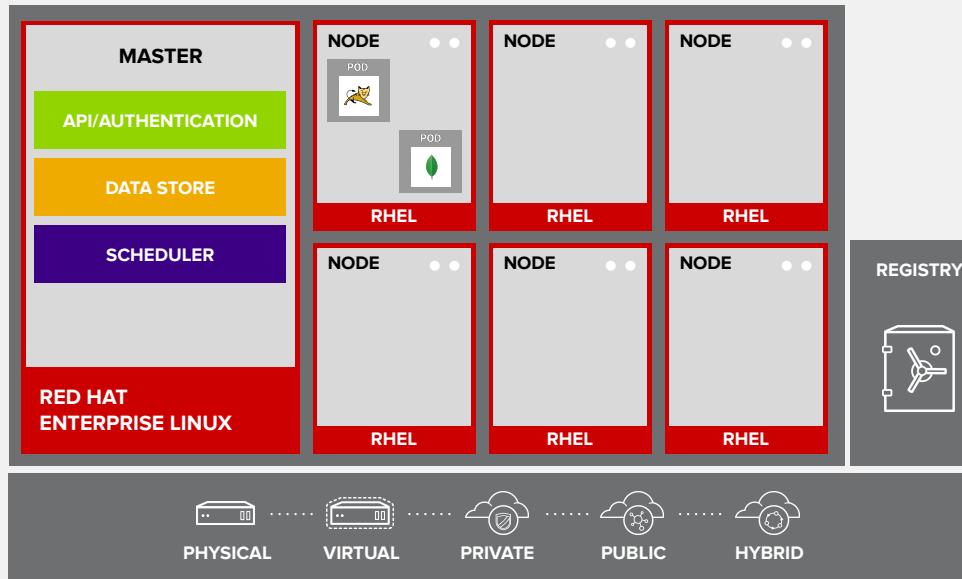
# DESIRED AND CURRENT STATE WITHIN THE CLUSTER



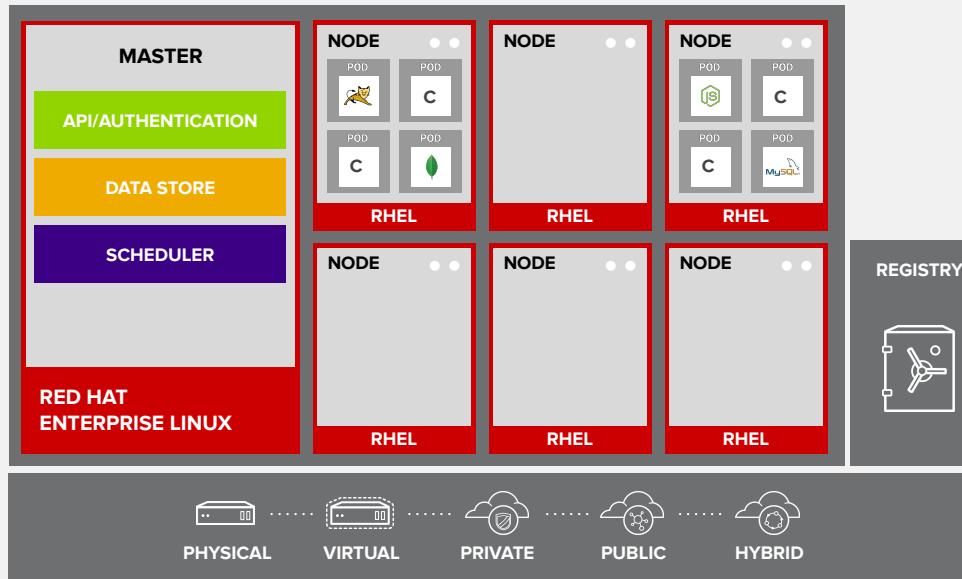
# INTEGRATION WITH THE REGISTRY



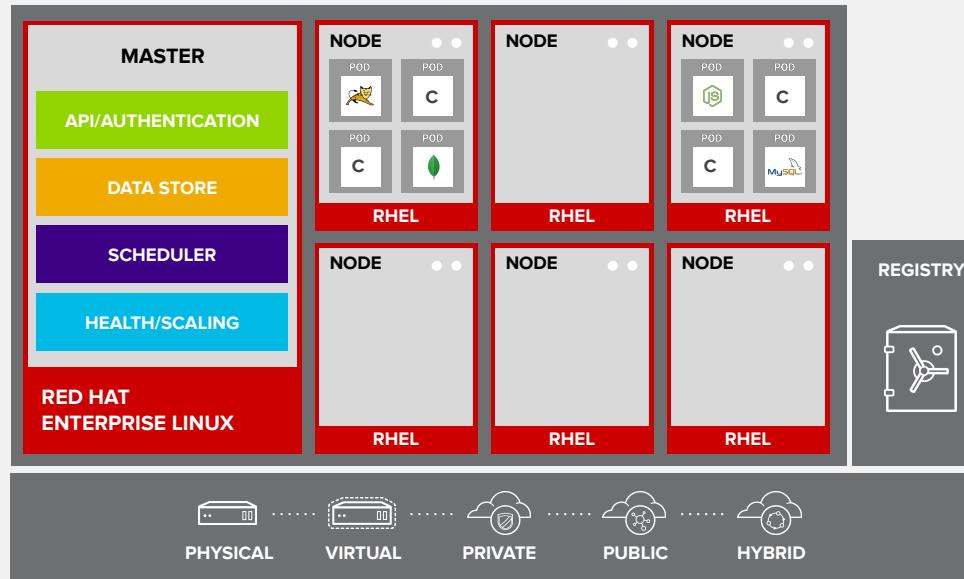
# ORCHESTRATION AND SCHEDULING



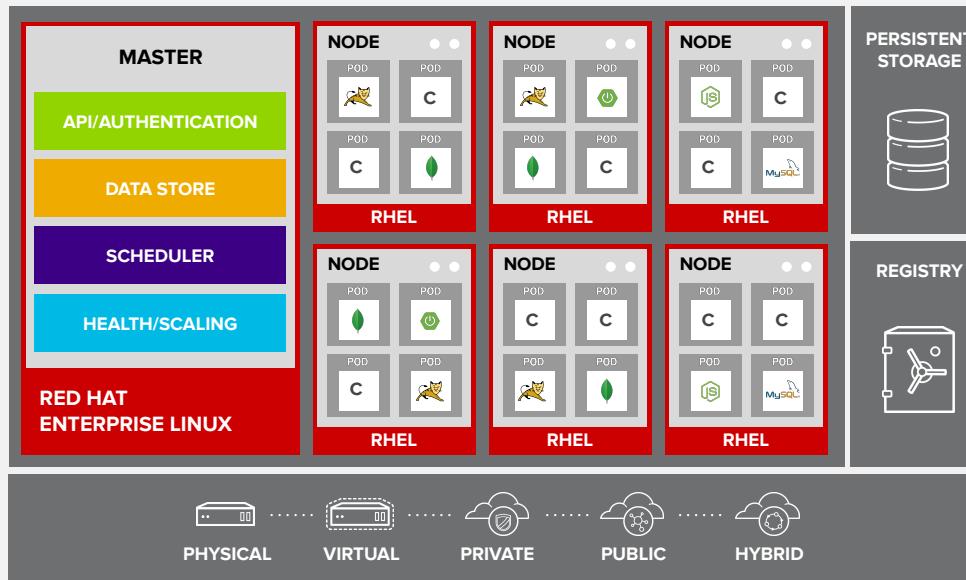
