LINUX CONTAINER INTERNALS

How they really work

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BASIC INFO

Introduction - Linux Container Internals

Wifi, Labs, Etc

- Labs
  - learn.openshift.com/training

AGENDA

Introduction - Linux Container Internals 2.1

Introduction

- At Red Hat we encourage networking and we'd like you to spend 2 to 3 minutes introducing yourselves to the person(s) next to you. Say what company or organization you're from, and what you're looking to learn from this tutorial.
- We will use a completely hosted solution called Katacoda for this lab:
  - All you need is a web browser and Internet access: SSID - OReilly18 Password - oscon2018
  - Instructions, code repositories, and terminal will be provided to a real, working virtual machine
  - All code is clickable, all you have to do is click on it and it will paste into the terminal
  - The environment can be reset at any time by refreshing (very nice)
- https://www.katacoda.com/fatherlinux/training/subsystems/

INTRODUCTION

AGENDA

Introduction - Linux Container Internals

Introduction

Four new tools in your toolbelt

Container Images

The new standard in software packaging

Container Hosts

Container runtimes, engines, daemons

Container Registries

Sharing and collaboration

Container Orchestration

Distributed systems and containers

AGENDA

Advanced - Linux Container Internals

Container Standards
Understanding OCI, CRI, CNI, and more

Container Tools Ecosystem
Podman, Buildah, and Skopeo

Production Image Builds
Sharing and collaboration between specialists

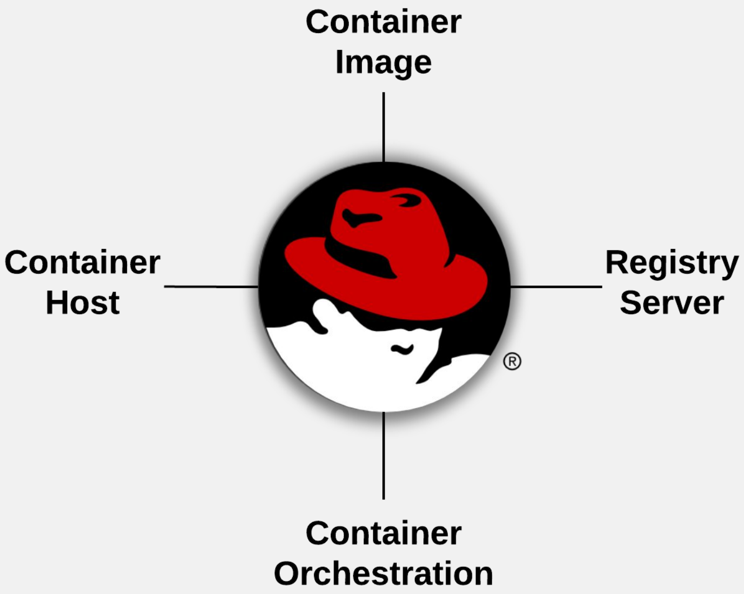
Intermediate Architecture
Production environments

Advanced Architecture
Building in resilience

Container History
Context for where we are today

Production-Ready Containers

What are the building blocks you need to think about?



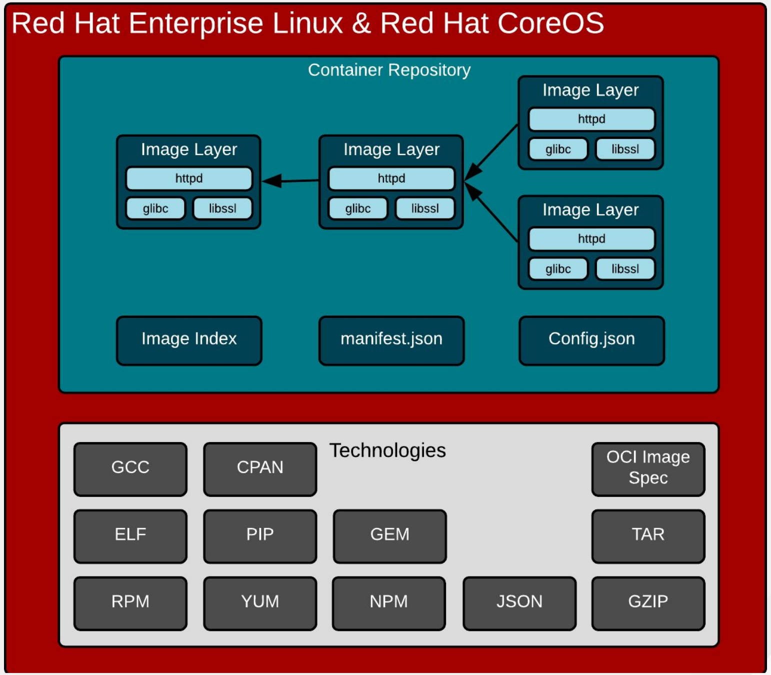
CONTAINER IMAGES

CONTAINER IMAGE

Open source code/libraries, in a Linux distribution, in a tarball

Even base images are made up of layers:

- Libraries (glibc, libssl)
- Binaries (httpd)
- Packages (rpms)
- Dependency Management (yum)
- Repositories (rhel7)
- Image Layer & Tags (rhel7:7.5-404)
- At scale, across teams of developers and CI/CD systems, consider all of the necessary technology

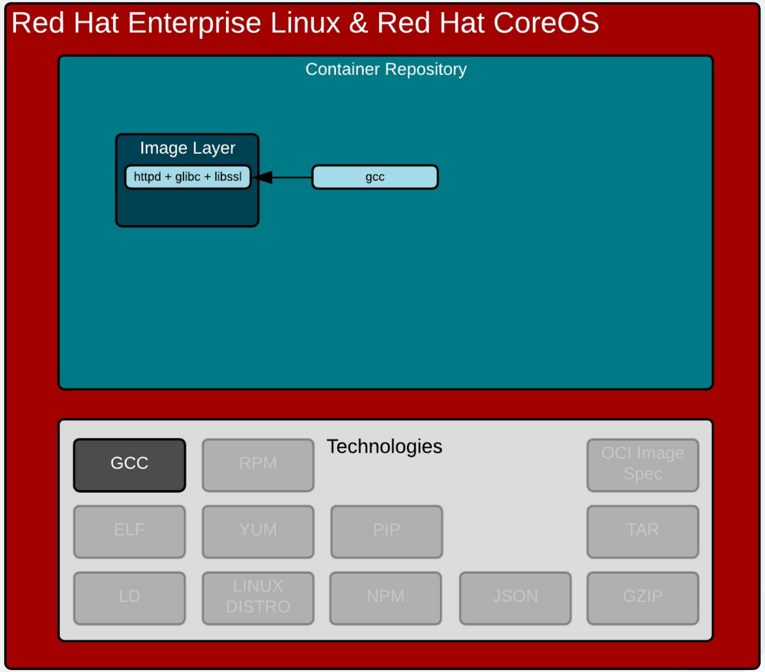


IT ALL STARTS WITH COMPILING

Statically linking everything into the binary

Starting with the basics:

- Programs rely on libraries
- Especially things like SSL - difficult to reimplement in for example PHP
- Math libraries are also common
- Libraries can be compiled into binaries - called static linking
- Example: C code + glibc + gcc = program

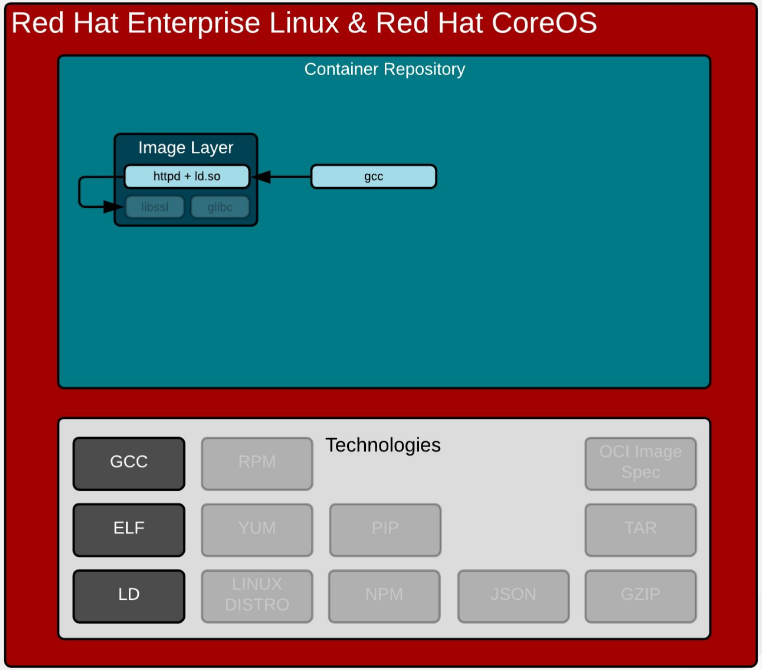


LEADS TO DEPENDENCIES

Dynamically linking libraries into the binary

Getting more advanced:

- This is convenient because programs can now share libraries
- Requires a dynamic linker
- Requires the kernel to understand where to find this linker at runtime
- Not terribly different than interpreters (hence the operating system is called an interpretive layer)

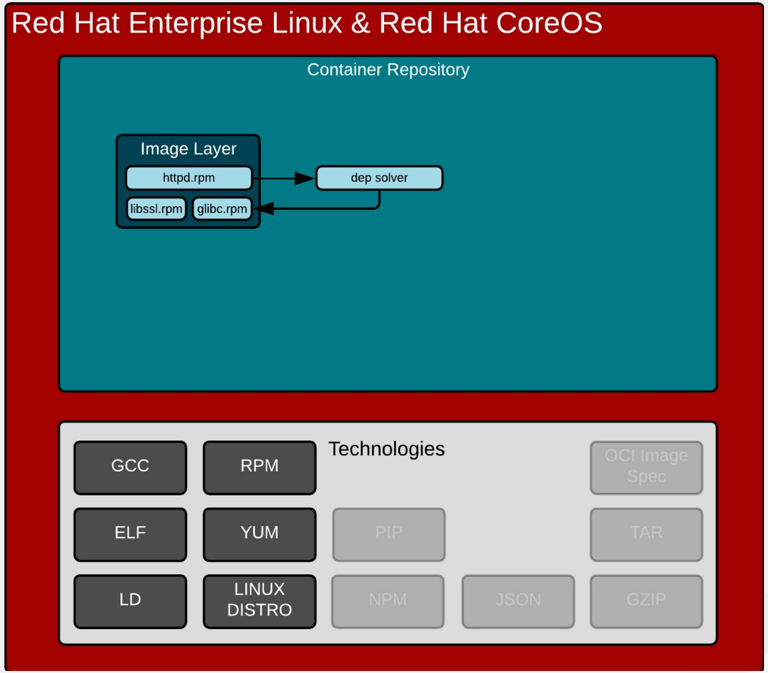


PACKAGING & DEPENDENCIES

RPM and Yum were invented a long time ago

Dependencies need resolvers:

- Humans have to create the dependency tree when packaging
- Computers have to resolve the dependency tree at install time (container image build)
- This is essentially what a Linux distribution does sans the installer (container image)

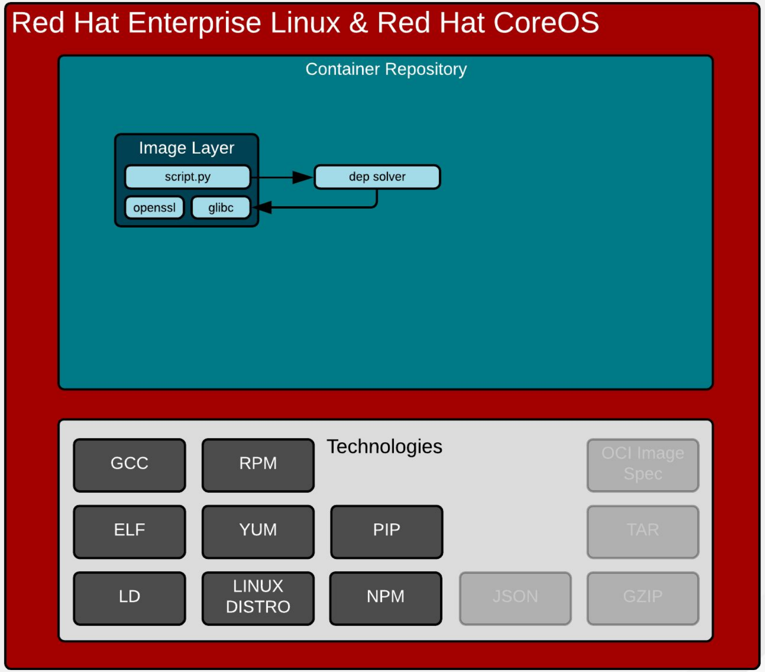


PACKAGING & DEPENDENCIES

Interpreters have to handle the same problems

Dependencies need resolvers:

- Humans have to create the dependency tree when packaging
- Computers have to resolve the dependency tree at install time (container image build)
- Python, Ruby, Node.js, and most other interpreted languages rely on C libraries for difficult tasks (ex. SSL)

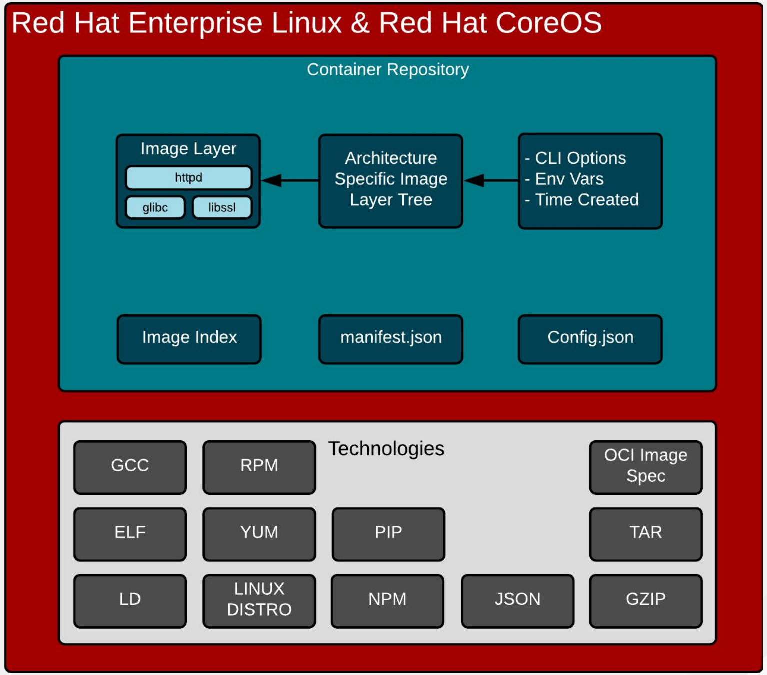


CONTAINER IMAGE PARTS

Governed by the OCI image specification standard

Lots of payload media types:

- Image Index/Manifest.json - provide index of image layers
- Image layers provide change sets - adds/deletes of files
- Config.json provides command line options, environment variables, time created, and much more
- Not actually single images, really repositories of image layers

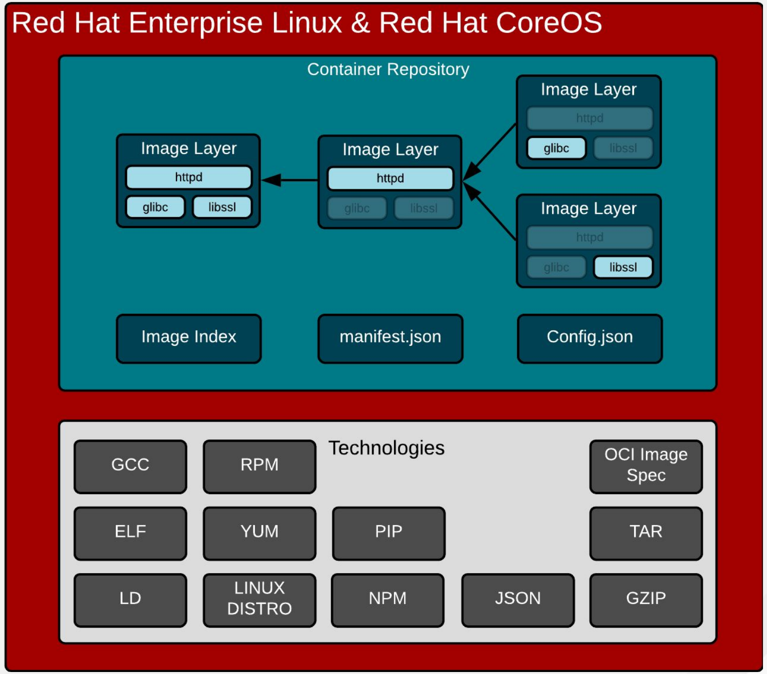


LAYERS ARE CHANGE SETS

Each layer has adds/deletes

Each image layer is a permutation in time:

- Different files can be added, updated or deleted with each change set
- Still relies on package management for dependency resolution
- Still relies on dynamic linking at runtime



LAYERS ARE CHANGE SETS

Some layers are given a human readable name

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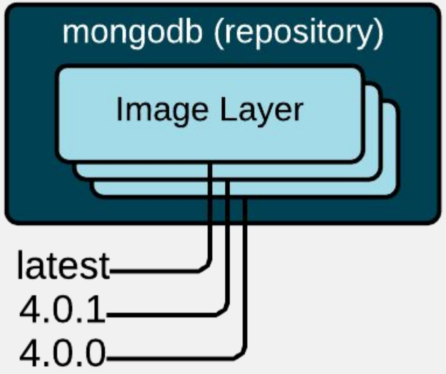

Layers and Tags

CONTAINER IMAGES & USER OPTIONS

Come with default binaries to start, environment variables, etc

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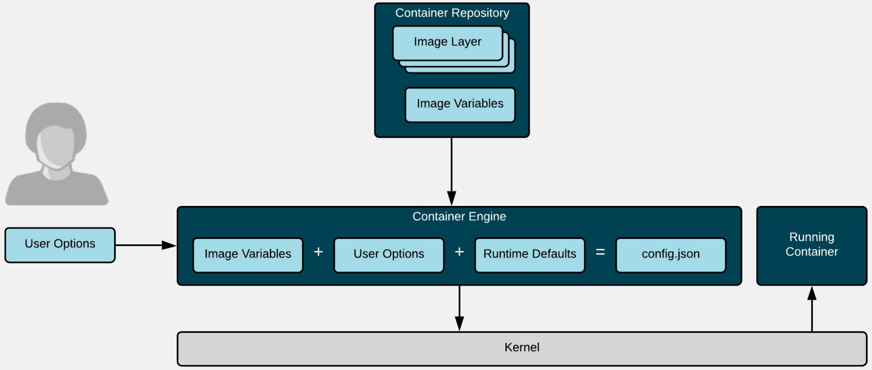
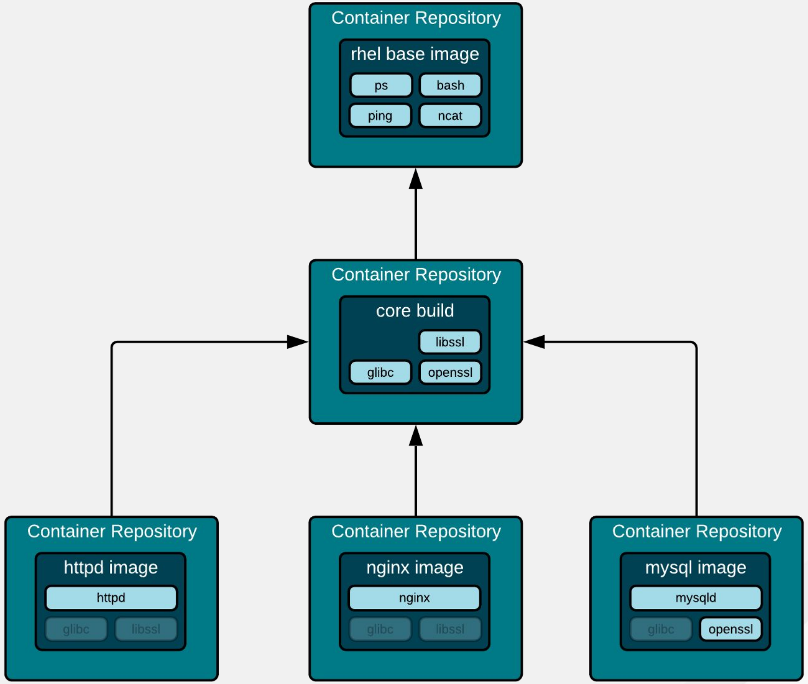


