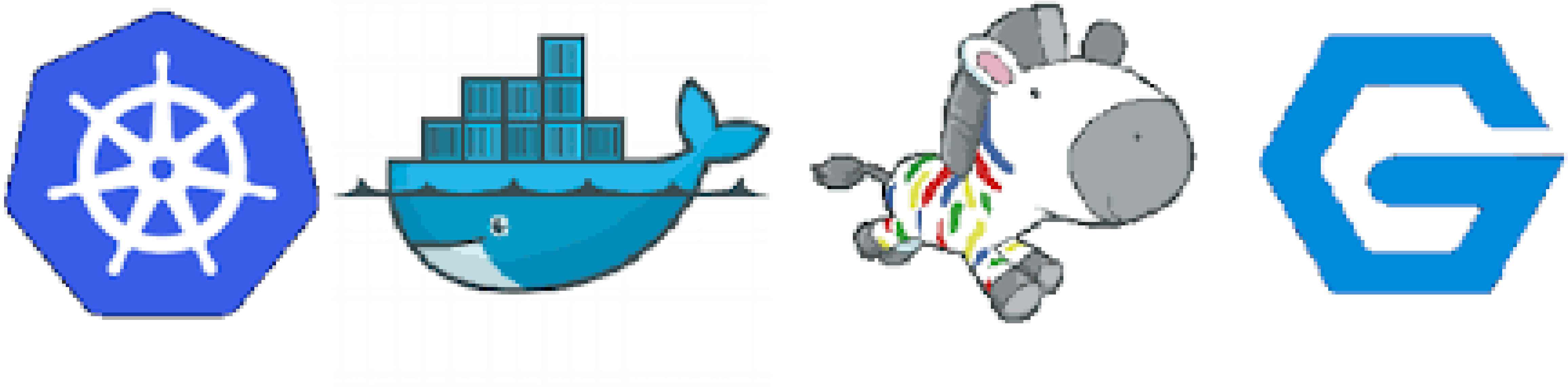
Introducing Container Technology

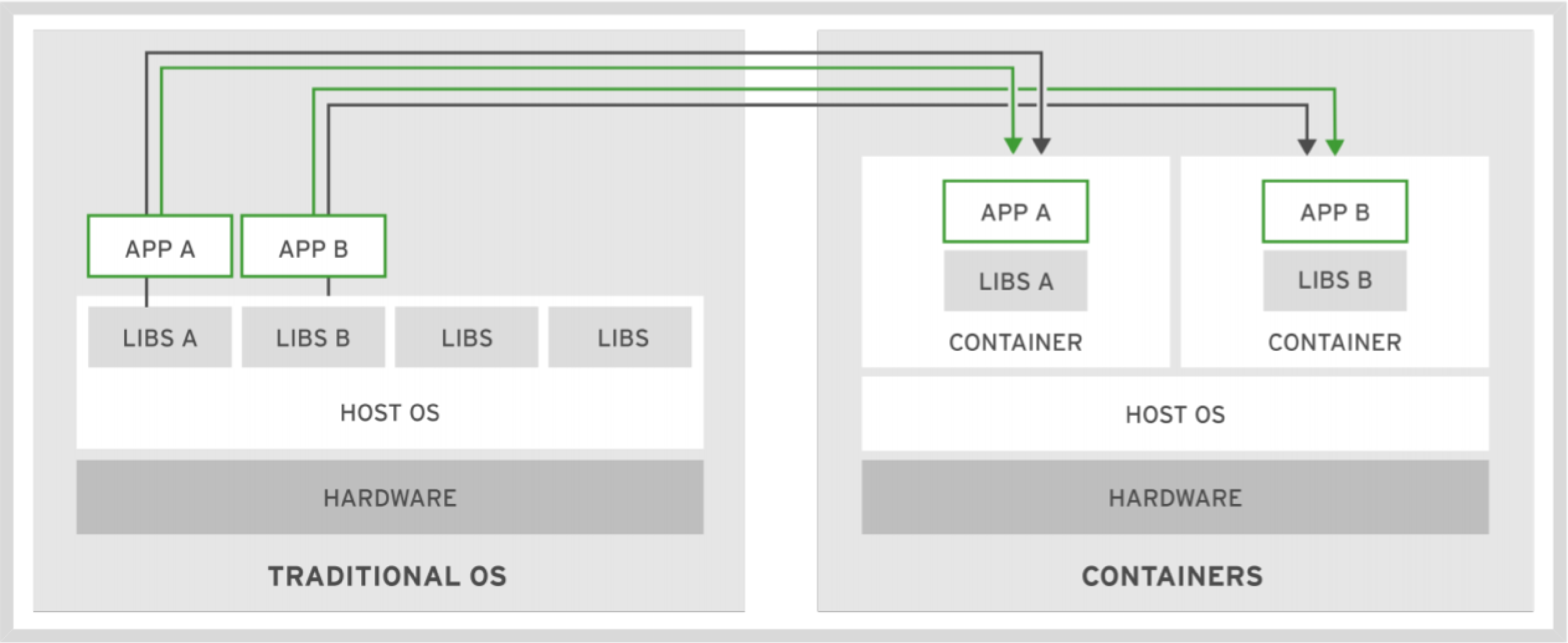
Agendas

- Overview of Container Technology
- Overview of Container Architecture
- Overview of Kubernetes and OpenShift
- DEMO 1: Quicky starts a webserver container
- DEMO 2: Quickly deploy a webserver container in OpenShift cluster



Overview of Container Technology

Containerized Overview



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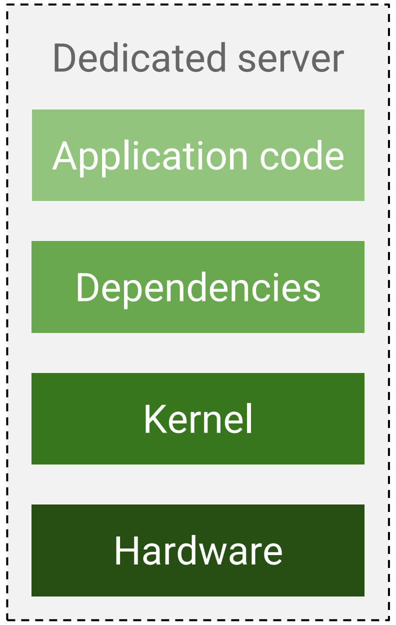
Advantages of using containers

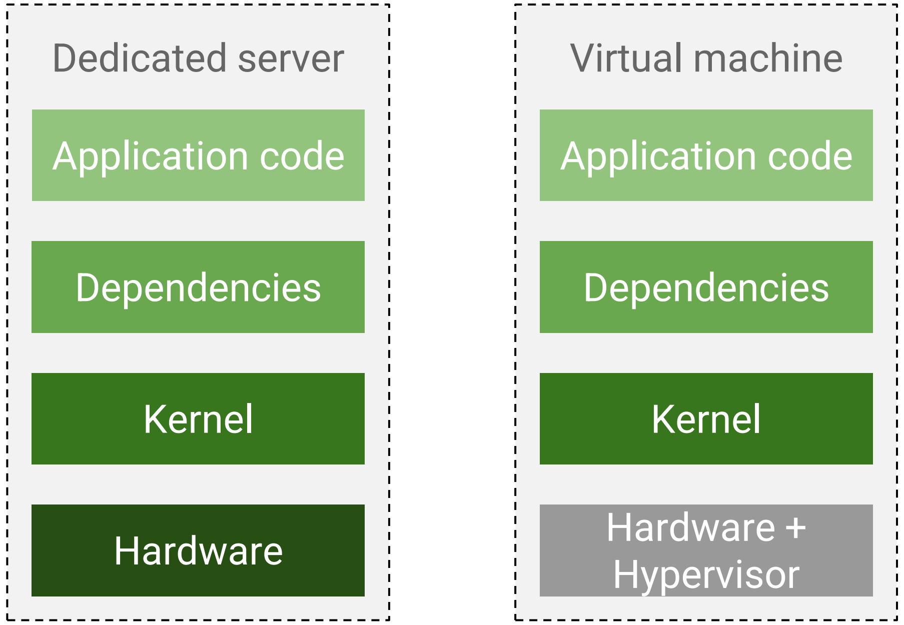
- Easier and faster to deploy
- Low hardware footprint
- Portable
- Universal format
  - Multi environment deployment
- Environment Isolation
  - Development, Testing and Production
- Reusability
- Ideal for microservices environment