# PLACEMENT BY POLICY



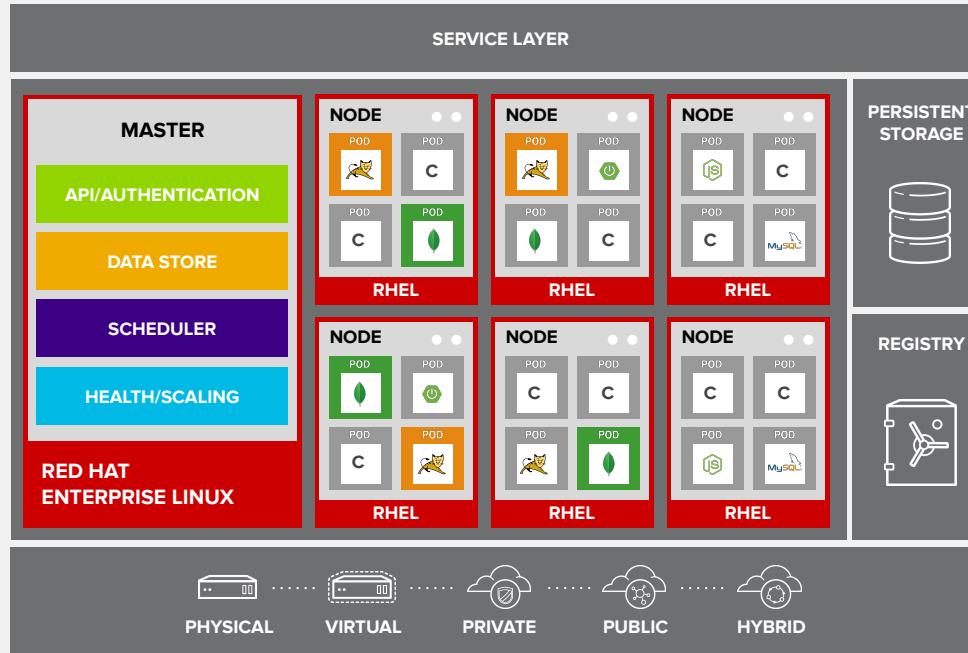
# AUTOSCALING PODS



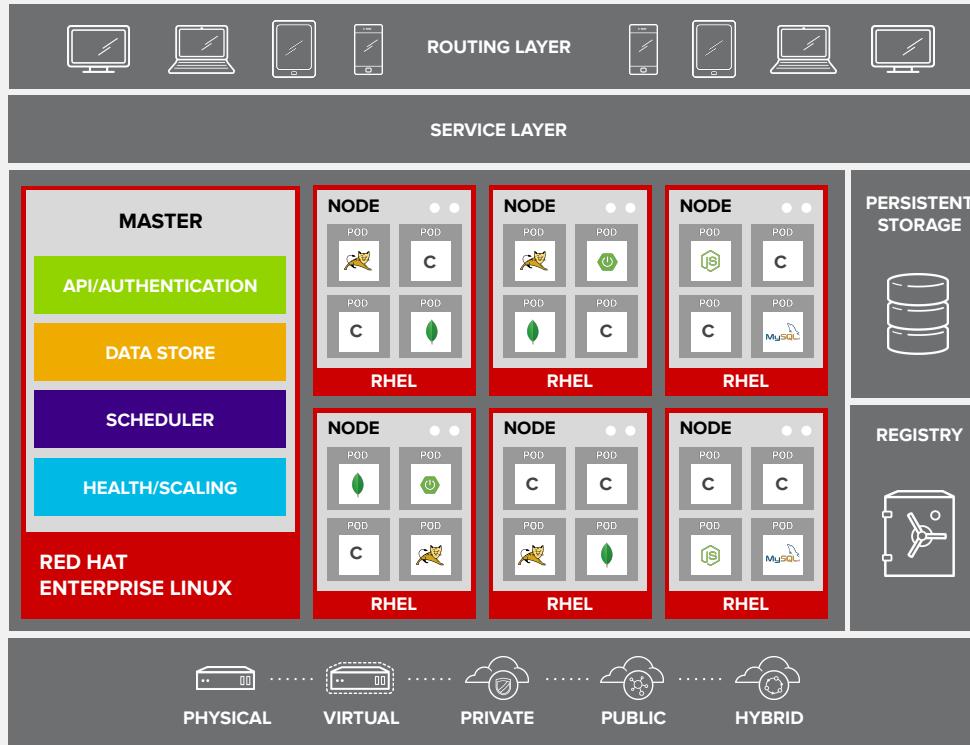
# PERSISTENT DATA IN CONTAINERS



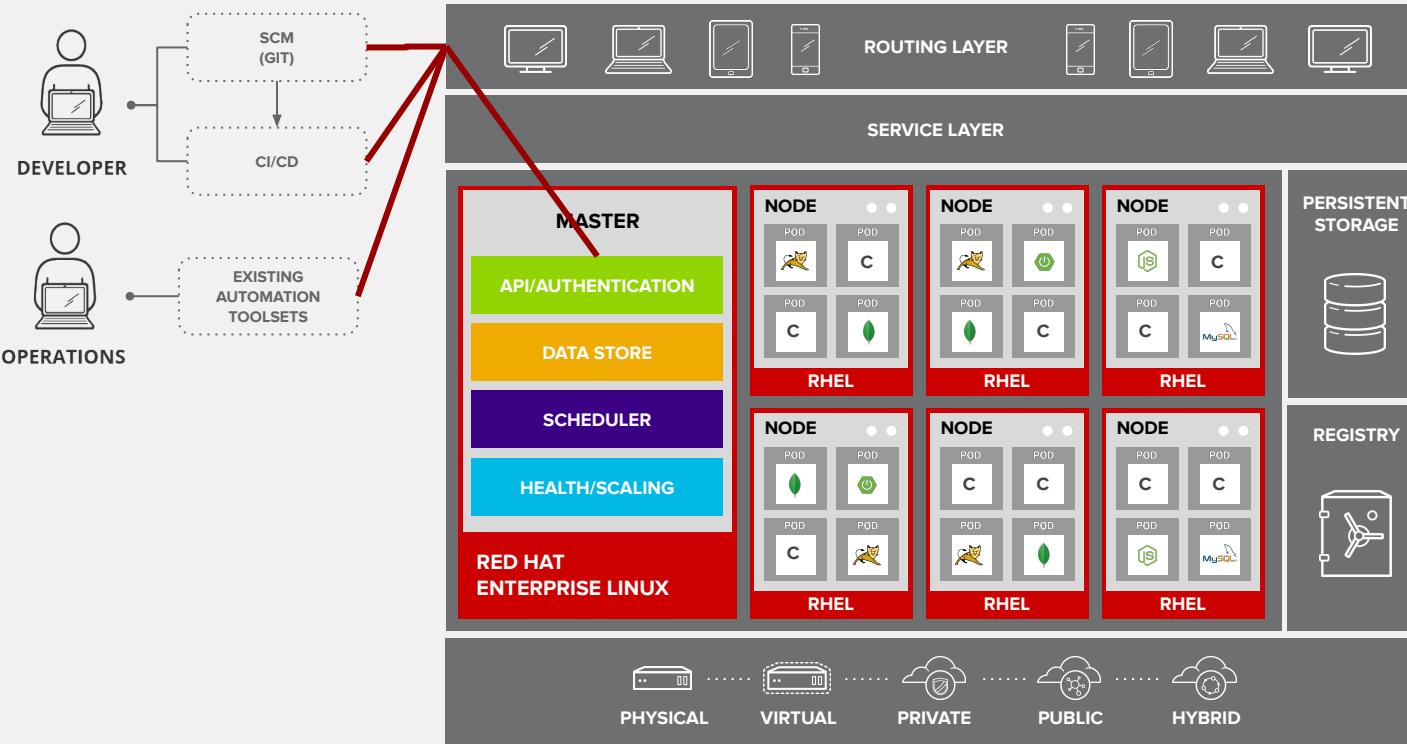
# ON TOP OF EVERYTHING IS THE SERVICE LAYER