INTER REPOSITORY DEPENDENCIES

Think through this problem as well

You have to build this dependency tree yourself:

- DRY - Do not repeat yourself. Very similar to functions and coding
- OpenShift BuildConfigs and DeploymentConfigs can help
- Letting every development team embed their own libraries takes you back to the 90s



CONTAINER IMAGE

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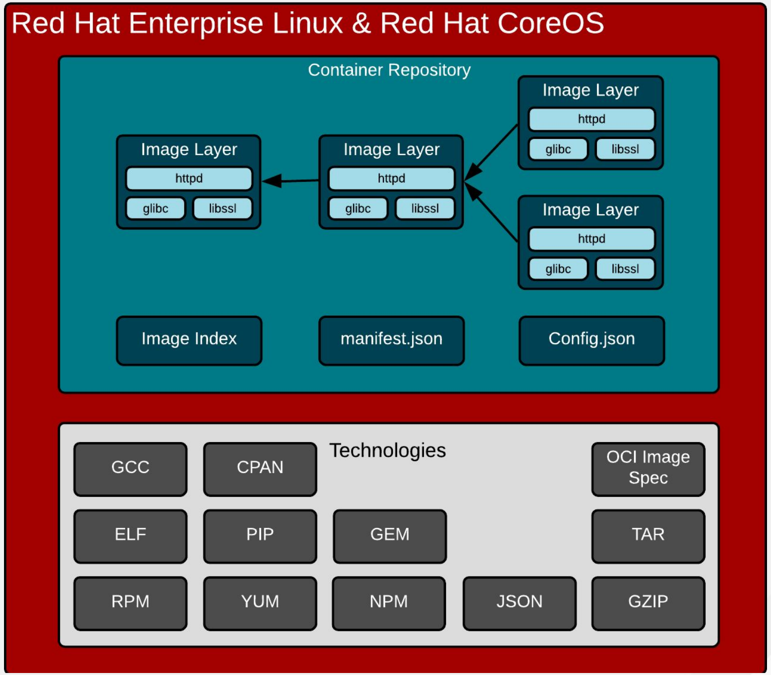


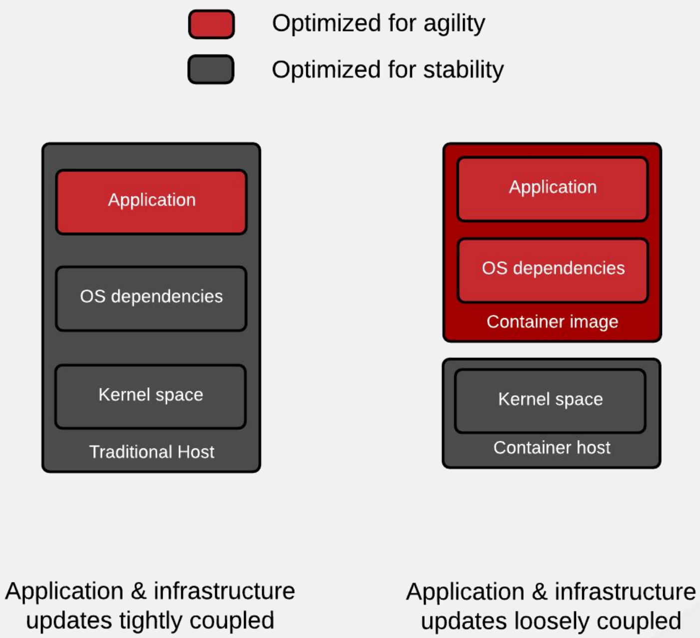
CONTAINER REGISTRIES

REGISTRY SERVERS

Better than virtual appliance market places :-)

Defines a standard way to:

- Find images
- Run images
- Build new images
- Share images
- Pull images
- Introspect images
- Shell into running container
- Etc, etc, etc

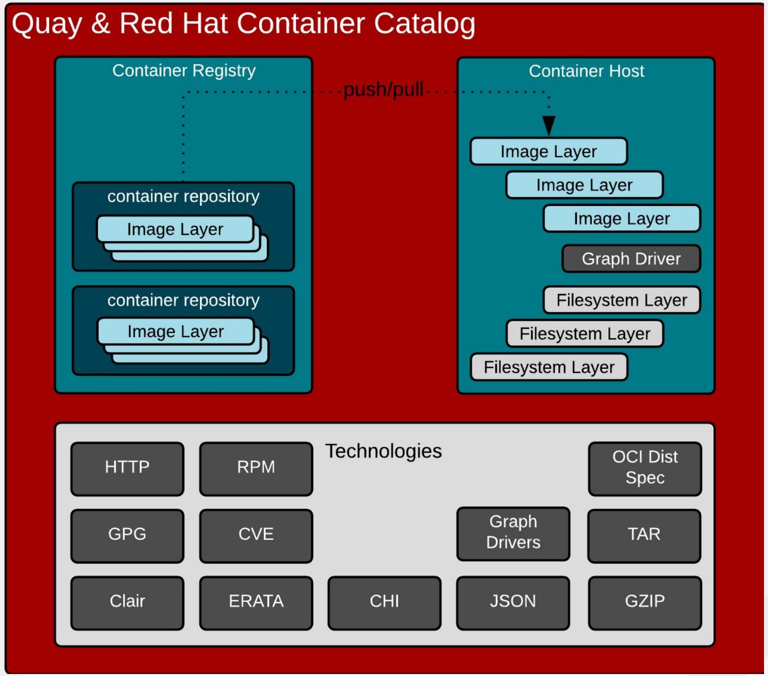


CONTAINER REGISTRY & STORAGE

Mapping image layers

Covering push, pull, and registry:

- Rest API (blobs, manifest, tags)
- Image Scanning (clair)
- CVE Tracking (errata)
- Scoring (Container Health Index)
- Graph Drivers (overlay2, dm)
- Responsible for maintaining chain of custody for secure images from registry to container host

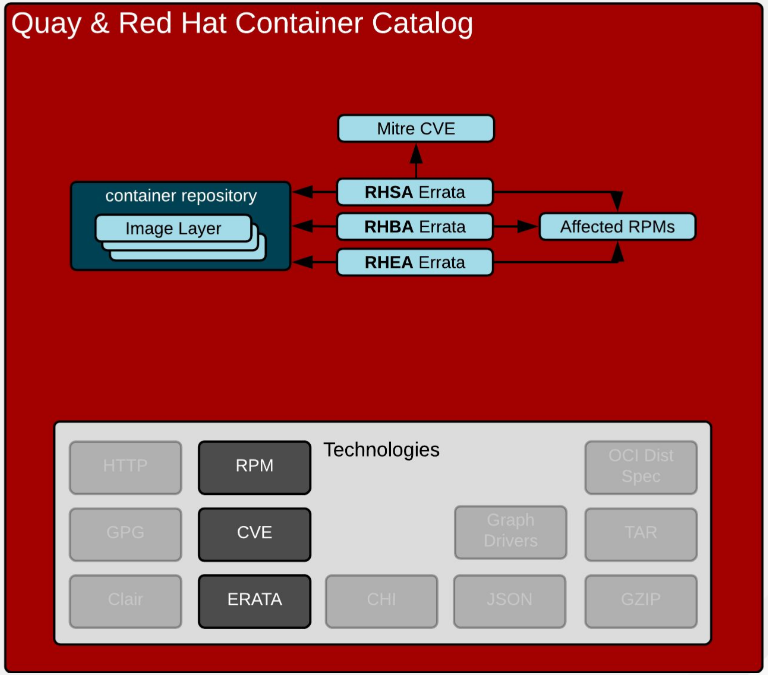


START WITH QUALITY REPOSITORIES

Repositories depend on good packages

Determining the quality of repository requires meta data:

- Errata is simple to explain, hard to build
    - Security Fixes
    - Bug Fixes
    - Enhancements
- Per container images layer (tag), often maps to multiple packages

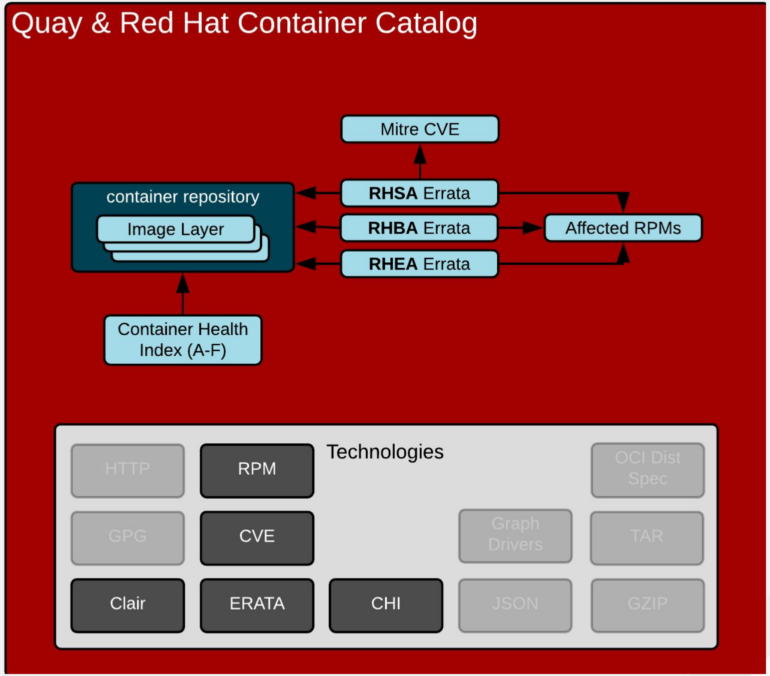


SCORING REPOSITORIES

Images age like cheese, not like wine

Based on severity and age of Security Errata:

- Trust is temporal
- Even good images go bad over time because the world changes around you