Legacy Data Center



Deployment ~months
Low utilization
Not portable

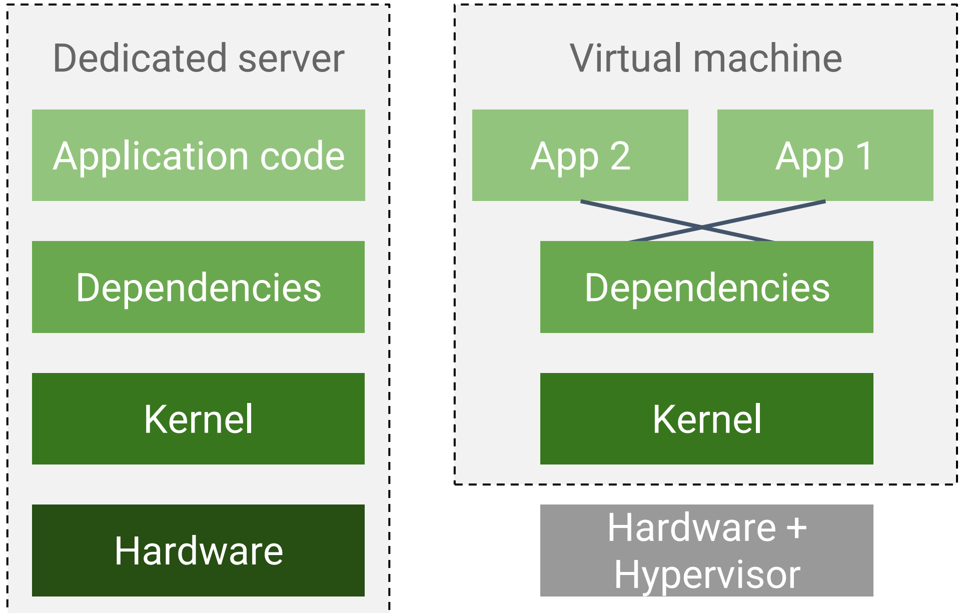
Hypervisors create and manage virtual machines