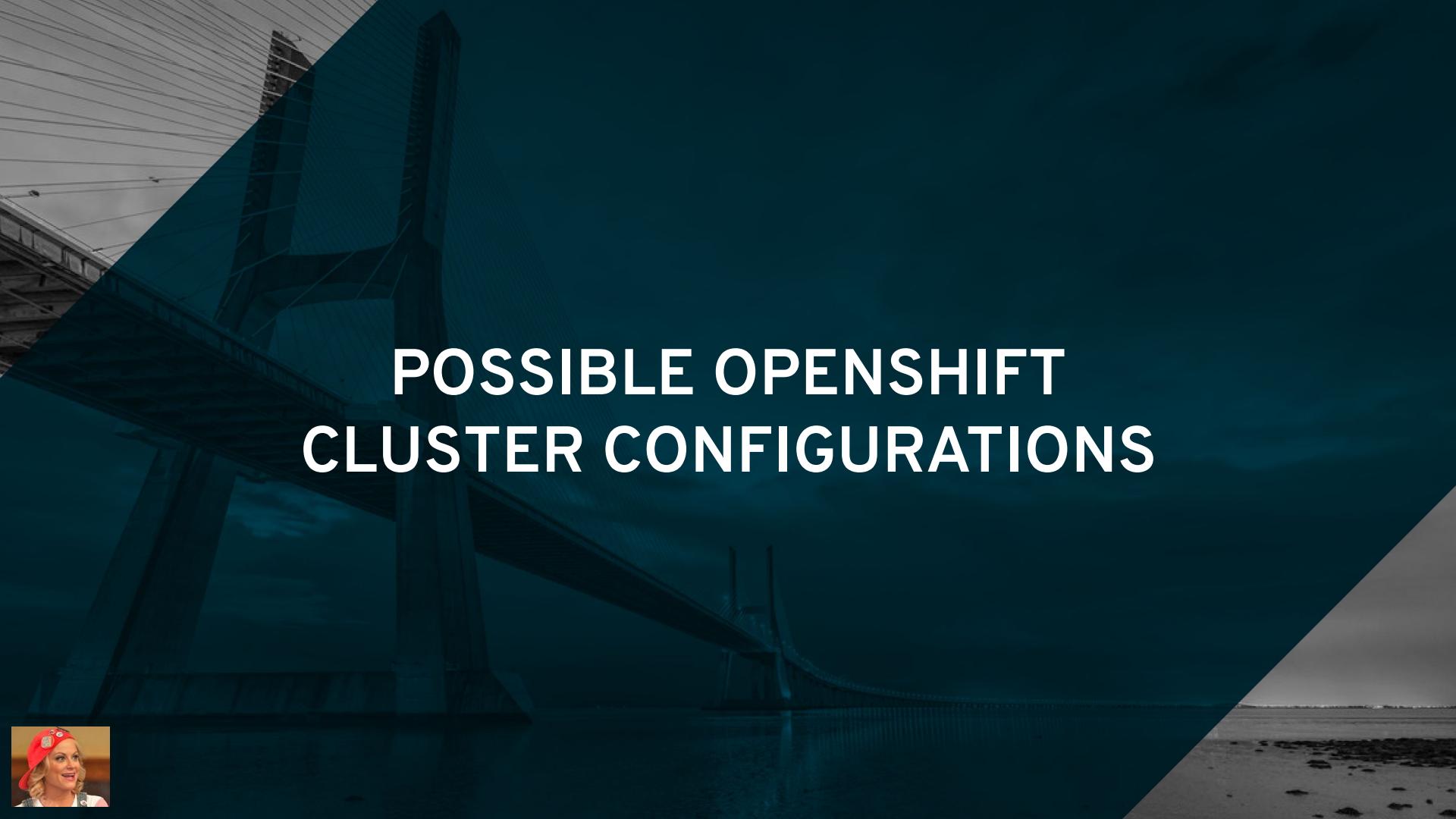


# AND ROUTING AND LOAD-BALANCING



# ACCESS VIA WEB, CLI, IDE AND API



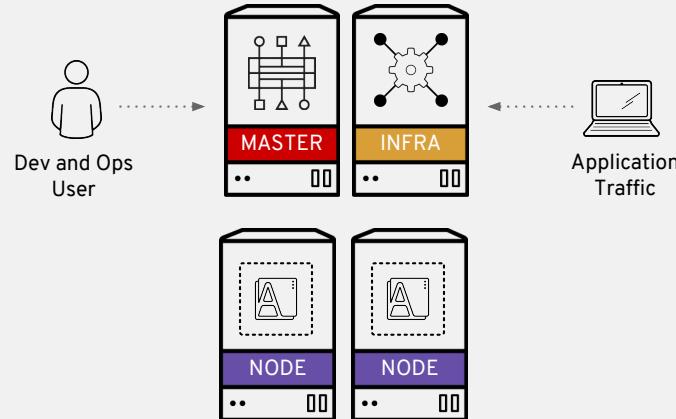


# POSSIBLE OPENSHIFT CLUSTER CONFIGURATIONS

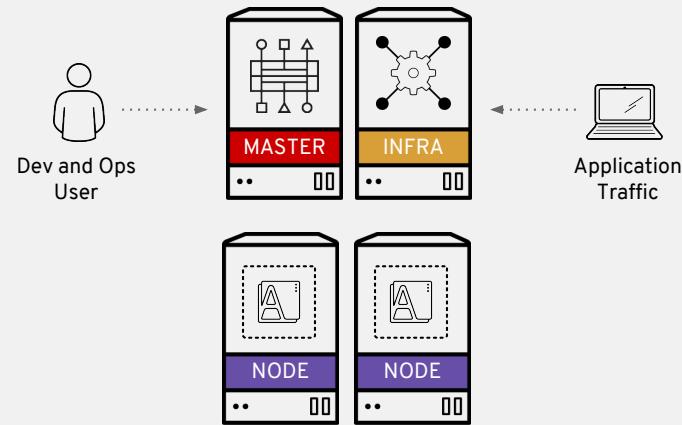


# FIRST, AN INFRASTRUCTURE NODE IS...

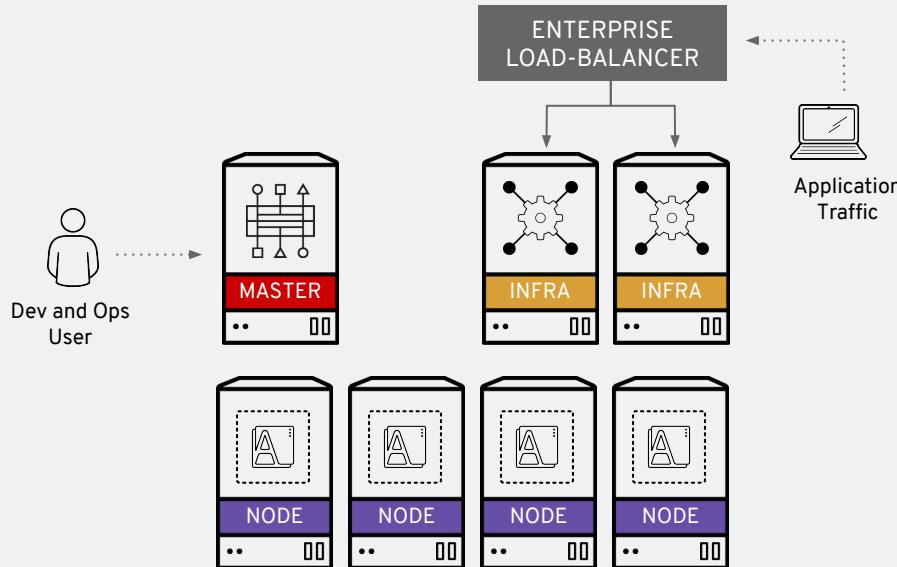
An infrastructure node is a node that is dedicated to infrastructure pods - like for the router, image registry, metrics, and logs.