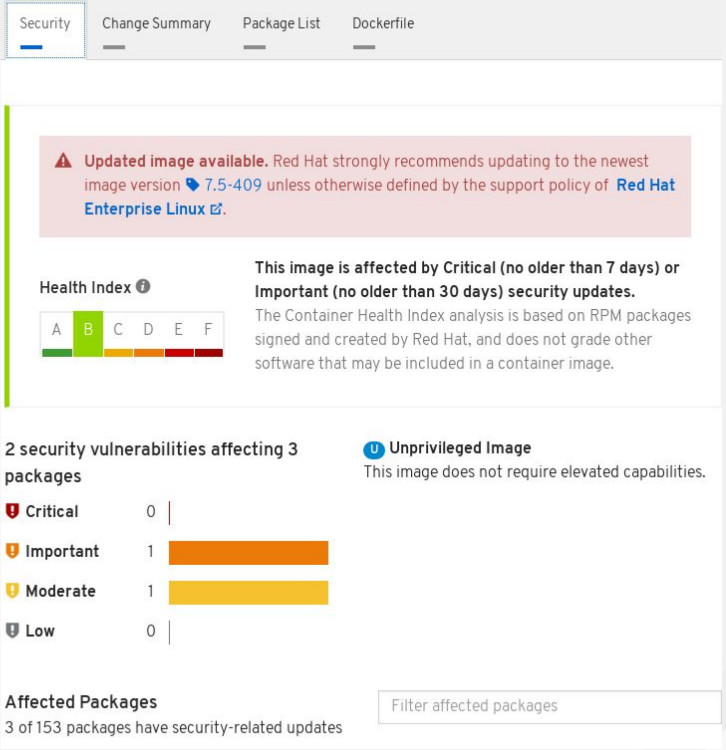


SCORING REPOSITORIES

Container Health Index

Based on severity and age of Security Errata:

- Trust is temporal
- Images must constantly be rebuilt to maintain score of “A”



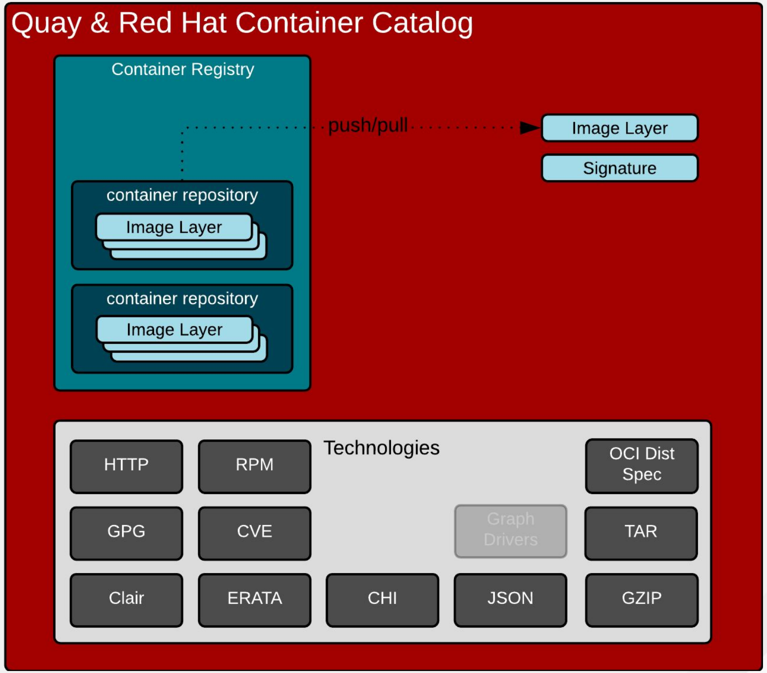
redhat.

PUSH, PULL & SIGNING

Signing and verification before/after transit

Registry has all of the image layers and can have the signatures as well:

- Download trusted thing
- Download from trusted source
- Neither is sufficient by itself



PUSH, PULL & SIGNING

Mapping image layers

Command:	docker pull registry.access.redhat.com/rhel7/rhel:latest						
Decomposition:	access.registry.redhat.com	/	rhel7	/	rhel	:	latest
Generalization:	Registry Server	/	namespace	/	repo	:	tag

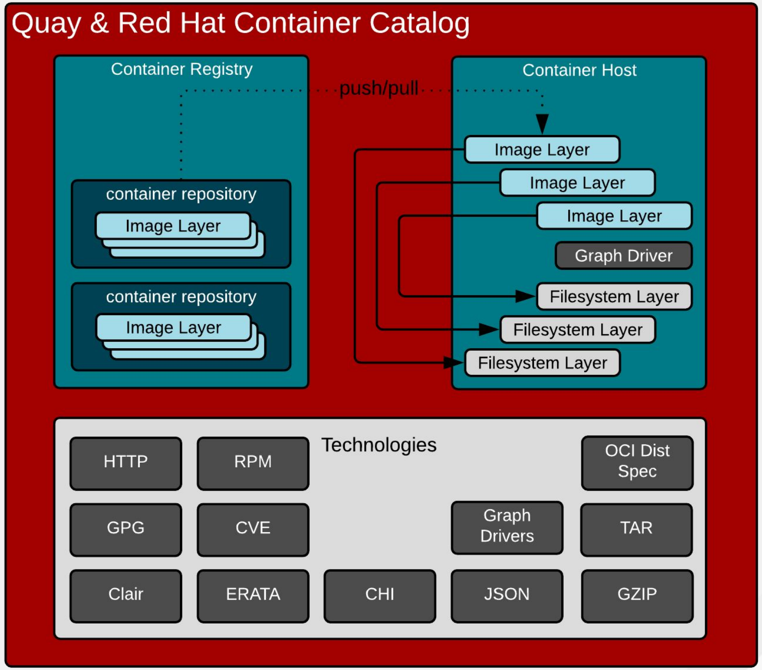
redhat.

GRAPH DRIVERS

Mapping layers uses file system technology

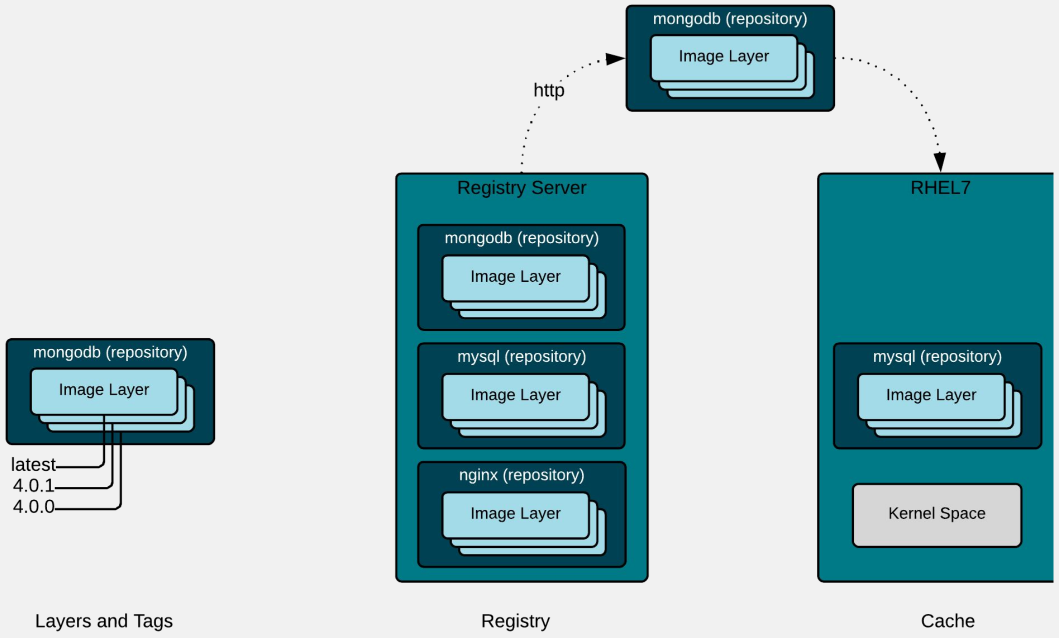
Local cache maps each layer to volume or filesystem layer:

- Overlay2 file system and container engine driver
- Device Mapper volumes and container engine driver



PUSH, PULL & SIGNING

Mapping image layers



CONTAINER REGISTRY & STORAGE

Mapping image layers

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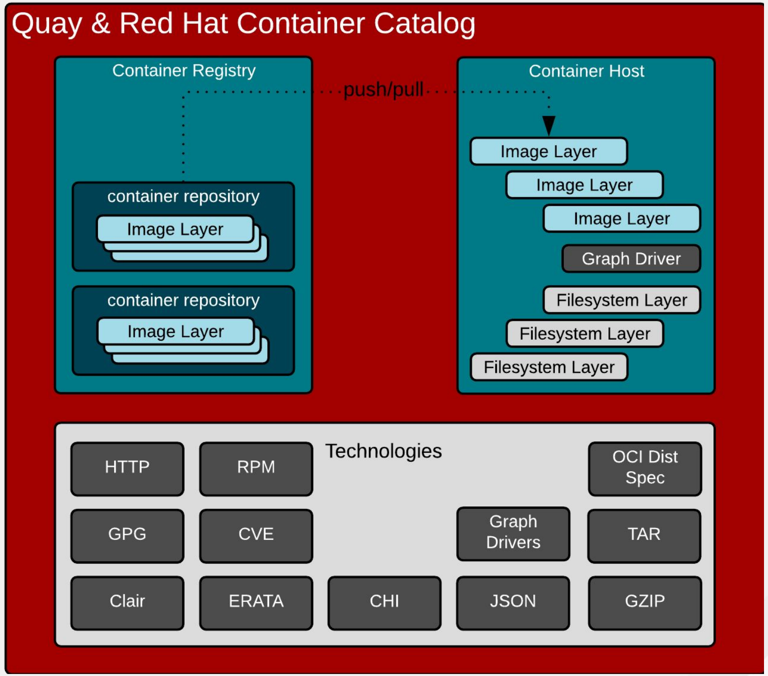