Deployment ~months
Low utilization
Not portable

Deployment ~days (mins)
Improved utilization
Hypervisor-specific

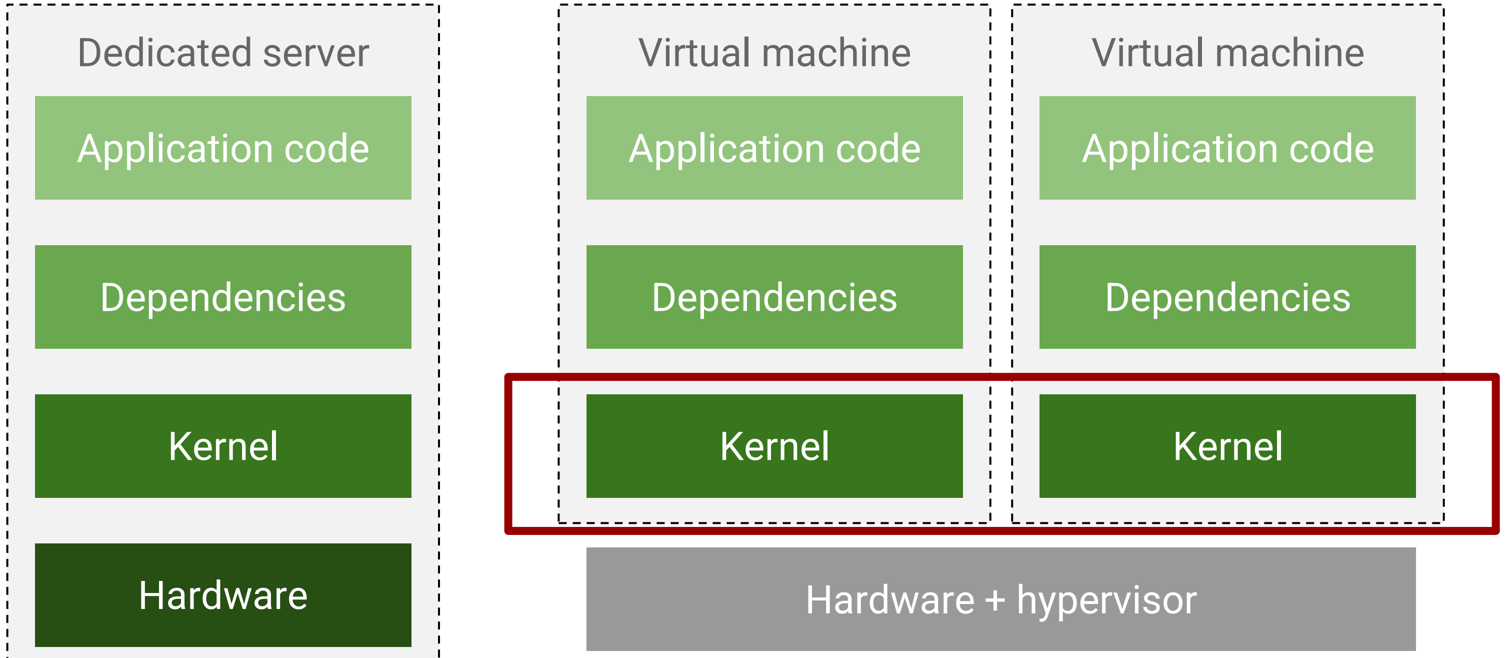
Running multiple apps on a single VM



Deployment ~months
Low utilization
Not portable

Virtualization
Hypervisor-specific
Low isolation; tied to OS

The VM-centric way to solve this problem



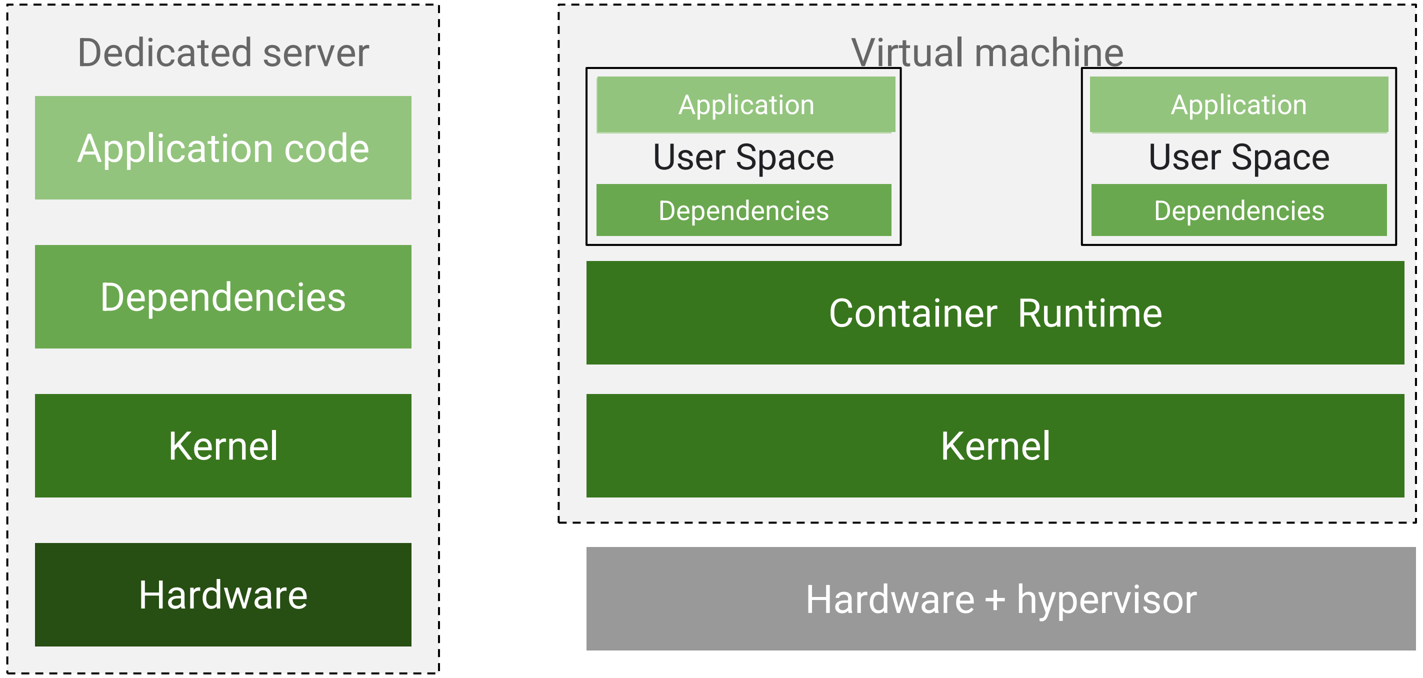
Not portable
Low utilization

Hypervisor-specific
Low isolation; tied to OS

Deployment ~days (mins)
Hypervisor-specific
Redundant OS

User space abstraction and containers

Deployment ~days (mins)
Container
Focuses on Application processes or code



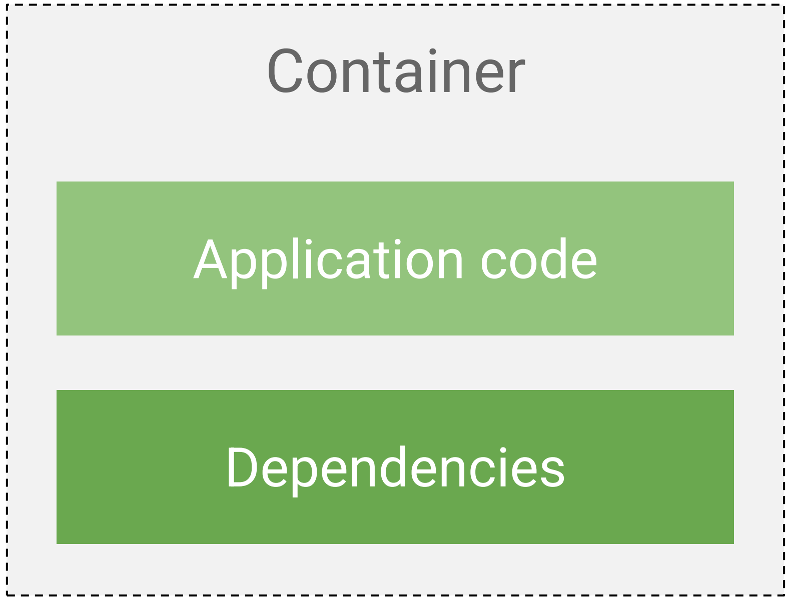
Not portable
Low utilization

Hypervisor-specific
Low isolation; tied to OS

Hypervisor-specific
Redundant OS

Containers

are lightweight, standalone, resource-efficient, portable, executable packages



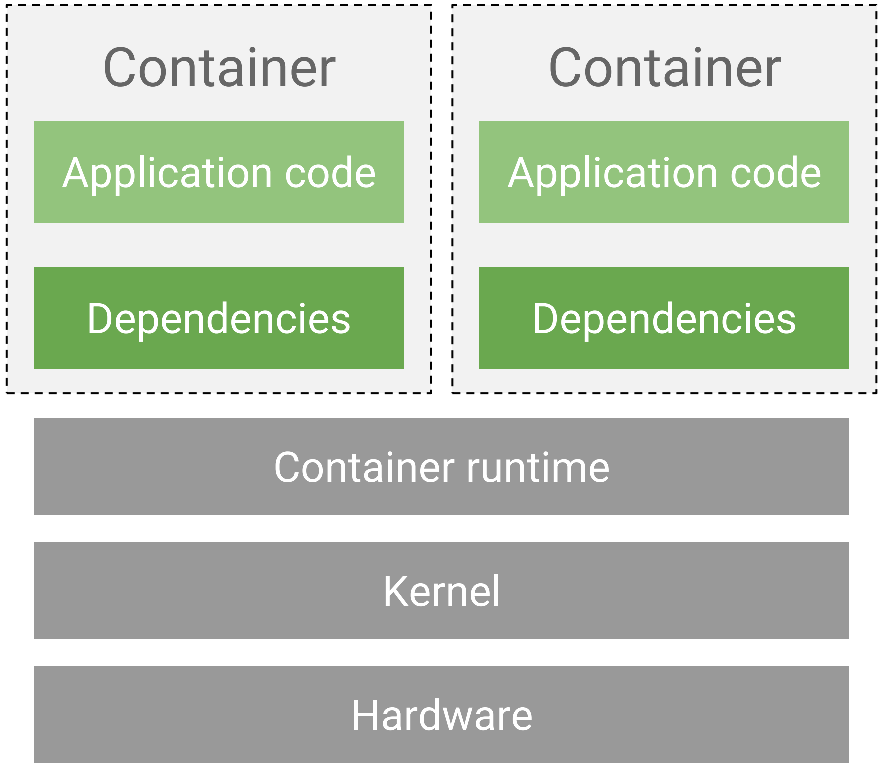
Container

Application code

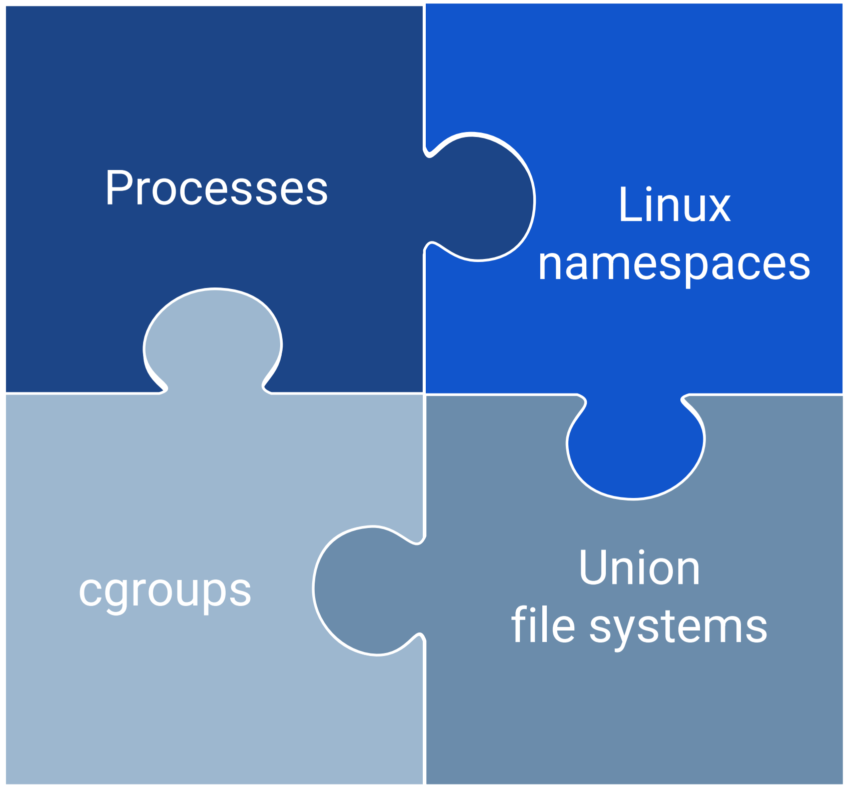
Dependencies

Why developers like containers?

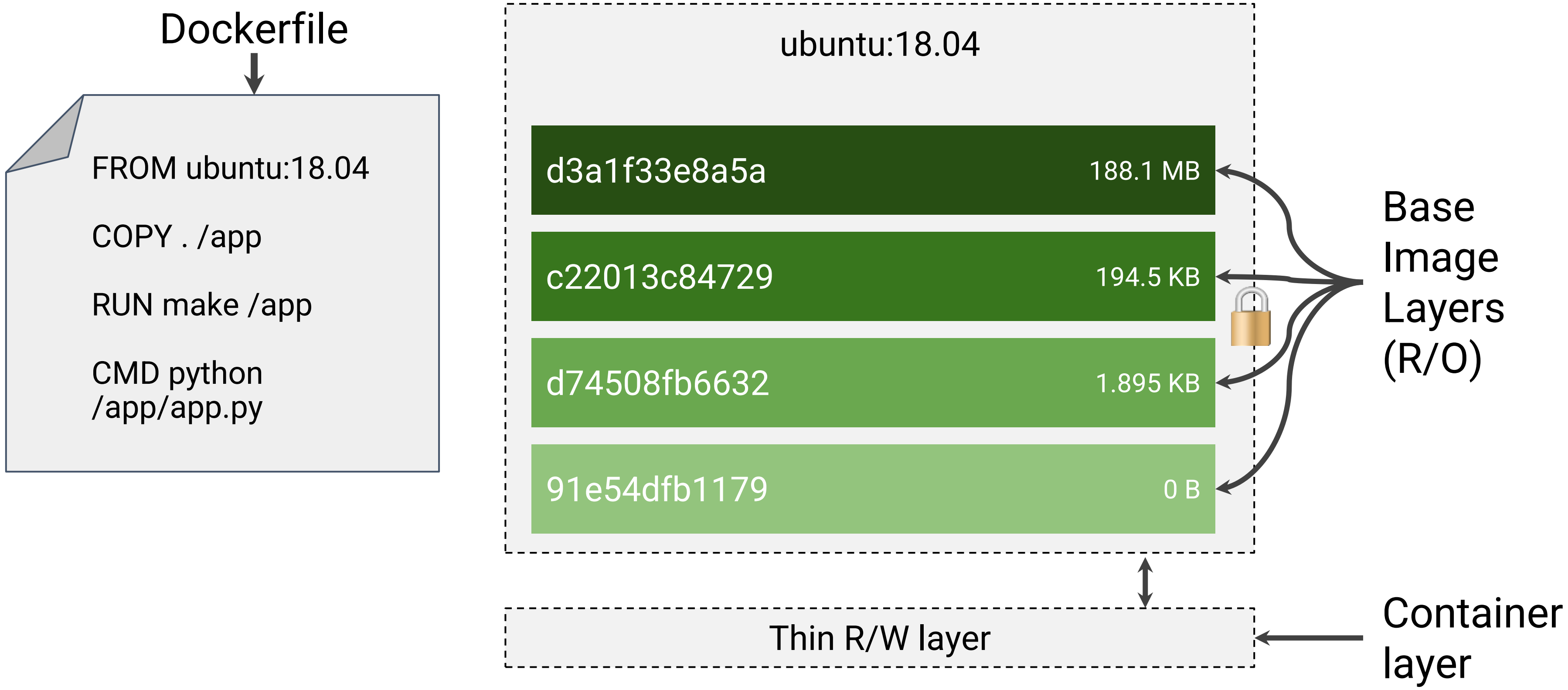
- Easier and faster to deploy
- Low hardware footprint
- Portable
- Universal format
  - Multi environment deployment
- Environment Isolation
  - Development, Testing and Production
- Reusability
- Ideal for microservices environment