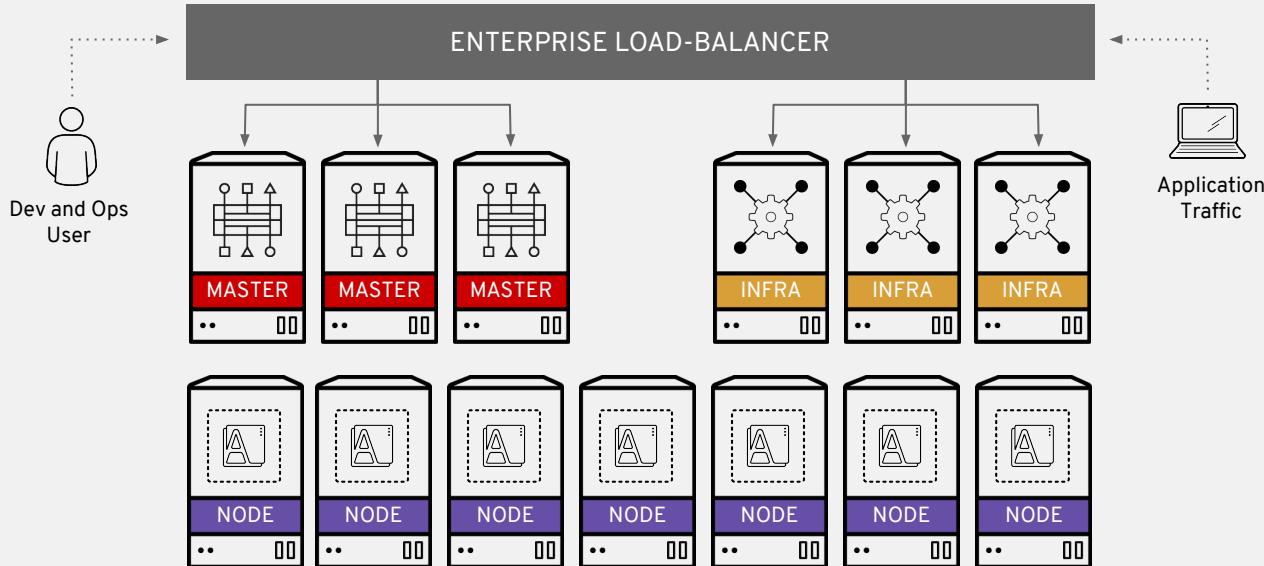
# PROOF-OF-CONCEPT ARCHITECTURE



# APP HIGH-AVAILABILITY ARCHITECTURE



# FULL HIGH-AVAILABILITY ARCHITECTURE

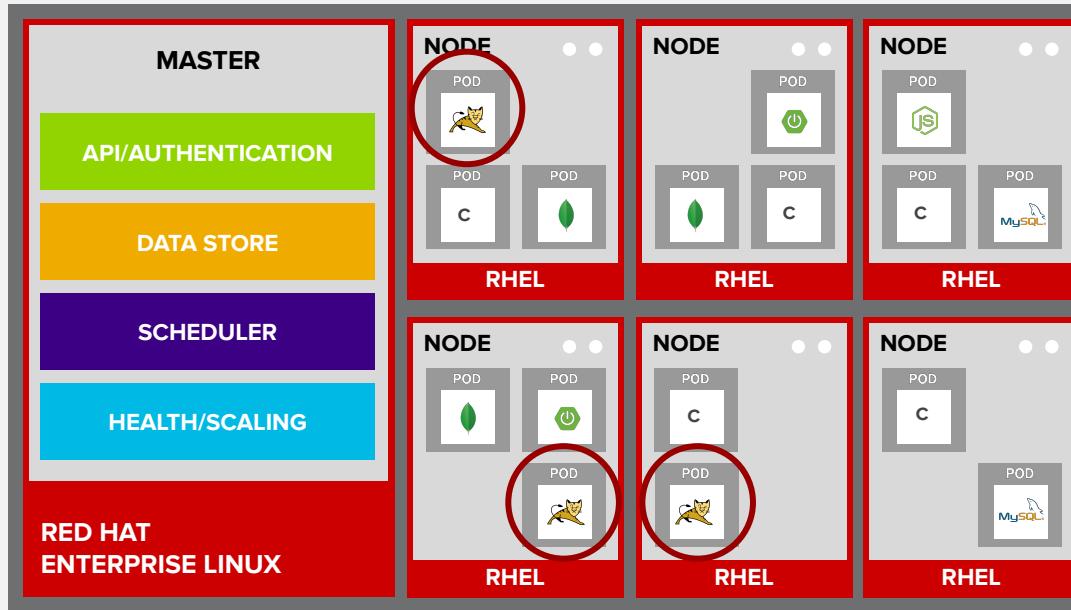


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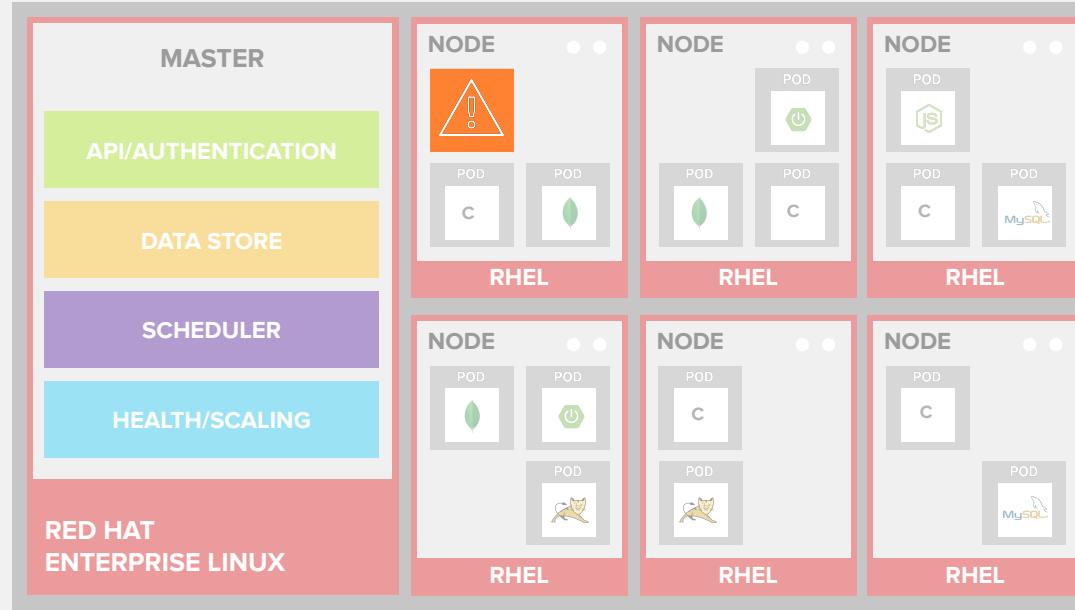
# OPENShift FEATURES DEEP DIVE

# MONITORING APPLICATION HEALTH

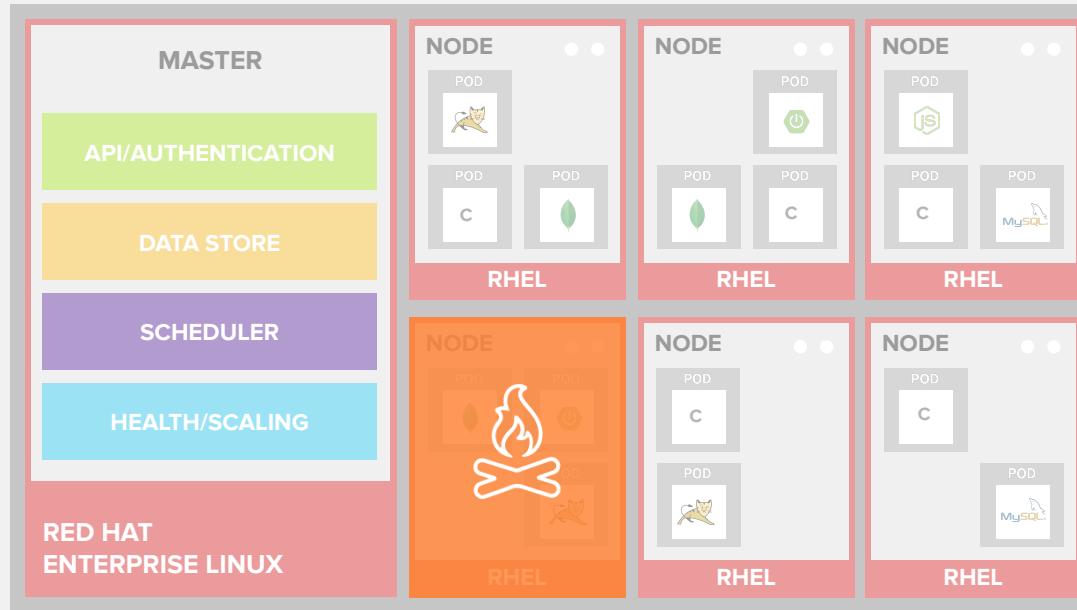
# AUTO-HEALING FAILED PODS - REPLICATION