CONTAINER HOSTS

CONTAINER HOST BASICS

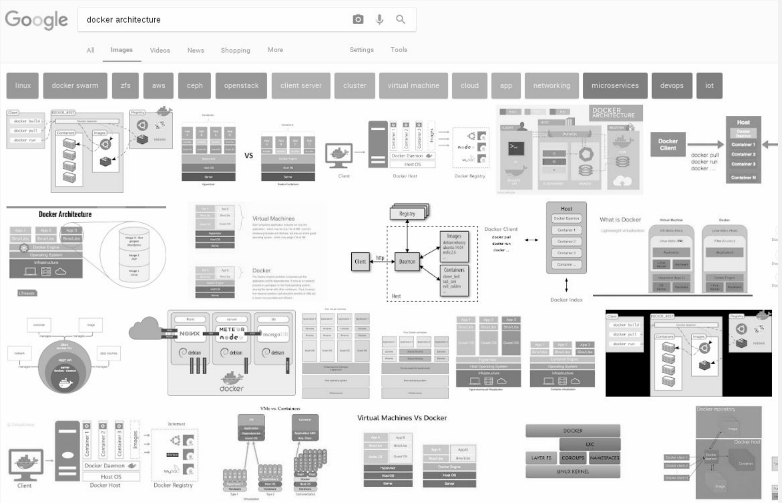
Container Engine, Runtime, and Kernel

CONTAINERS DON'T RUN ON DOCKER

The Internet is WRONG :-)

Important corrections

- Containers do not run ON docker. Containers are processes - they run on the Linux kernel. Containers are Linux processes (or Windows).
- The docker daemon is one of the many user space tools/libraries that talks to the kernel to set up containers

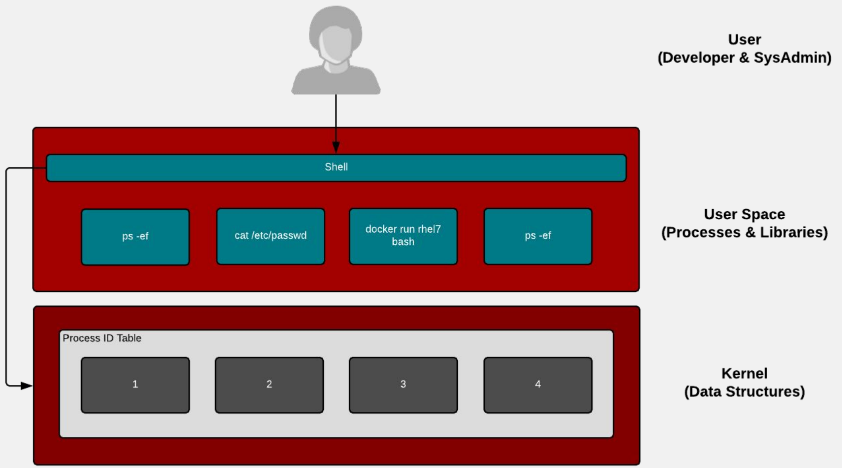


PROCESSES VS. CONTAINERS

Actually, there is no processes vs. containers in the kernel

User space and kernel work together

- There is only one process ID structure in the kernel
- There are multiple human and technical definitions for containers
- Container engines are one technical implementation which provides both a methodology and a definition for containers

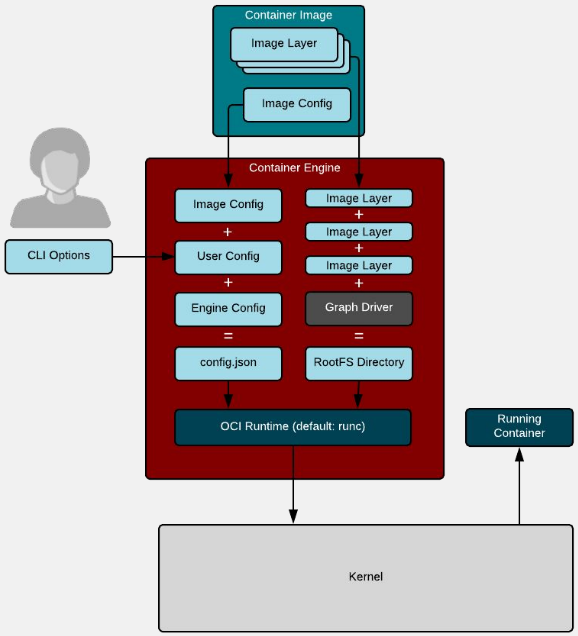


THE CONTAINER ENGINE IS BORN

This was a new concept introduced with Docker Engine and CLI

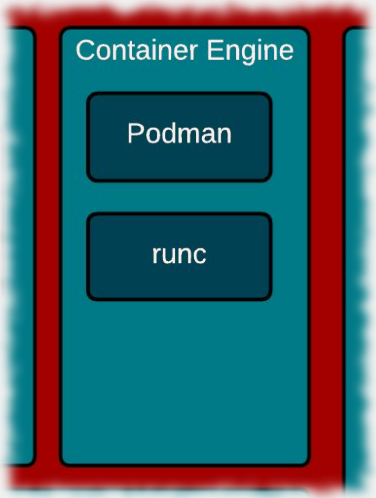
Think of the Docker Engine as a giant proof of concept - and it worked!

- Container images
- Registry Servers
- Ecosystem of pre-built images
- Container engine
- Container runtime (often confused)
- Container image builds
- API
- CLI
- A LOT of moving pieces

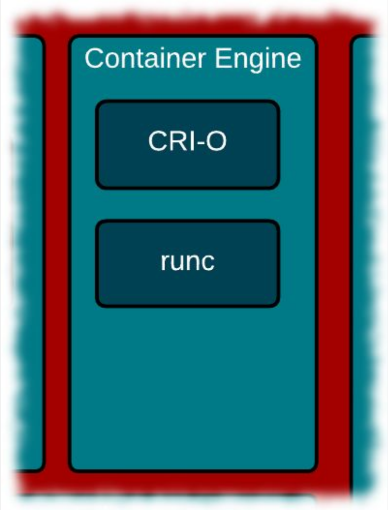


DIFFERENT ENGINES

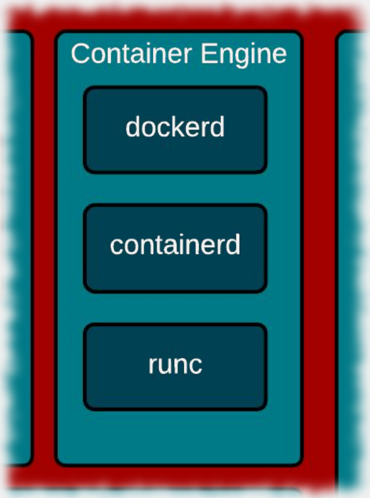
All of these container engines are OCI compliant



Podman



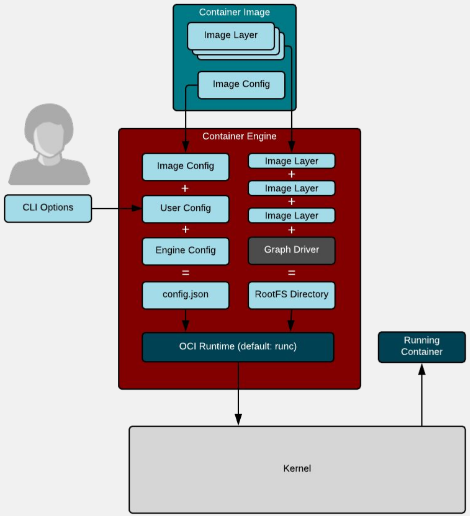
CRI-O



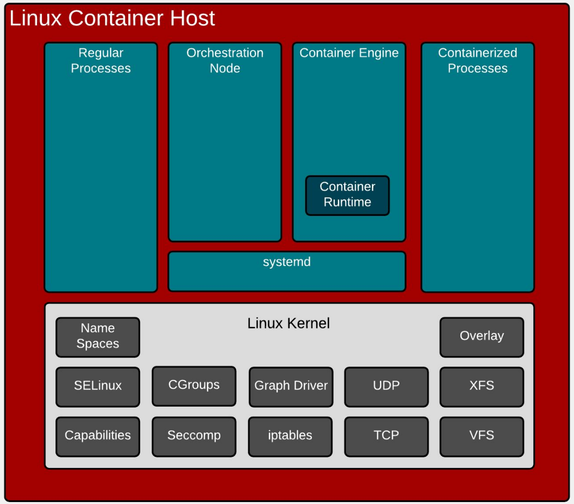
Docker

CONTAINER ENGINE VS. CONTAINER HOST

In reality the whole container host is the engine - like a Swiss watch



VS.

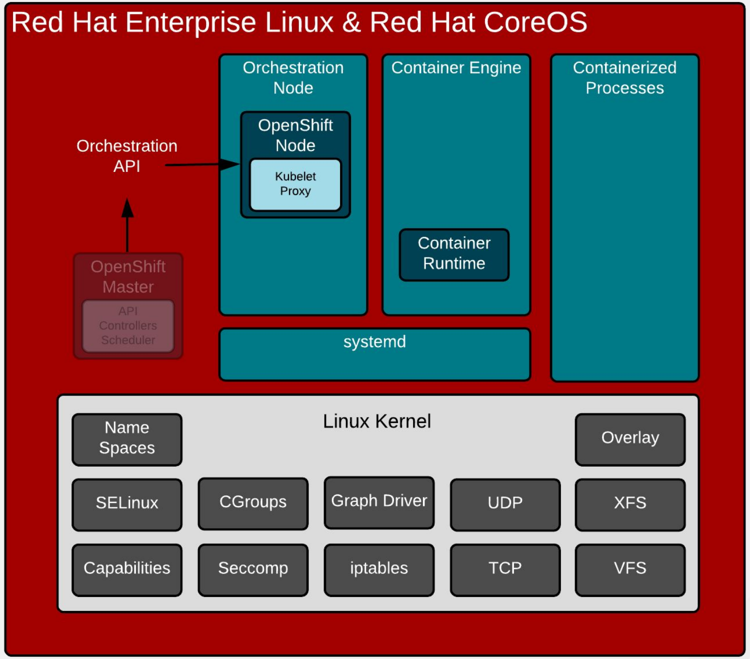


CONTAINER HOST

Released, patched, tested together

Tightly coupled communication through the kernel - all or nothing feature support:

- Operating System (kernel)
- Container Runtime (runc)
- Container Engine (Docker)
- Orchestration Node (Kubelet)
- Whole stack is responsible for running containers



CONTAINER ENGINE

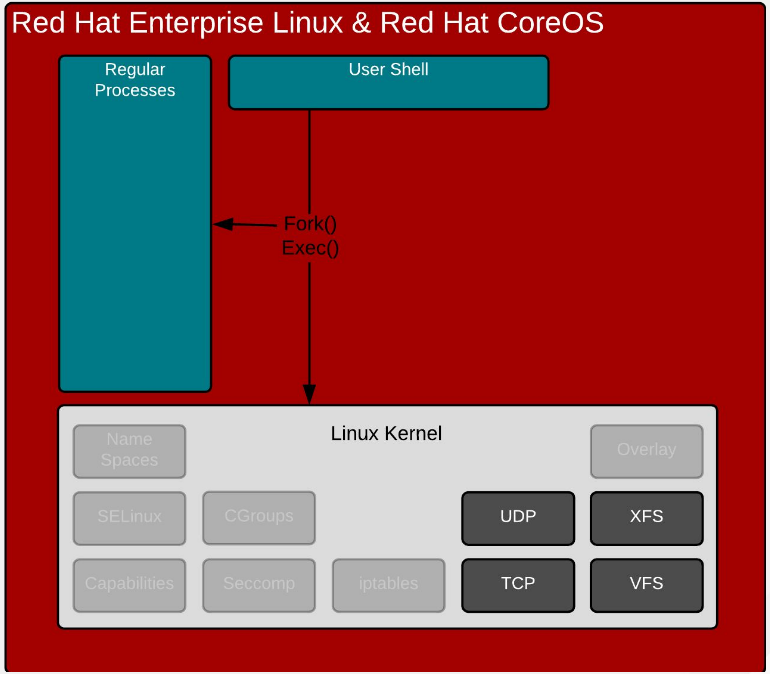
Defining a container

KERNEL

Creating regular Linux processes

Normal processes are created, destroyed, and managed with system calls:

- Fork() - Think Apache
- Exec() - Think ps
- Exit()
- Kill()
- Open()
- Close()
- System()

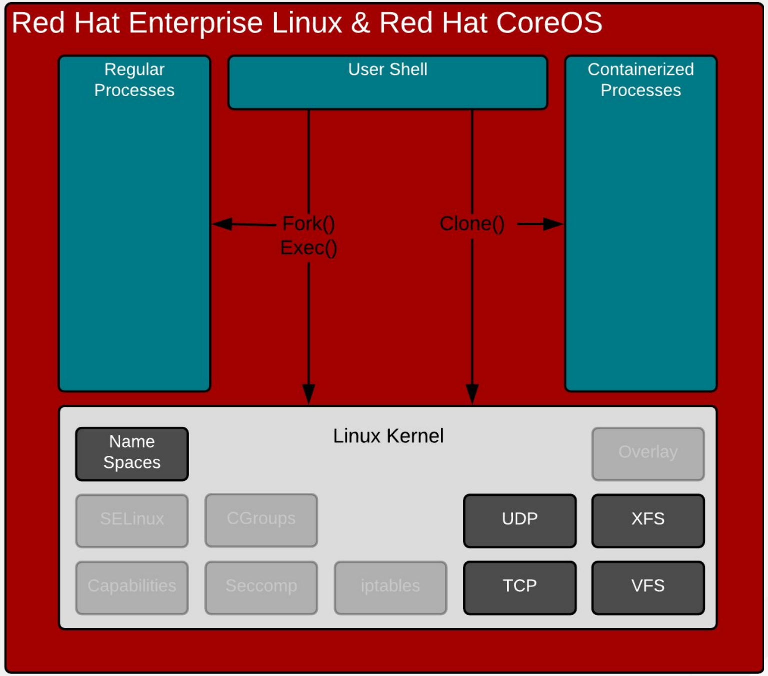


KERNEL

Creating “containerized” Linux processes

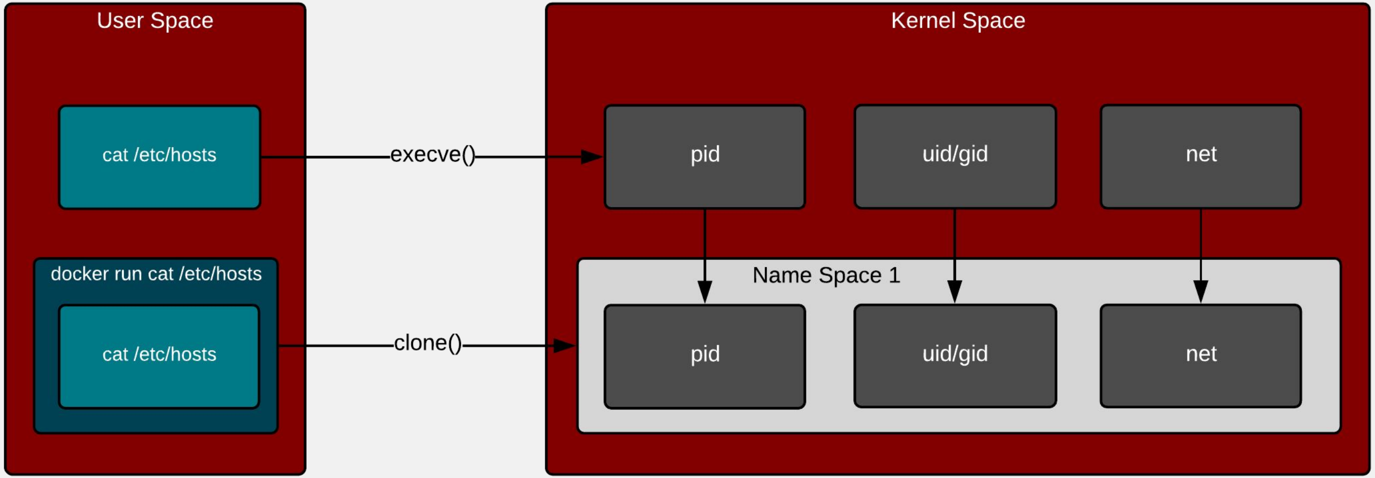
What is a container anyway?

- No kernel definition for what a container is - only processes
- Clone() - closest we have
- Creates namespaces for kernel resources
  - Mount, UTC, IPC, PID, Network, User
- Essentially, virtualized data structures