Containers use a varied set of Linux technologies



Containers are structured in layers



Dockerfile

```
FROM ubuntu:18.04

COPY . /app

RUN make /app

CMD python
/app/app.py
```

ubuntu:18.04

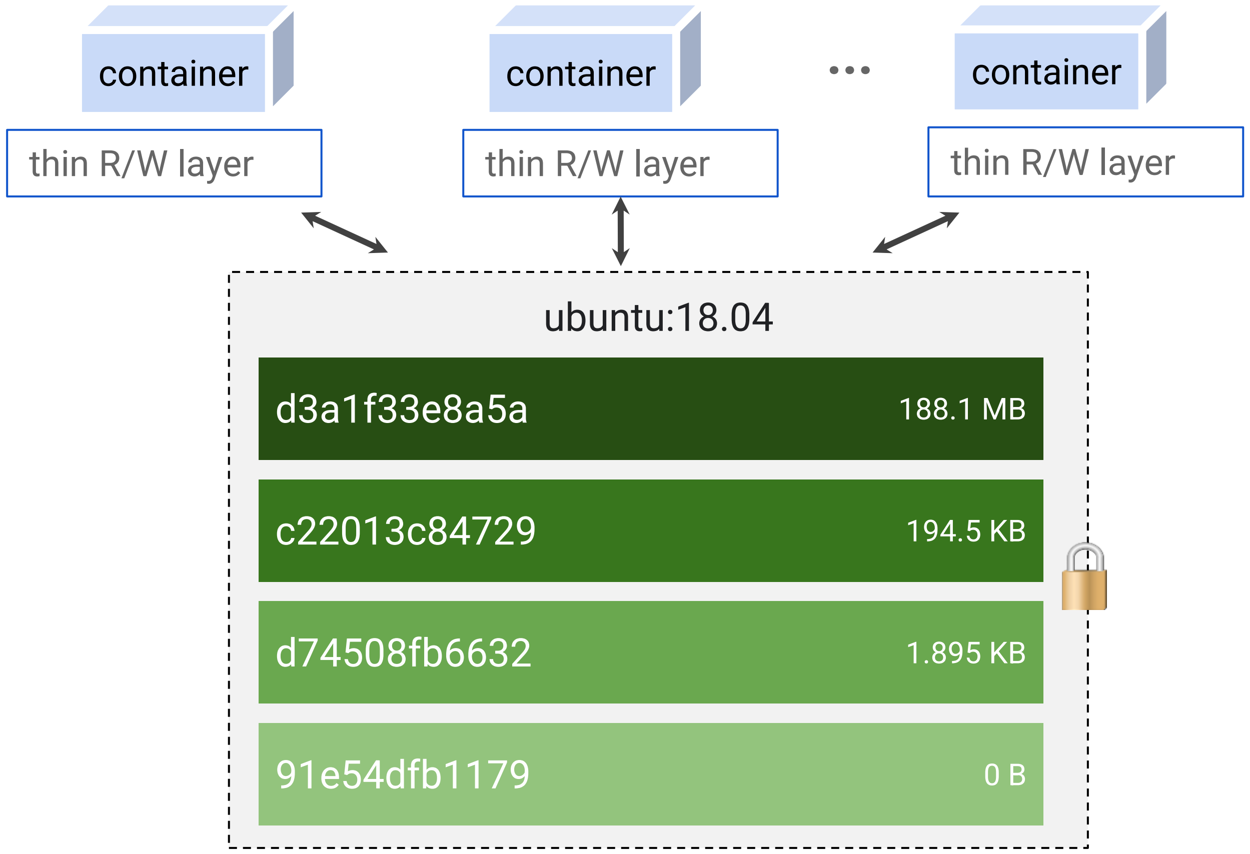
d3a1f33e8a5a	188.1 MB
c22013c84729	194.5 KB
d74508fb6632	1.895 KB
91e54dfb1179	0 B

Base Image Layers (R/O)

Thin R/W layer

Container layer

Containers promote smaller shared images



Quiz 1

Which two options are examples of software applications that might run in a container? (Choose two.)

a) A database-driven Python application accessing services such as a MySQL database, a file transfer protocol (FTP) server, and a web server on a single physical host.

b) A Java Enterprise Edition application, with an Oracle database, and a message broker running on a single VM.

c) An I/O monitoring tool responsible for analyzing the traffic and block data transfer.

d) A memory dump application tool capable of taking snapshots from all the memory CPU caches for debugging purposes.

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Quiz 2

Which two of the following use cases are best suited for containers? (Choose two.)

a) A software provider needs to distribute software that can be reused by other companies in a fast and error-free way.

b) A company is deploying applications on a physical host and would like to improve its performance by using containers.

c) Developers at a company need a disposable environment that mimics the production environment so that they can quickly test the code they develop.

d) A financial company is implementing a CPU-intensive risk analysis tool on their own containers to minimize the number of processors needed.

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Quiz 3

A company is migrating their PHP and Python applications running on the same host to a new architecture. Due to internal policies, both are using a set of custom made shared libraries from the OS, but the latest update applied to them as a result of a Python development team request broke the PHP application. Which two architectures would provide the best support for both applications? (Choose two.)

a) Deploy each application to different VMs and apply the custom made shared libraries individually to **each VM host.**

b) Deploy each application to different containers and apply the custom made shared libraries individually to **each container.**

c) Deploy each application to different VMs and apply the custom made shared libraries to **all VM hosts.**

d) Deploy each application to different containers and apply the custom made shared libraries to **all containers.**

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d) Deploy each application to different containers and apply the custom made shared libraries to all containers.

Quiz 4

Which three kinds of applications can be packaged as containers for immediate deployment? (Choose three.)

a) A virtual machine hypervisor

b) A blog software, such as WordPress

c) A database

d) A local file system recovery tool

e) A web server

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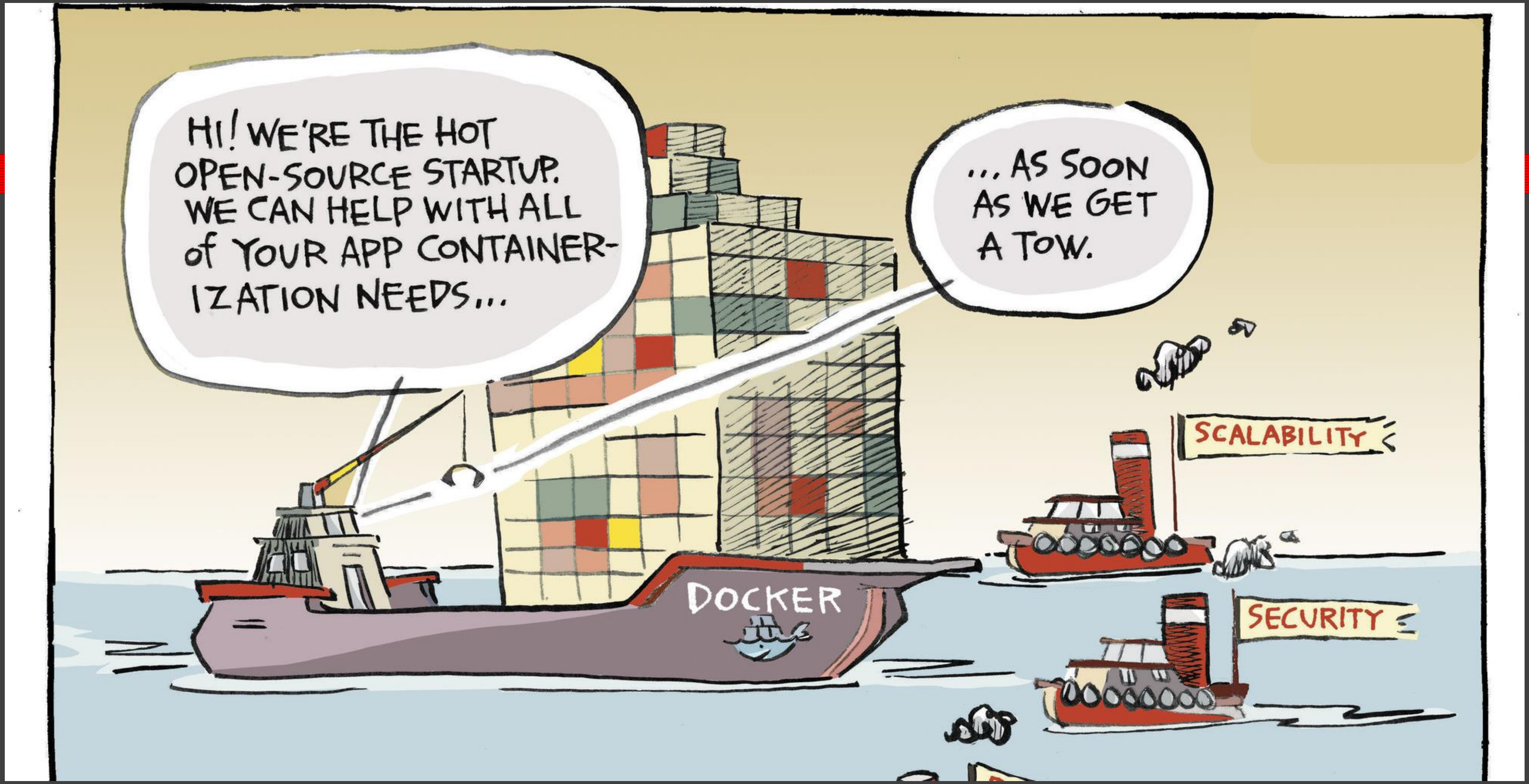
Overview of Container Architecture

After completing this section, you will be able to:

- Describe the architecture of Linux containers.
- Install the podman utility to manage containers.