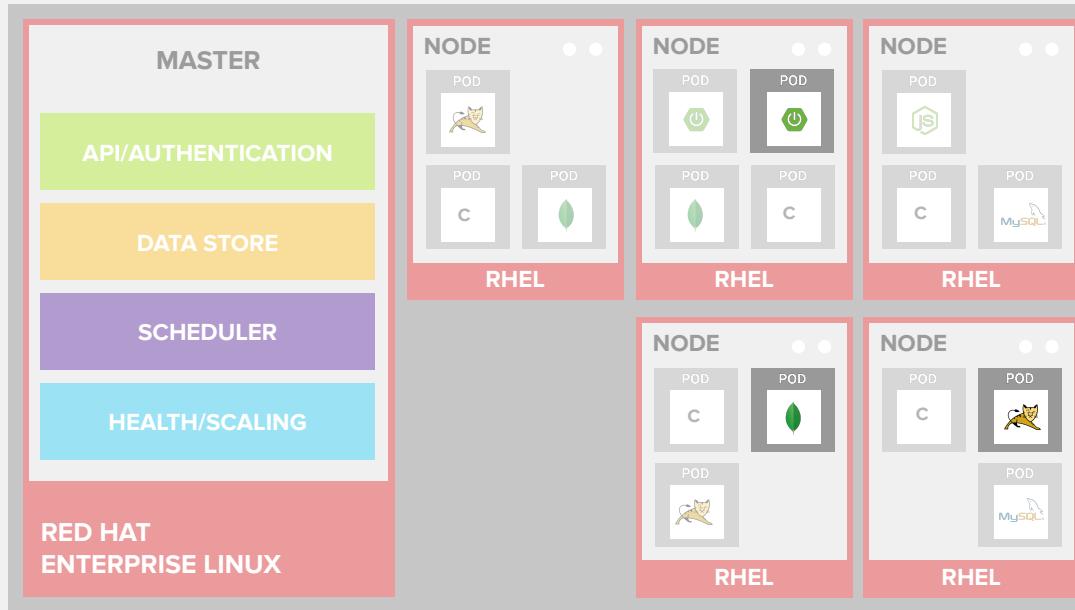
# AUTO-HEALING FAILED CONTAINERS



# AUTO-HEALING FAILED NODES

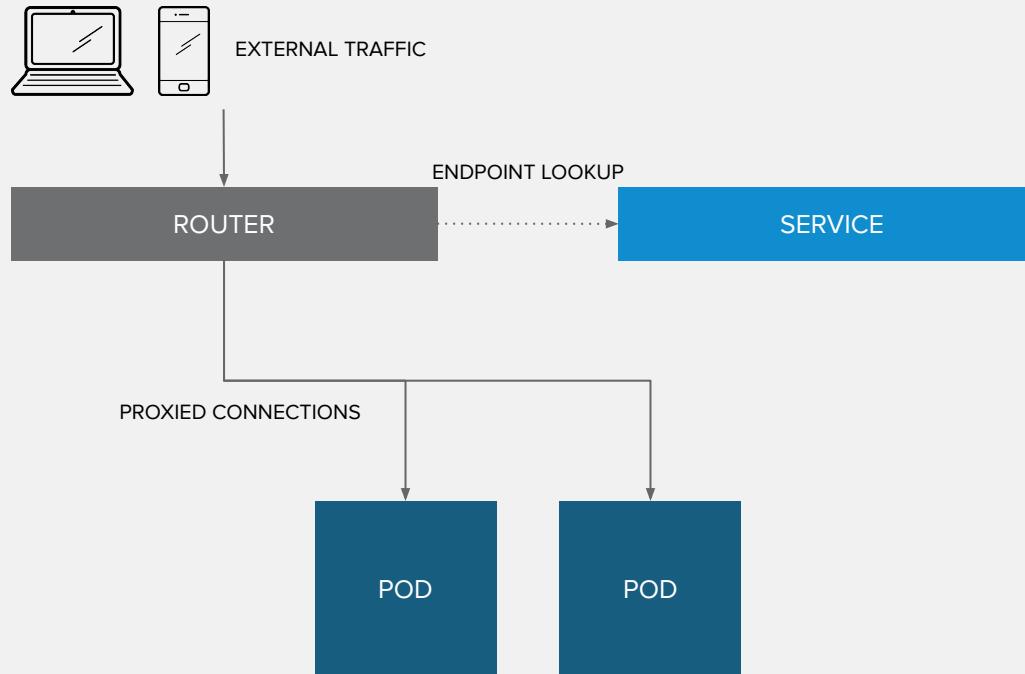


# AUTO-HEALING FAILED NODES



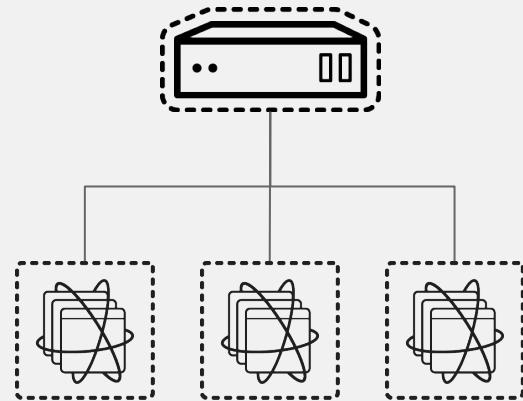
# NETWORKING

# ROUTES EXPOSES SERVICES EXTERNALLY



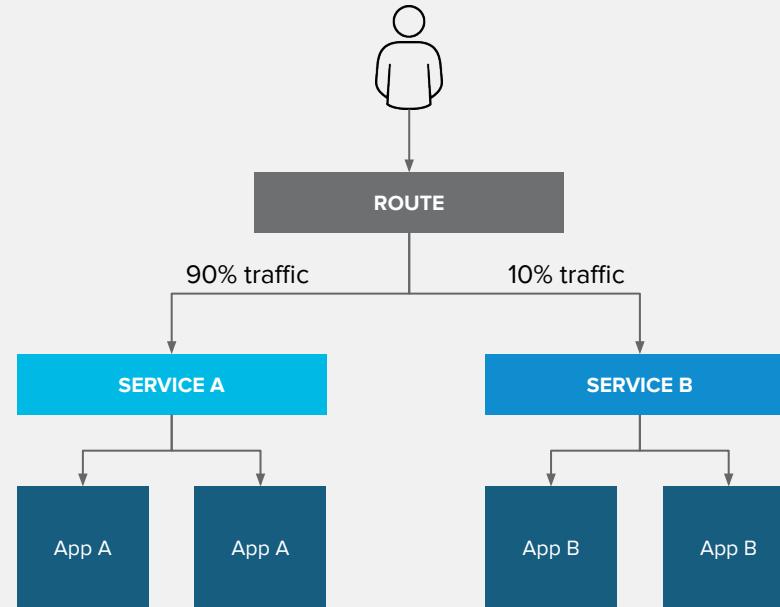
# ROUTING AND EXTERNAL LOAD-BALANCING

- Pluggable routing architecture
  - HAProxy Router
  - F5 Router
- Multiple-routers with traffic sharding
- Router supported protocols
  - HTTP/HTTPS
  - WebSockets
  - TLS with SNI
- Non-standard ports via cloud load-balancers, external IP, and NodePort



# ROUTES CAN SPLIT TRAFFIC

Split Traffic Between  
Multiple Services For A/B  
Testing, Blue/Green and  
Canary Deployments

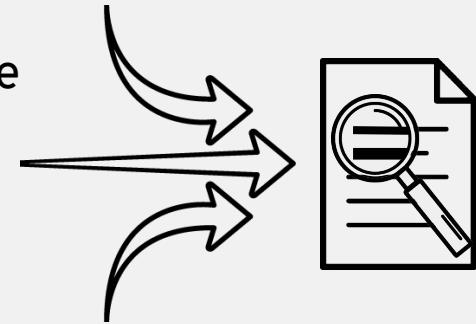


# LOGGING & METRICS

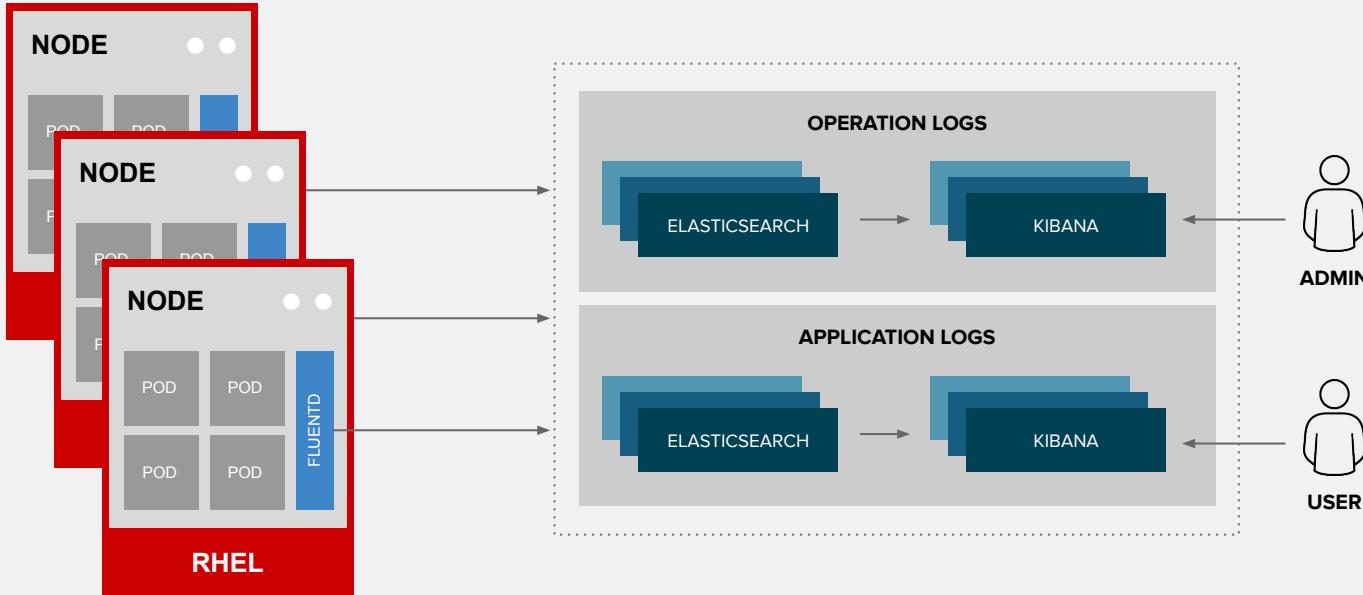


# CENTRAL LOG MANAGEMENT WITH EFK

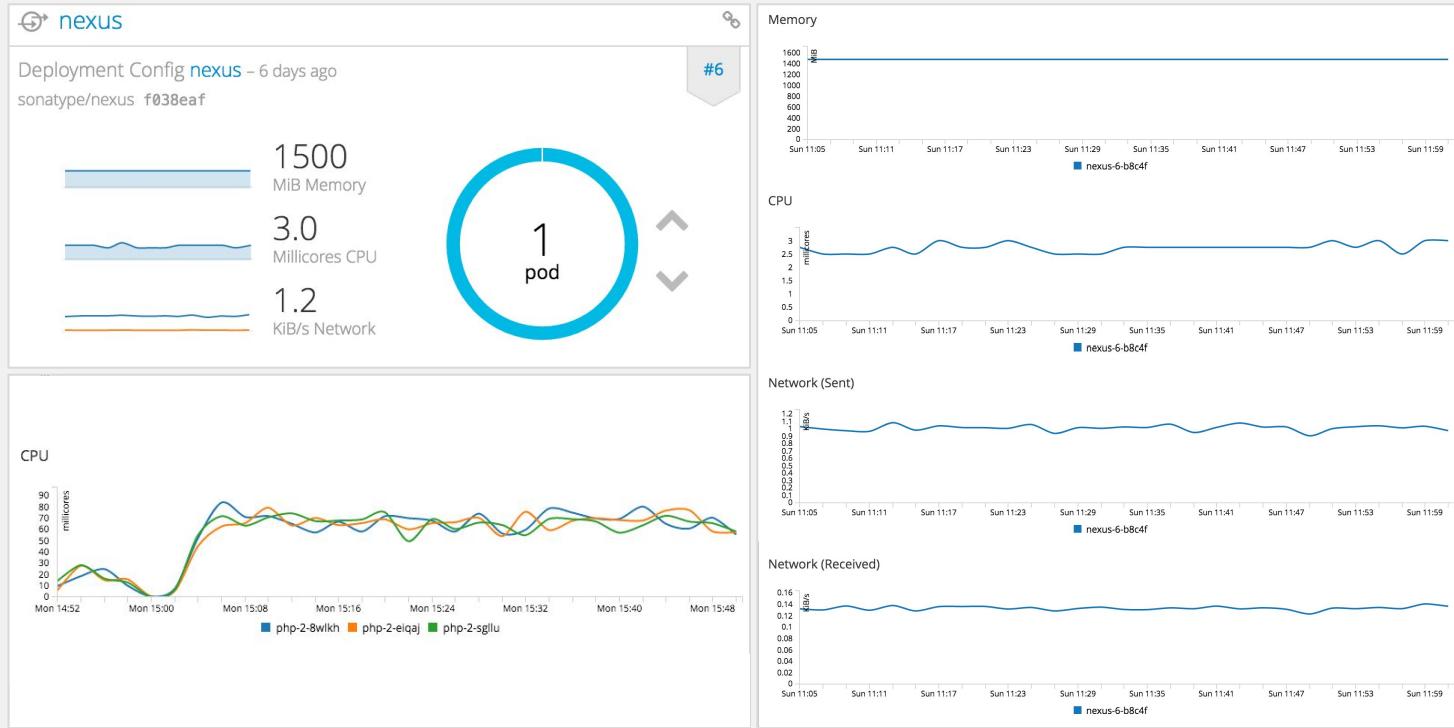
- EFK stack to aggregate logs for hosts and applications
  - **Elasticsearch:** a search and analytics engine to store logs
  - **Fluentd:** gathers logs and sends to Elasticsearch.
  - **Kibana:** A web UI for Elasticsearch.



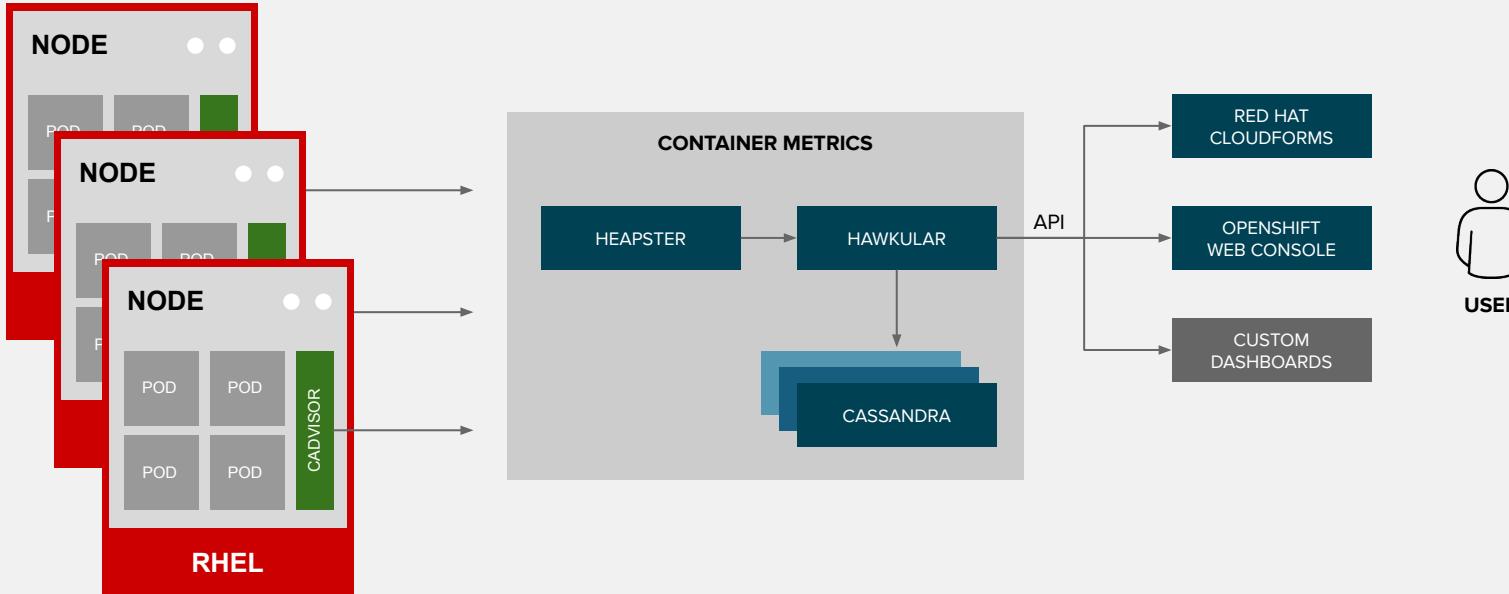
# CENTRAL LOG MANAGEMENT WITH EFK



# CONTAINER METRICS



# CONTAINER METRICS



# SECURITY

# AUTOMATED & INTEGRATED SECURITY



## CONTROL

Application Security

Container Content

CI/CD Pipeline

Container Registry

Deployment Policies



## DEFEND

Infrastructure

Container Platform

Container Host Multi-tenancy

Network Isolation

Storage

Audit & Logging

API Management

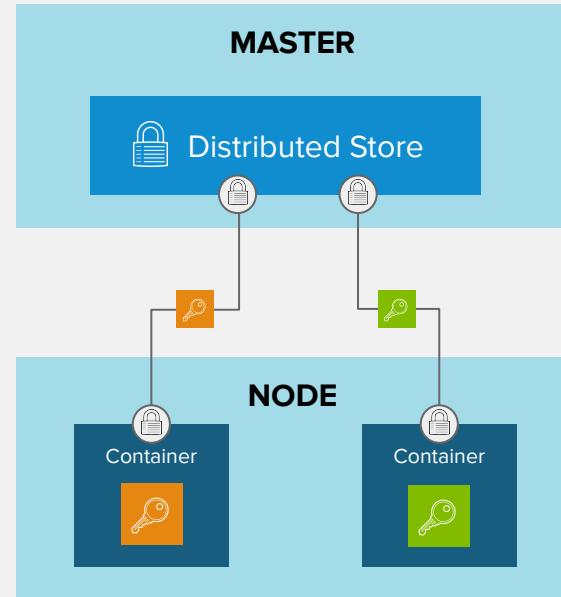


## EXTEND

Security Ecosystem

# SECRETS

- Secure mechanism for holding sensitive data:
  - Passwords and credentials
  - SSH Keys
  - Certificates
- Secrets are made available as
  - Environment variables
  - Volume mounts
  - Interaction with external systems
- Encrypted in transit and at rest
- Never rest on the nodes



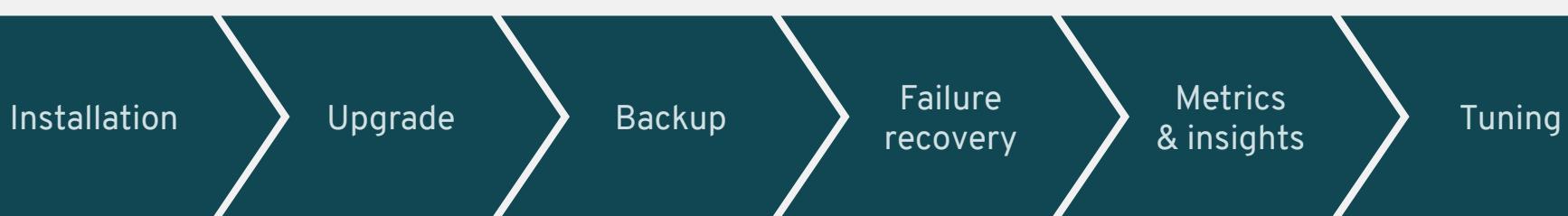
# OPERATOR FRAMEWORK

(coming soon)

# KUBERNETES OPERATOR FRAMEWORK

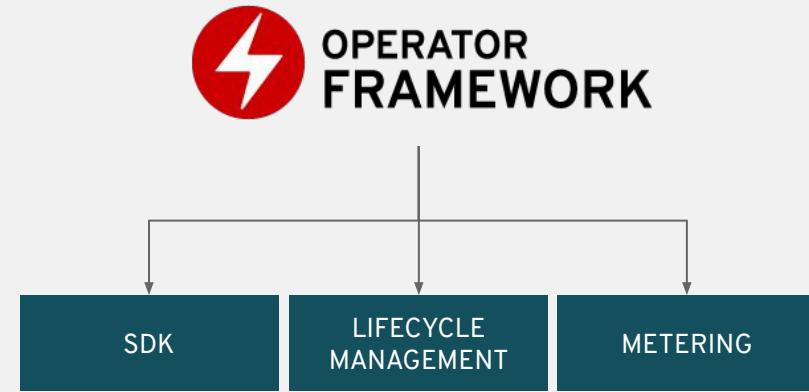
Operator Framework is an open source toolkit to manage application instances on Kubernetes in an effective, automated and scalable way.

## AUTOMATED LIFECYCLE MANAGEMENT



# KUBERNETES OPERATOR FRAMEWORK

Operators **codify operational knowledge** and workflows to automate lifecycle management of containerized applications with Kubernetes

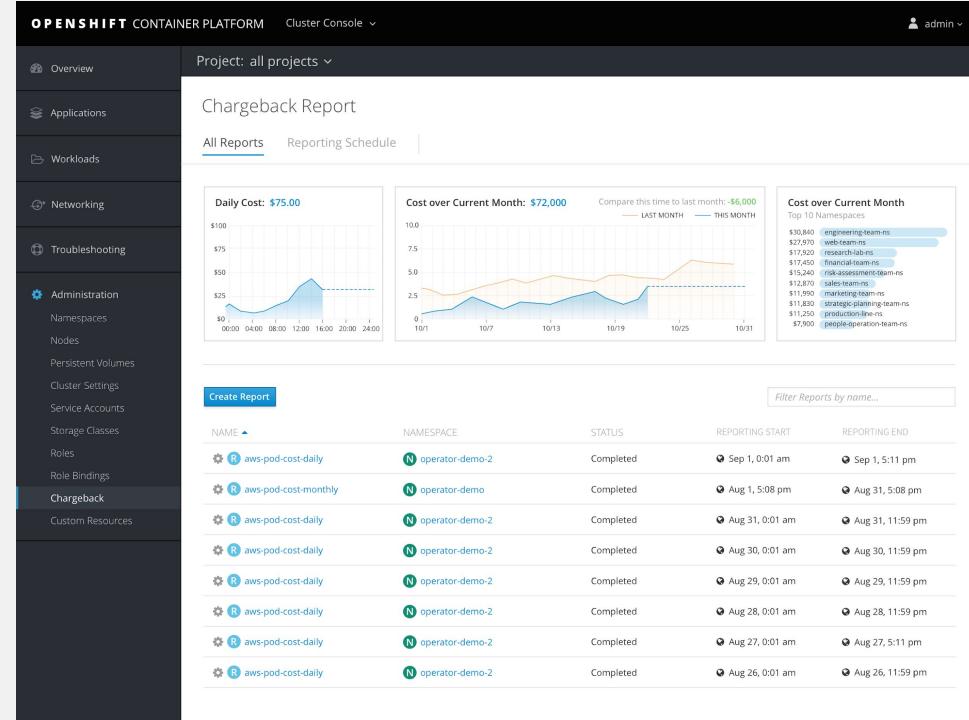


# WHY OPERATOR FRAMEWORK?



# OPERATOR METERING

- Based on Prometheus
- Reports namespace, pods and custom label query
- Easy to process by accounting or custom software