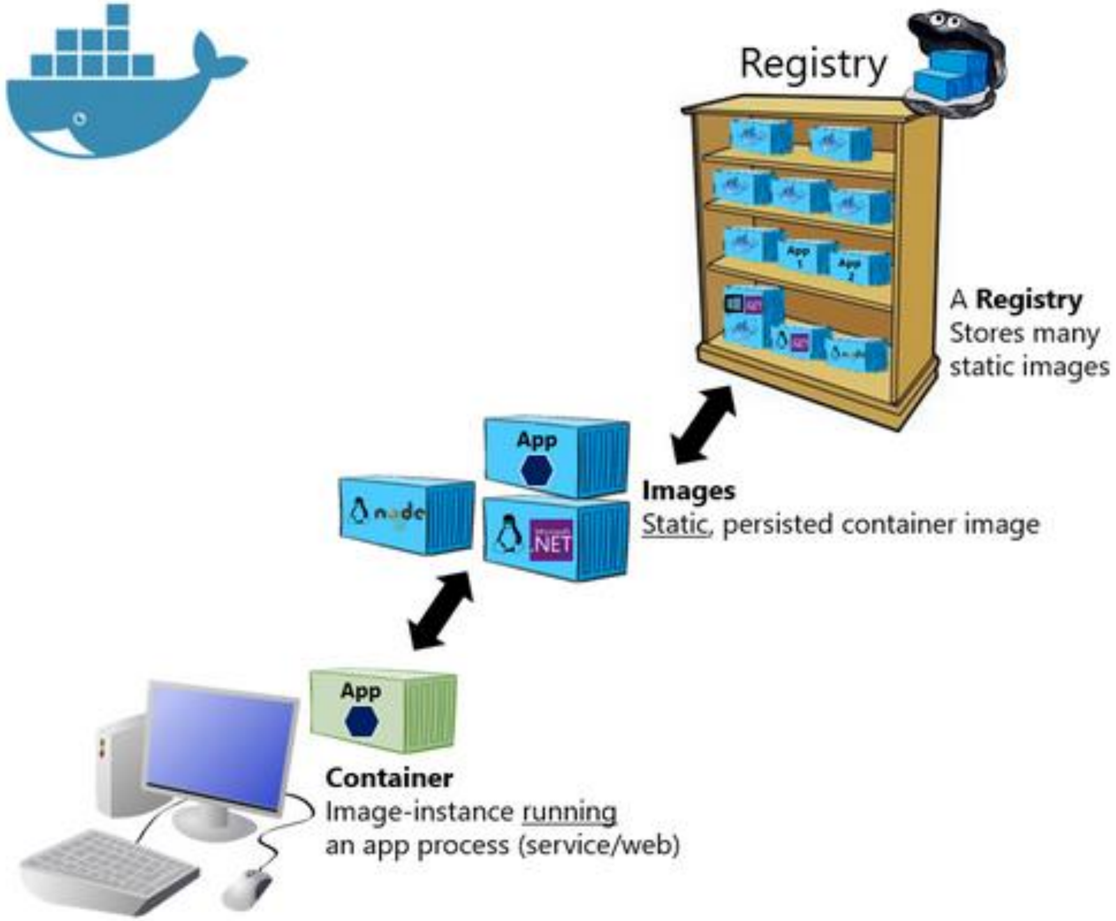

HI! WE'RE THE HOT OPEN-SOURCE STARTUP. WE CAN HELP WITH ALL of YOUR APP CONTAINERIZATION NEEDS...
..., AS SOON AS WE GET A TOW.
DOCKER
SCALABILITY
SECURITY

Terminology

- Namespaces
- Control groups (cgroups)
- Seccomp
- SELinux

Describing Linux Container Architecture

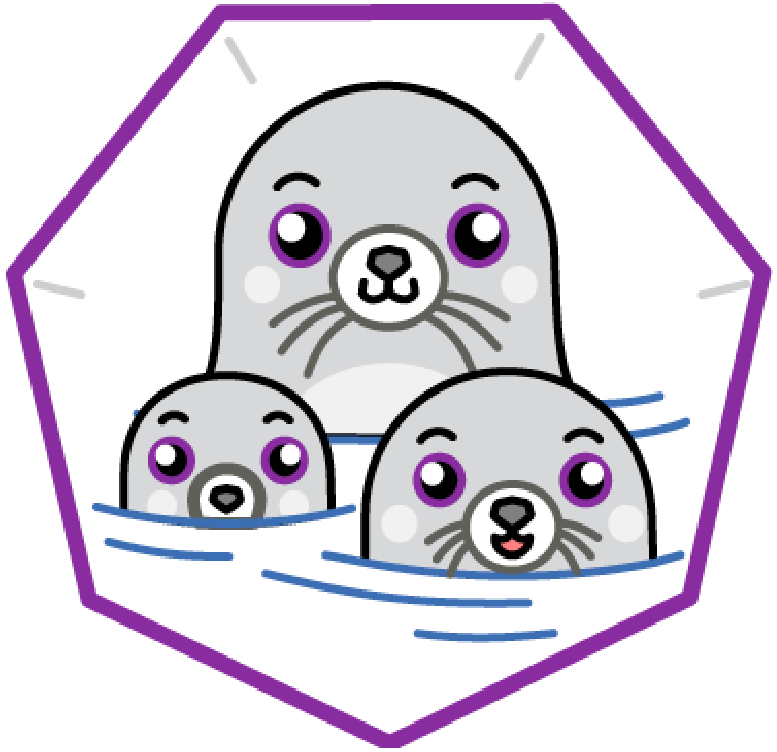
- Container is a process
- Start from image
- Immutable view of image
- Image versioning
  - Automation
  - Rapid provisioning
- Locally or remotely stored
- Image Repository
  - Docker Hub - docker.io
  - Red Hat Container Catalog - access.redhat.registry
  - Red Hat Quay - quay.io
  - Google Container Registry - gcr.io
  - Amazon Elastic Container Registry – ecr.io



Managing Containers with Podman

- Build image
- Search image from local or remote registry
- Uses Open Container Initiative (OCI) specification
- Improvised from Docker cli
- Compatible with K8s.
- Install Podman

```
# sudo yum install podman or
# sudo dnf install podman
```



Overview of Kubernetes and OpenShift

After completing this section, you will be:

- Identifying the limitations of Linux containers and the need for container orchestration.
- Describing the Kubernetes container orchestration tool.
- Describing Red Hat OpenShift Container Platform (RHOCP).

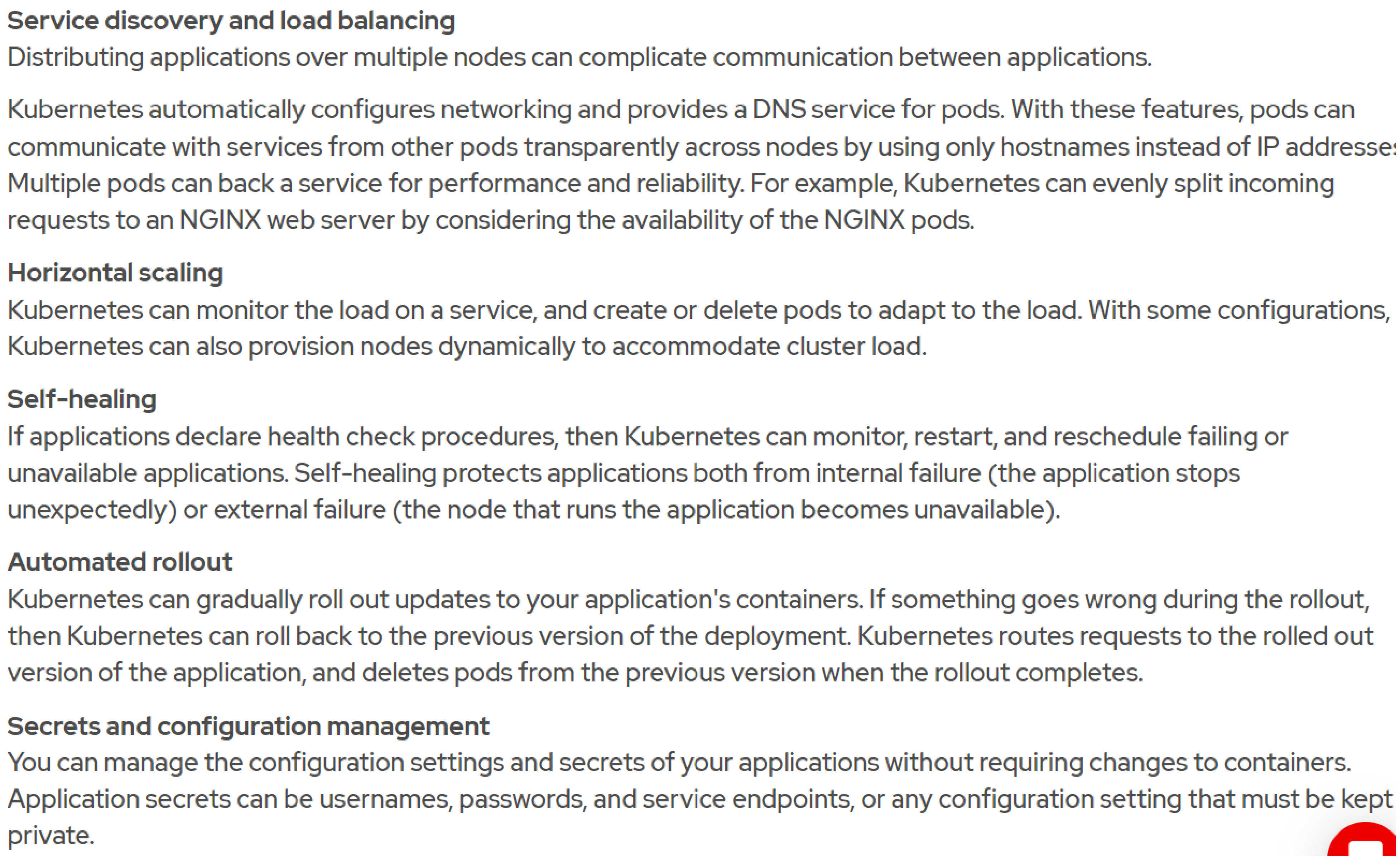
Limitations of Linux containers and the need for container orchestration.

- Cannot scale seamlessly
- Manually starting on different node
- Doesn’t works seamlessly on multi-node environment
- Doesn’t works seamlessly on multi-platform environment
- Manual migration
- Slow in reacting to service deterioration
- Manual update

Kubernetes Features

- Simplifies deployment and management
- Automate scaling
- Auto-healing or Self-healing
- Automated rollout
- Secrets and configuration management
- Multi-platform
  - Windows
  - Linuxes
- Hybrid platform
  - On-prem
  - In the cloud
- Fully managed life cycle operations

Kubernetes Features



Service discovery and load balancing
Distributing applications over multiple nodes can complicate communication between applications.

Kubernetes automatically configures networking and provides a DNS service for pods. With these features, pods can communicate with services from other pods transparently across nodes by using only hostnames instead of IP addresses. Multiple pods can back a service for performance and reliability. For example, Kubernetes can evenly split incoming requests to an NGINX web server by considering the availability of the NGINX pods.

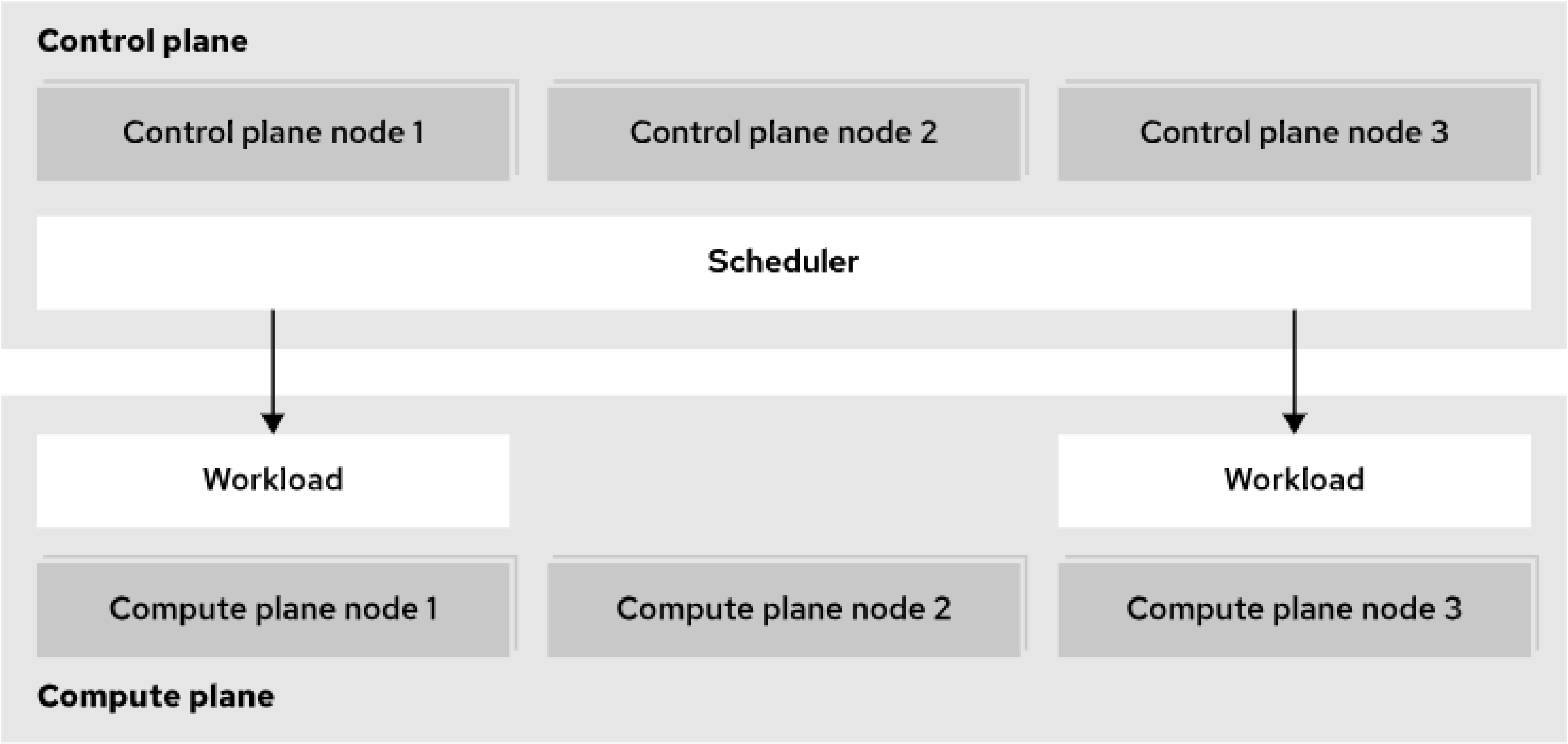
Horizontal scaling
Kubernetes can monitor the load on a service, and create or delete pods to adapt to the load. With some configurations, Kubernetes can also provision nodes dynamically to accommodate cluster load.

Self-healing
If applications declare health check procedures, then Kubernetes can monitor, restart, and reschedule failing or unavailable applications. Self-healing protects applications both from internal failure (the application stops unexpectedly) or external failure (the node that runs the application becomes unavailable).

Automated rollout
Kubernetes can gradually roll out updates to your application's containers. If something goes wrong during the rollout, then Kubernetes can roll back to the previous version of the deployment. Kubernetes routes requests to the rolled out version of the application, and deletes pods from the previous version when the rollout completes.

Secrets and configuration management
You can manage the configuration settings and secrets of your applications without requiring changes to containers. Application secrets can be usernames, passwords, and service endpoints, or any configuration setting that must be kept private.