# THE INDUSTRY IS ALIGNING BEHIND THE KUBERNETES OPERATOR FRAMEWORK

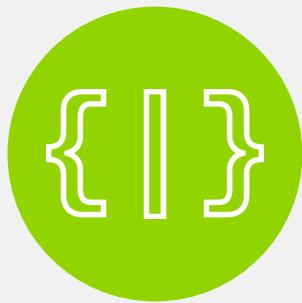


60+ Certified ISV Operators in Red Hat Early Access Program

# CONTAINER IMAGE BUILD AND DEPLOY STRATEGIES



# BUILD AND DEPLOY CONTAINER IMAGES



DEPLOY YOUR  
SOURCE CODE

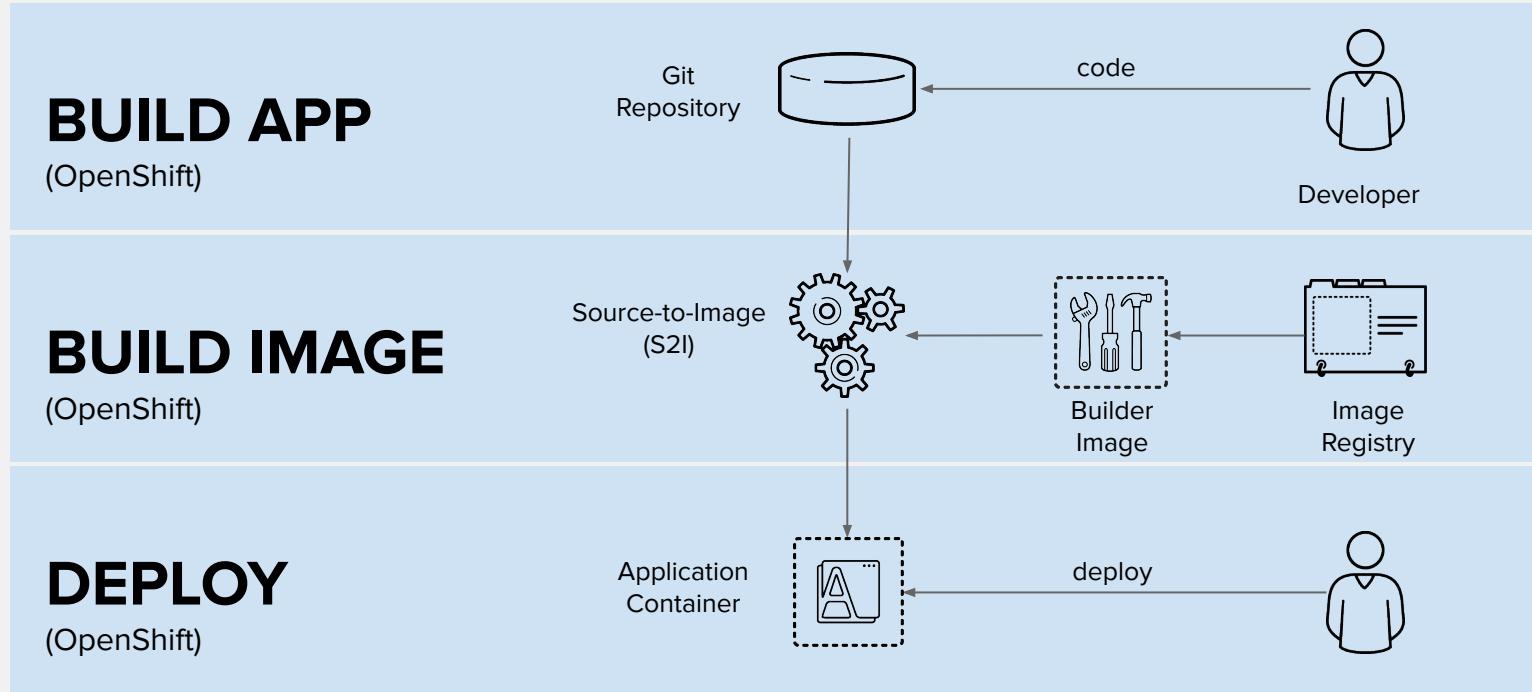


DEPLOY YOUR  
APP BINARY

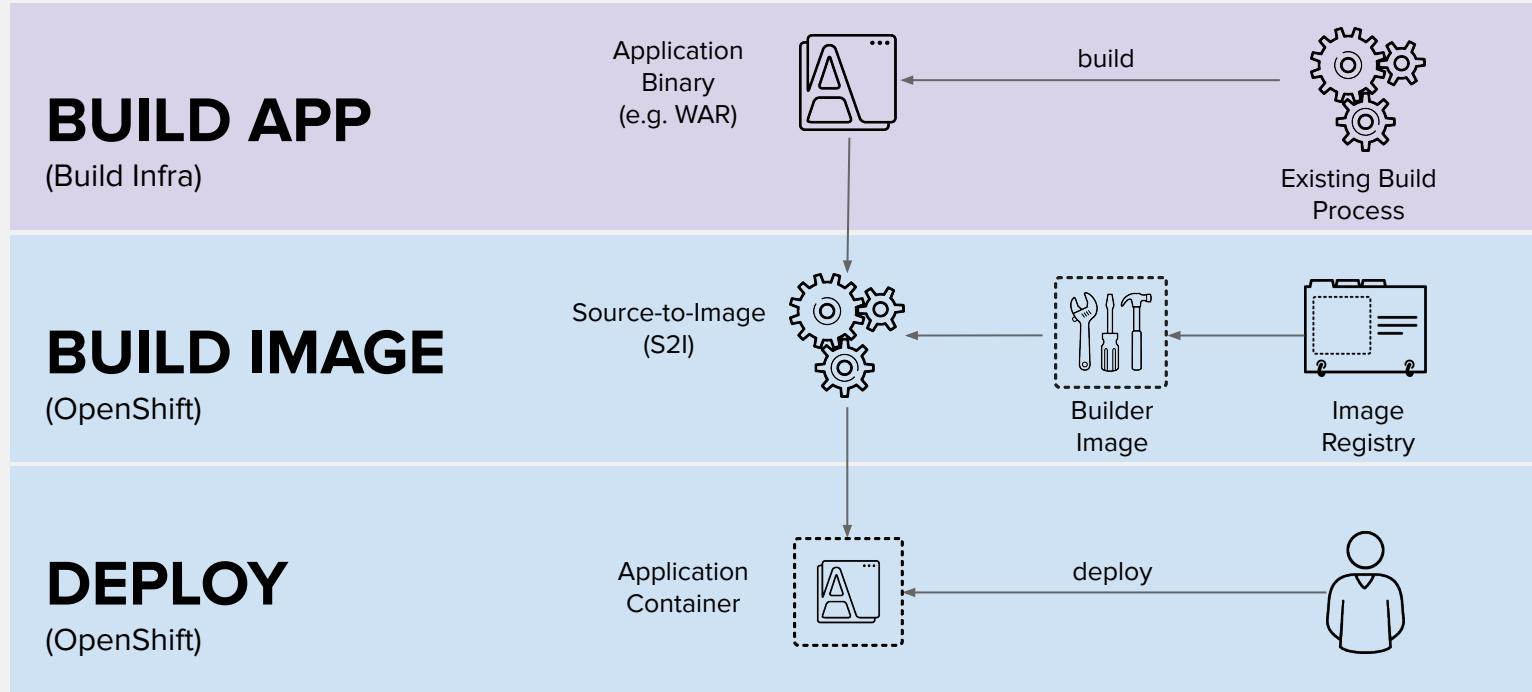


DEPLOY YOUR  
CONTAINER IMAGE

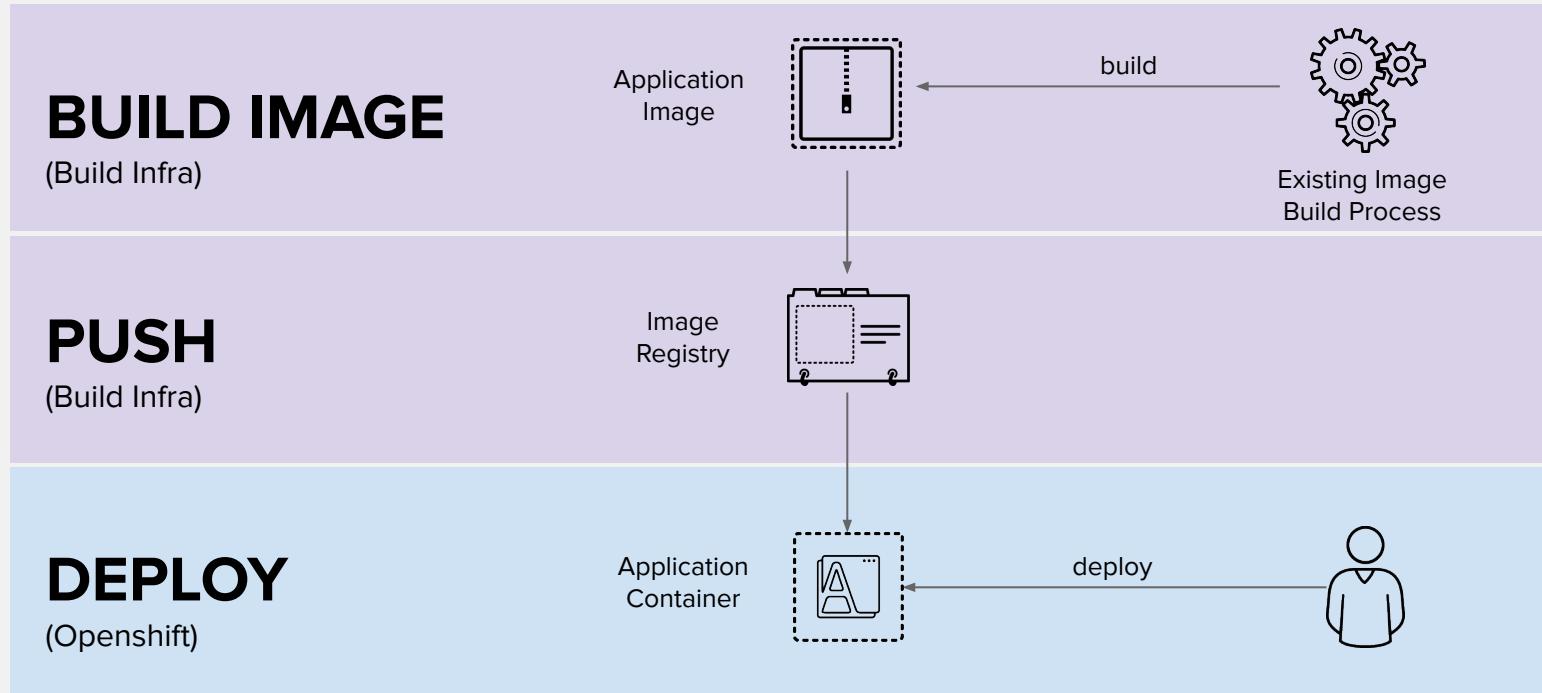
# DEPLOY SOURCE CODE WITH SOURCE-TO-IMAGE (S2I)