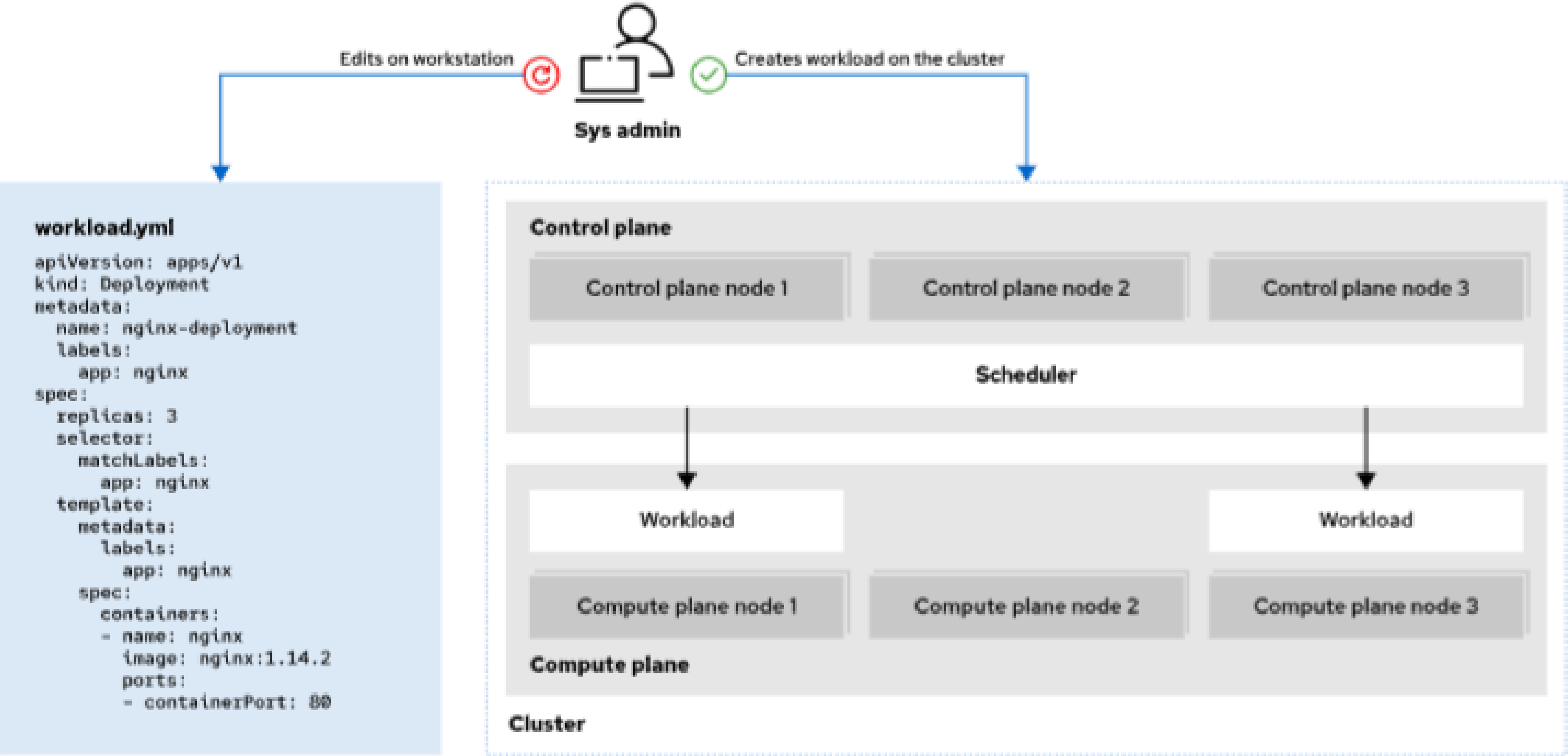
Kubernetes Architectural Concepts



OpenShift Overview

- Red Hat OpenShift Container Platform (RHOCP)
- Set of modular components and services
- Based on Kubernetes specifications
- Enhanced capabilities:
  - Remote Management
  - Multitenancy
  - Increased Security
  - Monitoring and Auditing
- With OCPv4, implement CoreOS

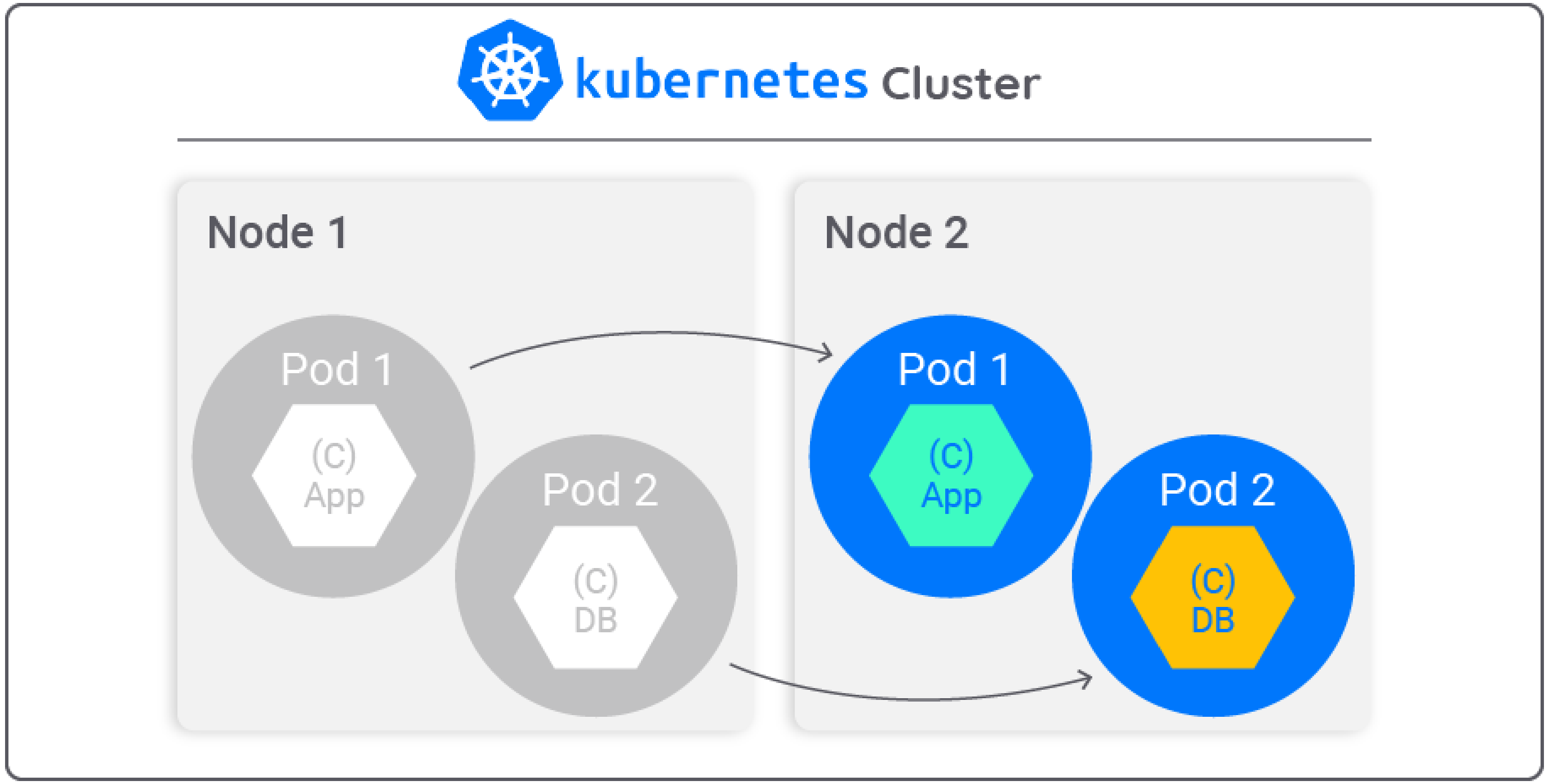
The Kubernetes API and Configuration Model