# DEPLOY APP BINARY WITH SOURCE-TO-IMAGE (S2I)



# DEPLOY DOCKER IMAGE



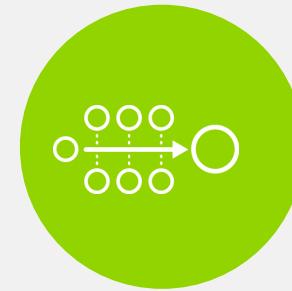
# OPENSHIFT LOVES CI/CD! (AND JENKINS)



JENKINS-AS-A SERVICE  
ON OPENSHIFT



HYBRID JENKINS INFRA  
WITH OPENSHIFT



EXISTING CI/CD  
DEPLOY TO OPENSHIFT

# 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 agents
- Auto-provisioning of Jenkins master
- OpenShift Pipeline build strategies
  - Embedded Jenkinsfile
  - Jenkinsfile from a Git repository

```
apiVersion: v1
kind: BuildConfig
metadata:
  name: app-pipeline
spec:
  strategy:
    type: JenkinsPipeline
    jenkinsPipelineStrategy:
      jenkinsfile: |->
        node('maven') { <----- Provision a
          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 agent for  
running Maven



# OPENSHIFT 4 THEMES



# IMMUTABLE INFRASTRUCTURE WITH RED HAT COREOS



**RED HAT®**  
CoreOS

- Minimal Linux distribution
- Optimized for running containers
- Decreased attack surface
- Over-the-air automated updates
- Immutable foundation for OpenShift
- Bare-metal and cloud host configuration

# AUTOMATED OPERATIONS

Fully automated day-1 and day-2 operations for Kubernetes

INSTALL

DEPLOY

HARDEN

OPERATE

## AUTOMATED OPERATIONS

Infra provisioning

Full-stack deployment

Secure defaults

Multi-cluster aware

Embedded OS

On-premises and cloud

Network isolation

Monitoring and alerts

Unified experience

Audit and logs

Full-stack patch & upgrade

Signing and policies

Zero downtime upgrades

Vulnerability scanning

# 2019 Roadmap

Q2 CY2019 OpenShift 4.1		Q3 CY2019 OpenShift 4.2		Q4 CY19/Q1 CY20 OpenShift 4.3	
HOSTED	HOSTED	HOSTED	HOSTED	PLATFORM	HOSTED
HOSTED	HOSTED	HOSTED	HOSTED	APP	HOSTED
HOSTED	HOSTED	HOSTED	HOSTED	DEV	HOSTED
<ul style="list-style-type: none"><li>• OpenShift Serverless (Knative) - DP</li><li>• OpenShift Pipelines (Tekton) Dev Preview</li><li>• CodeReady Workspaces</li><li>• CodeReady Containers Alpha</li><li>• Developer CLI (odo) Beta</li></ul> <ul style="list-style-type: none"><li>• OperatorHub</li><li>• Operator Lifecycle Manager</li><li>• Service Mesh (~2 month after)</li></ul> <ul style="list-style-type: none"><li>• Kubernetes 1.13 with CRI-O runtime</li><li>• RHEL CoreOS, RHEL7</li><li>• Automated Installer for AWS</li><li>• Pre-existing Infra Installer for Bare Metal, VMware, AWS</li><li>• Automated, one-click updates</li><li>• Multus (Kubernetes multi-network)</li><li>• Quay v3</li></ul> <ul style="list-style-type: none"><li>• <a href="http://cloud.redhat.com">cloud.redhat.com</a> - Multi-Cluster Mgmt</li><li>• OCP Cluster Subscription Management</li><li>• Azure Red Hat OpenShift</li><li>• OpenShift Dedicated consumption pricing</li></ul>	<ul style="list-style-type: none"><li>• Developer Console GA</li><li>• OpenShift Serverless (Knative) - TP</li><li>• OpenShift Pipelines (Tekton) Tech Preview</li><li>• CodeReady Containers GA</li><li>• Developer CLI (odo) GA</li></ul> <ul style="list-style-type: none"><li>• GPU metering</li><li>• OperatorHub Enhancements</li><li>• Operator Deployment Field Forms</li><li>• Application Binding with Operators</li><li>• Application Migration Console</li></ul> <ul style="list-style-type: none"><li>• Kubernetes 1.14 w/ CRI-O runtime</li><li>• Disconnected Install and Update</li><li>• Automated Installer for Azure, OSP, GCP</li><li>• OVN Tech Preview</li><li>• FIPS</li><li>• Federation Workload API</li><li>• Automated App cert rotation</li><li>• OpenShift Container Storage 4.2</li></ul> <ul style="list-style-type: none"><li>• <a href="http://cloud.redhat.com">cloud.redhat.com</a> - Multi-Cluster Deployment</li><li>• Proactive Support Operator</li></ul>	<ul style="list-style-type: none"><li>• OpenShift Serverless (Knative) - GA</li><li>• OpenShift Pipelines (Tekton) GA</li></ul> <ul style="list-style-type: none"><li>• Metering for Services</li><li>• Windows Containers</li></ul> <ul style="list-style-type: none"><li>• Kubernetes 1.15 w/ CRI-O runtime</li><li>• Automated Installer for IBM Cloud, Alibaba, RHV, Bare Metal Hardware Appliance</li><li>• Pre-existing Infra Installer for Azure, OSP, GCP</li><li>• OVN GA w/ Windows Networking Integration</li></ul> <ul style="list-style-type: none"><li>• <a href="http://cloud.redhat.com">cloud.redhat.com</a> - Subscription Mgmt Consumption Improvements</li></ul>			

# REFERENCE ARCHITECTURES

# REFERENCE ARCHITECTURES

[OpenShift on VMware vCenter](#)

[OpenShift on Red Hat OpenStack Platform](#)

[OpenShift on Amazon Web Services](#)

[OpenShift on Google Cloud Platform](#)

[OpenShift on Microsoft Azure](#)

[OpenShift on Red Hat Virtualization](#)

[OpenShift on HPE Servers with Ansible Tower](#)

[OpenShift on VMware vCenter 6 with Gluster](#)

[Deploying an OpenShift Distributed Architecture](#)

[OpenShift Architecture and Deployment Guide](#)

[OpenShift Scaling, Performance, and Capacity Planning](#)

[Application Release Strategies with OpenShift](#)

[Building Polyglot Microservices on OpenShift](#)

[Building JBoss EAP 6 Microservices on OpenShift](#)

[Building JBoss EAP 7 Microservices on OpenShift](#)

[Business Process Management with JBoss BPM Server on OpenShift](#)

[Build and Deployment of Java Applications on OpenShift](#)

[Building Microservices on OpenShift with Fuse Integration...](#)

[JFrog Artifactory on OpenShift Container Platform](#)

[Spring Boot Microservices on Red Hat OpenShift](#)

[API Management with Red Hat 3scale on OpenShift](#)

[App CI/CD on OCP with Jenkins](#)

# END OF WORKSHOP LINKS

- [OpenShift Interactive Learning Portal](#) - An online interactive learning environment where you can run through various scenarios related to using OpenShift.
- [OpenShift Cookbook](#) - Recipes of common tasks that users could need to do on OpenShift.
- [OKD](#) - The upstream Open Source community distribution of Kubernetes that powers OpenShift.
- [Minishift](#) - A tool which can be used to install a local OpenShift cluster on your own computer, running in a virtual machine.
- [OpenShift Online](#) - A shared public hosting environment for running your applications using OpenShift.
- [OpenShift.io](#) - An online development environment for planning, creating and deploying hybrid cloud services using OpenShift.
- [OpenShift Dedicated](#) - A dedicated hosting environment for running your applications, managed and supported for you by Red Hat.
- [OpenShift Container Platform](#) - The Red Hat supported OpenShift product for installation on premise or in hosted cloud environments.

The following free online eBooks are also available for download related to OpenShift.

- [OpenShift for Developers](#)



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# THANK YOU



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