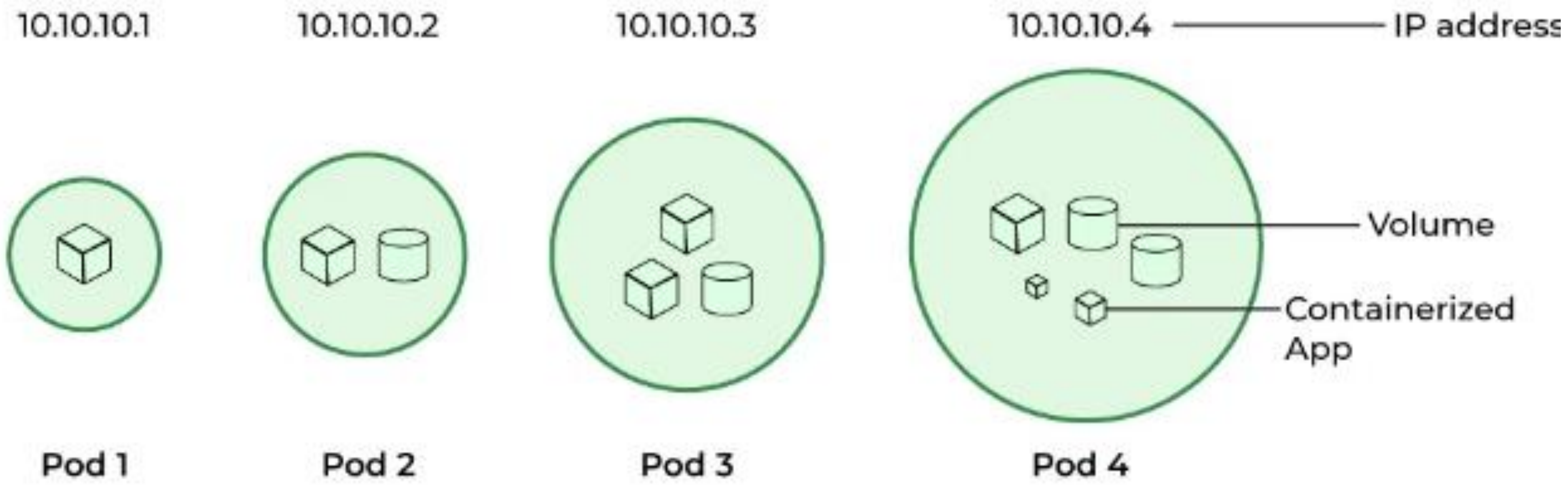
workload.yml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment
  labels:
    app: nginx
spec:
  replicas: 3
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx:1.14.2
        ports:
        - containerPort: 80
```

Containers ->
Pods ->
Nodes



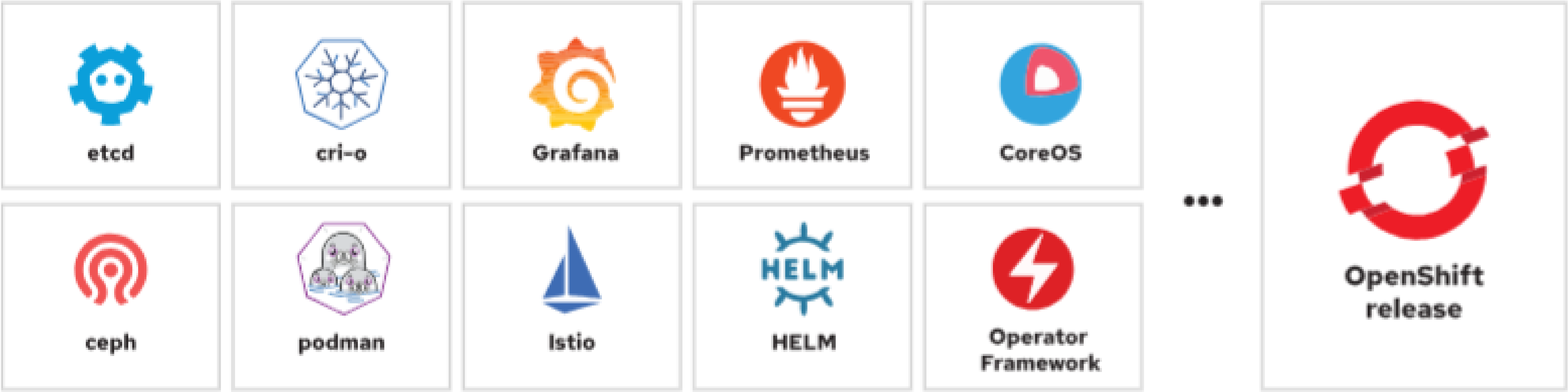
Containers -> Pods -> Nodes



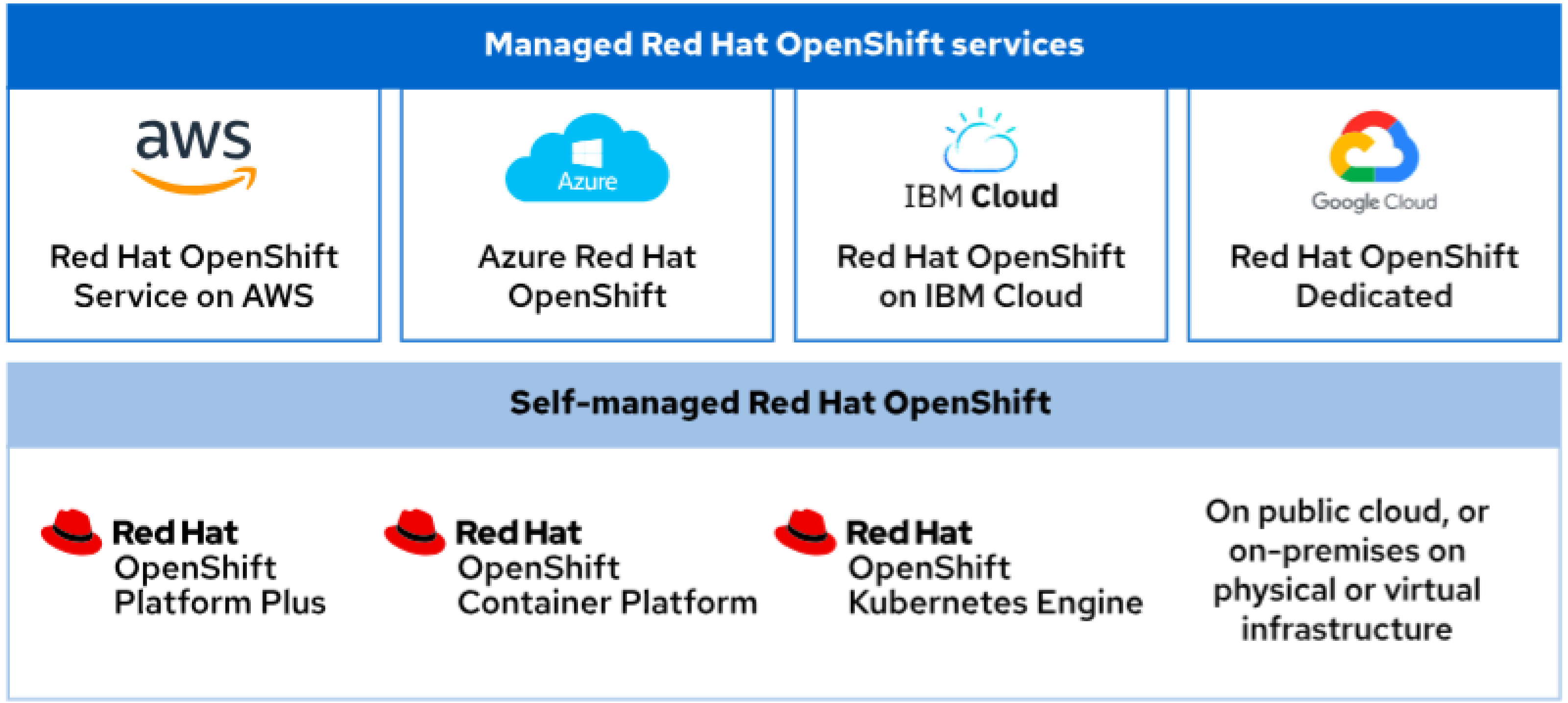
OpenShift Features

- OpenShift adds the following features to a Kubernetes cluster
- Built-in container registry
- CI/CD pipelines,
- Source-to-Image (S2I)
- Easily expose services to outside world
- Metrics and Logging
- Unified UI

Various functions



Red Hat OpenShift Editions



Managed Red Hat OpenShift services

aws
Red Hat OpenShift Service on AWS

Azure
Azure Red Hat OpenShift

IBM Cloud
Red Hat OpenShift on IBM Cloud

Google Cloud
Red Hat OpenShift Dedicated

Self-managed Red Hat OpenShift

Red Hat OpenShift Platform Plus

Red Hat OpenShift Container Platform

Red Hat OpenShift Kubernetes Engine

On public cloud, or on-premises on physical or virtual infrastructure

Quiz 1

Which three of the following statements are correct regarding container limitations? (Choose three.)

a) Containers are easily orchestrated in large numbers.

b) Lack of automation increases response time to problems.

c) Containers do not manage application failure inside them.

d) Containers are not load-balanced.

e) Containers are heavily isolated packaged applications.

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d) Containers are not load-balanced.
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Quiz 2

Which two of the following statements are correct regarding Kubernetes? (Choose two.)

a) Kubernetes is a container.

b) Kubernetes can only use Docker containers.

c) Kubernetes is a container orchestration system.

d) Kubernetes simplifies management, deployment, and scaling of containerized applications.

e) Applications managed in a Kubernetes cluster are harder to maintain.

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Quiz 3

3. Which three of the following statements are true regarding Red Hat OpenShift v4? (Choose three.)

a) OpenShift provides additional features to a Kubernetes infrastructure.

b) Kubernetes and OpenShift are mutually exclusive.

c) OpenShift hosts use Red Hat Enterprise Linux as the base operating system.

d) OpenShift simplifies development incorporating a Source-to-Image technology and CI/CD pipelines.

e) OpenShift simplifies routing and load balancing.

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Quiz 4

What features does OpenShift offer that extend Kubernetes capabilities? (choose two.)

a) Operators and the Operator Framework.

b) Routes to expose services to the outside world.

c) An integrated development workflow.

d) Self-healing and health checks.

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Chapter Summary

In this chapter, you learned:

- Containers are an isolated application runtime created with very little overhead.
- A container image packages an application with all of its dependencies, making it easier to run the application in different environments.
- Applications such as Podman create containers using features of the standard Linux kernel.
- Container image registries are the preferred mechanism for distributing container images to multiple users and hosts.
- OpenShift orchestrates applications composed of multiple containers using Kubernetes.
- Kubernetes manages load balancing, high availability, and persistent storage for containerized applications.
- OpenShift adds to Kubernetes multitenancy, security, ease of use, and continuous integration and continuous development features.
- OpenShift routes enable external access to containerized applications in a manageable way.