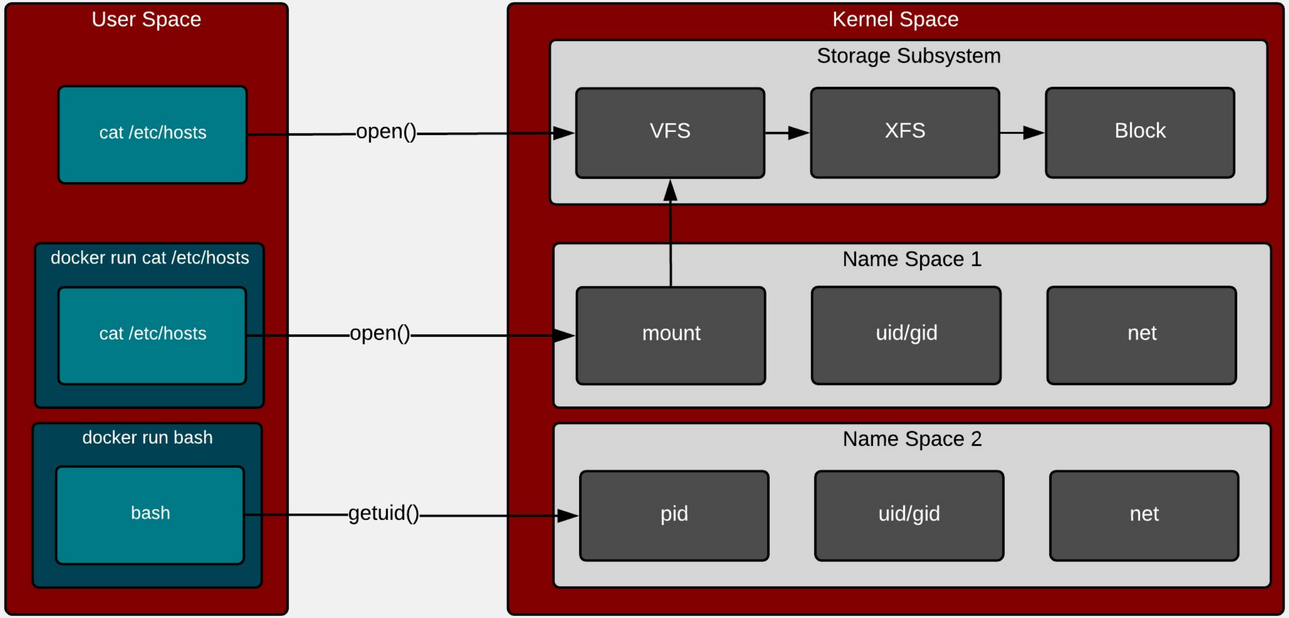
KERNEL

Namespaces are all you get with the clone() syscall



KERNEL

Even namespaced resources use the same subsystem code

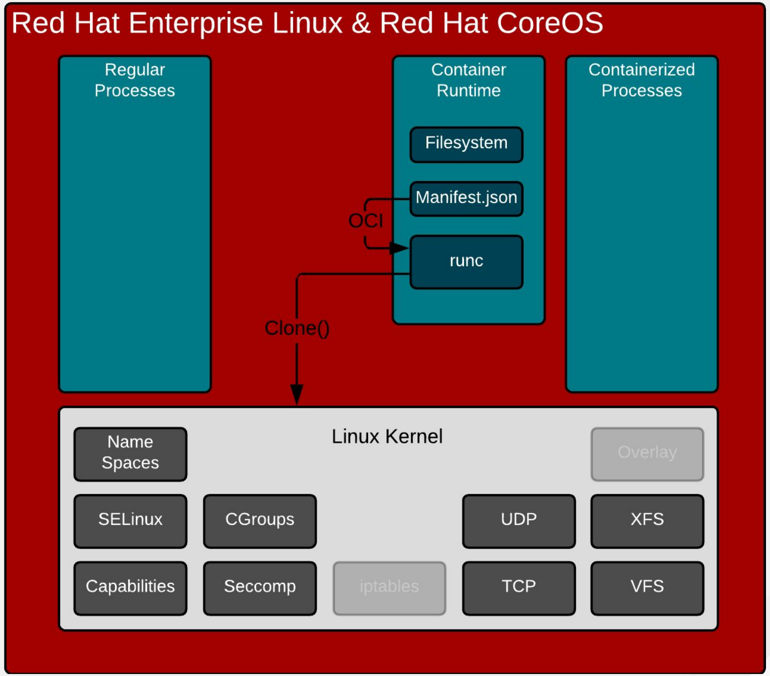


CONTAINER RUNTIME

Standarding the way user space communicates with the kernel

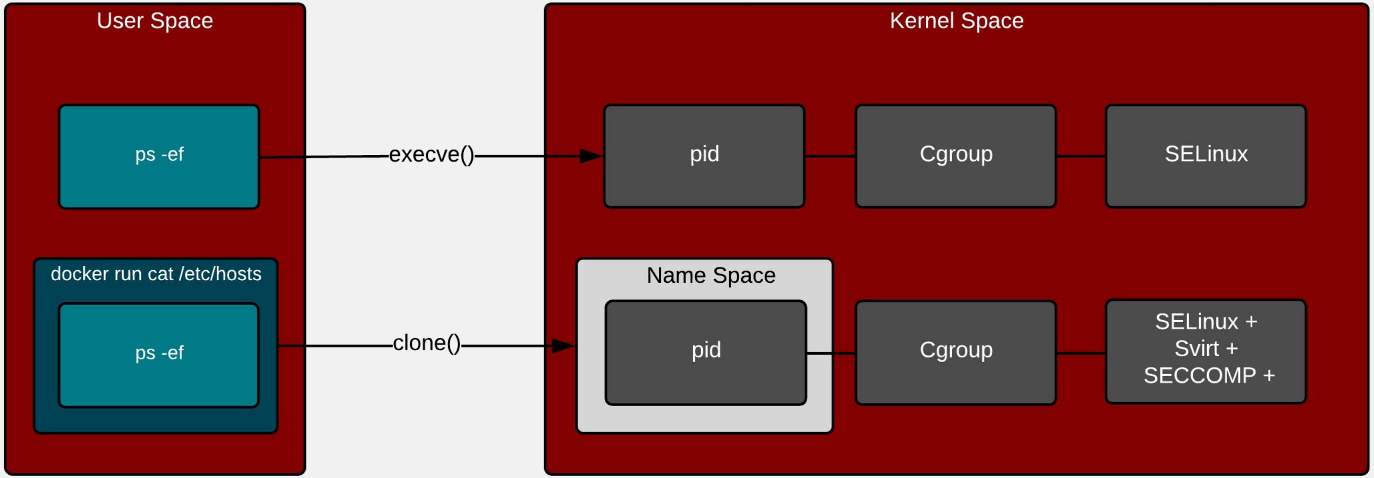
Expects some things from the user:

- OCI Manifest - json file which contains a familiar set of directives - read only, seccomp rules, privileged, volumes, etc
- Filesystem - just a plain old directory which has the extracted contents of a container image



CONTAINER RUNTIME

Adds in cgroups, SELinux, sVirt, and SECCOMP

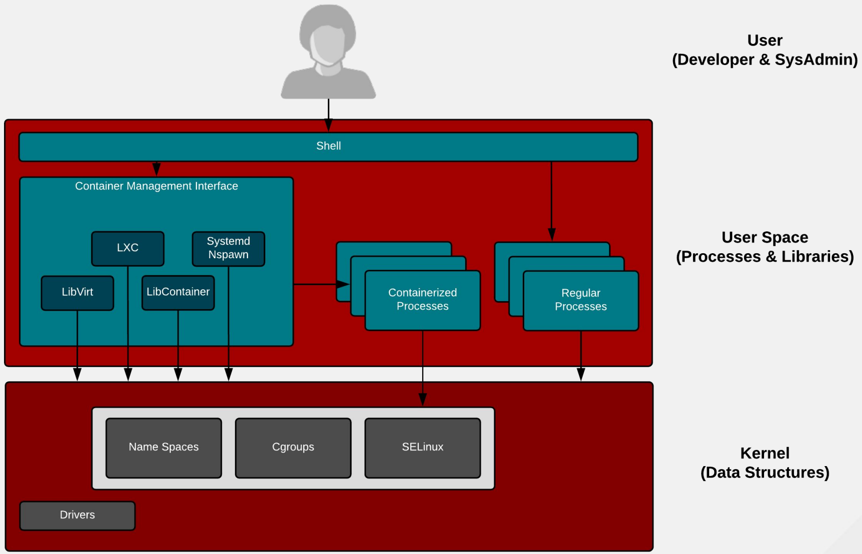


CONTAINER RUNTIME

But, there were others before runc, what's the deal?

There is a rich history of standardization attempts in Linux:

- LibVirt
- LXC
- Systemd Nspawn
- LibContainer (eventually became runc)

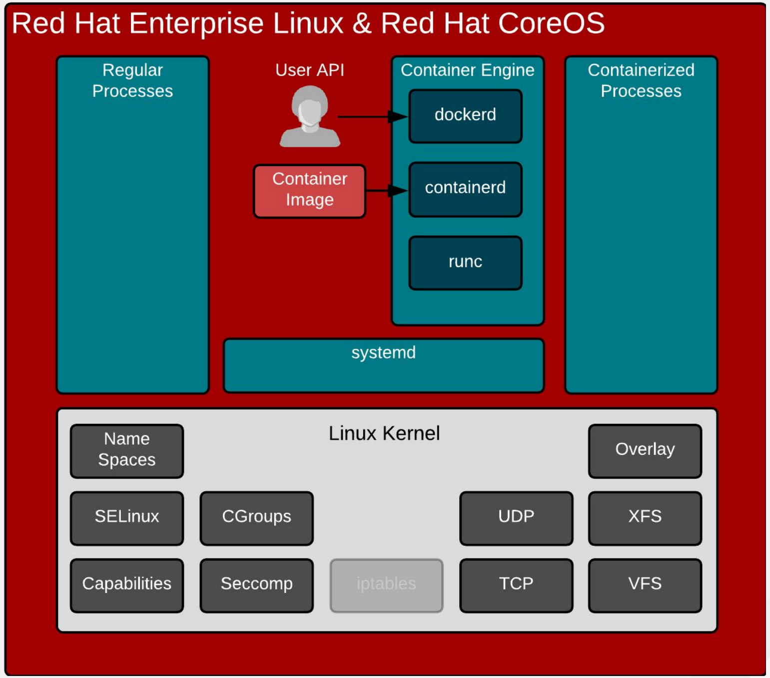


CONTAINER ENGINE

Provides an API prepares data & metadata for runc

Three major jobs:

- Provide an API for users and robots
- Pulls image, decomposes, and prepares storage
- Prepares configuration - passes to runc

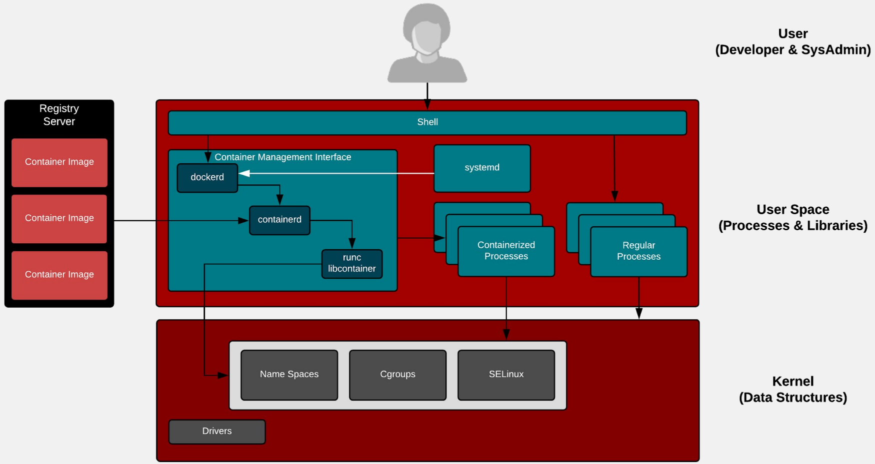


PROVIDE AN API

Regular processes, daemons, and containers all run side by side

In action:

- Number of daemons & programs working together
  - dockerd
  - containerd
  - runc

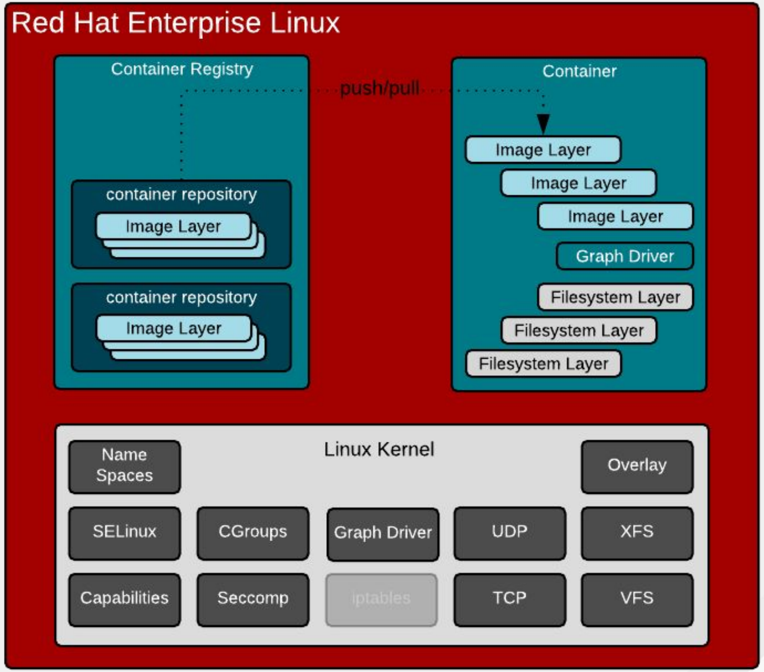


PULL IMAGES

Mapping image layers

Pulling, caching and running containers:

- Most container engines use graph drivers which rely on kernel drivers (overlay, device mapper, etc)
- There is work going on to do this in user space, but there are typically performance trade offs

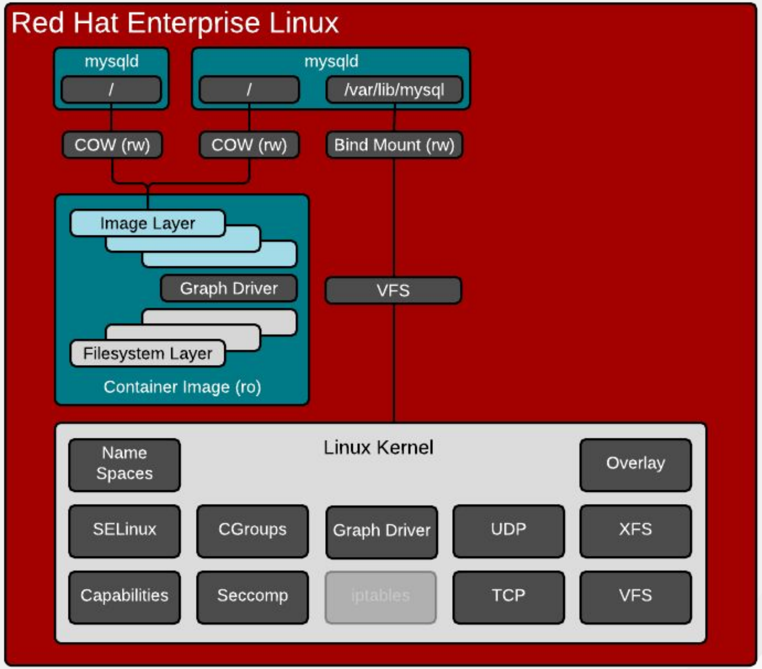


PREPARE STORAGE

Copy on write and bind mounts

Understanding implications of bind mounts:

- Copy on write layers can be slow when writing lots of small files
- Bind mounted data can reside on any VFS mount (NFS, XFS, etc)

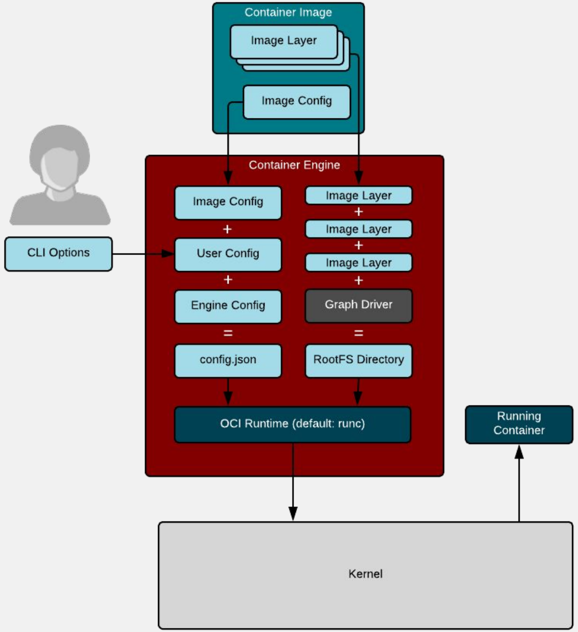


PREPARE CONFIGURATION

Combination of image, user, and engine defaults

Three major inputs:

- User inputs can override defaults in image and engine
- Image inputs can override engine defaults
- Engine provides sane defaults so that things work out of the box

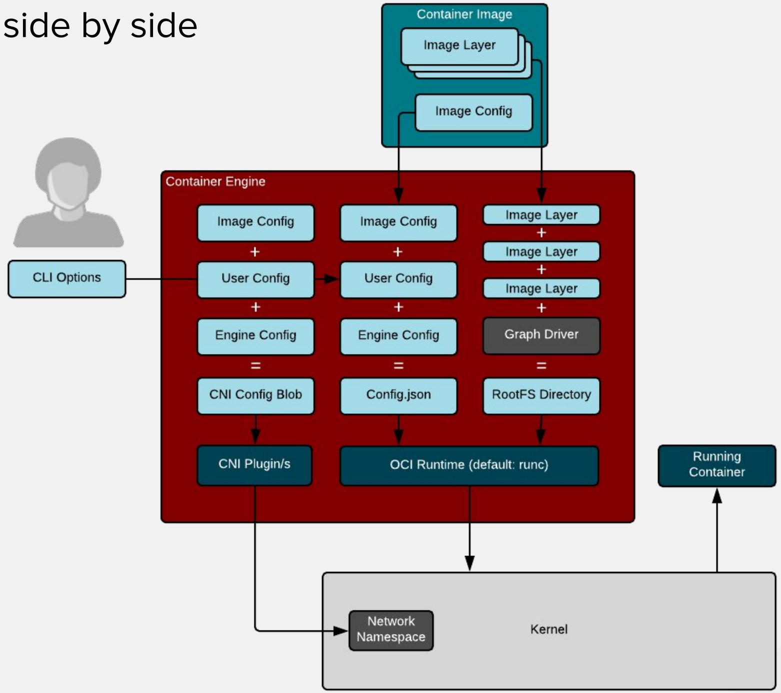


PREPARE CONFIGURATION + CNI

Regular processes, daemons, and containers all run side by side

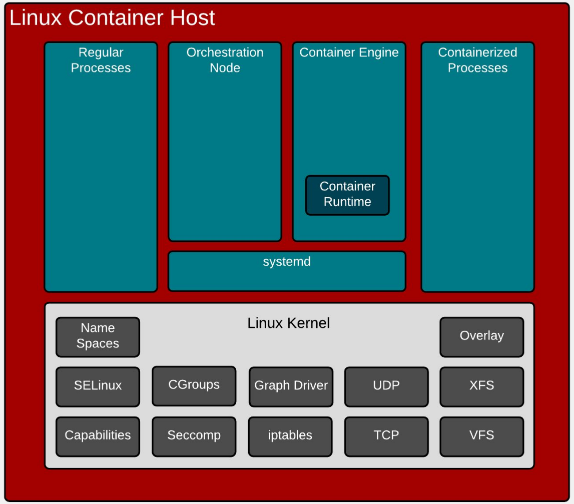
In action:

- Takes user specified options
- Pulls image, expands, and parses metadata
- Creates and prepares CNI json blob
- Hands CNI blob and environment variables to one or more plugins (bridge, portmapper, etc)



ENGINE, RUNTIME, KERNEL, AND MORE

All of these must revision together and prevent regressions together



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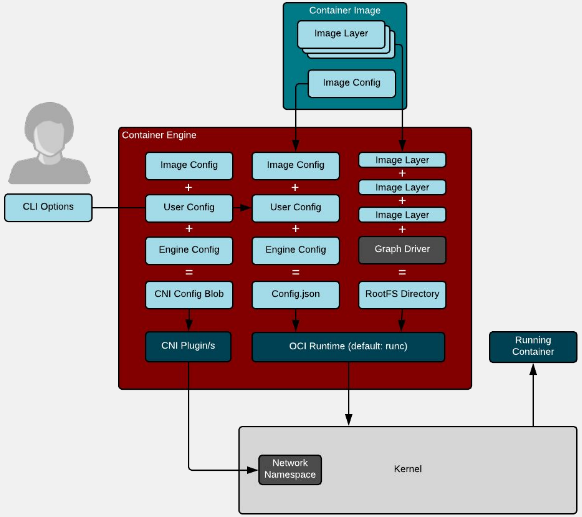


BONUS INFORMATION

Other related technology

Containers With Advanced Isolation

Kata Containers, gVisor, and *KubeVirt (because deep down inside you want to know)*

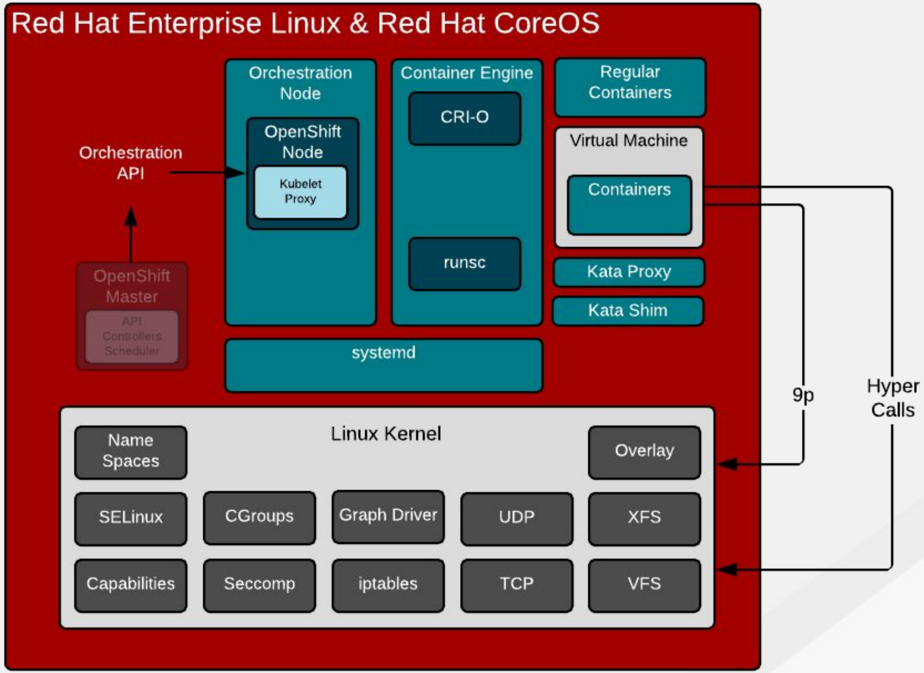
- **Kata Containers** integrate at the container runtime layer
- **gVisor** integrates at the container runtime layer
- **KubeVirt** not advanced container isolation. Add-on to Kubernetes which extends it to schedule VM workloads side by side with container workloads

Kata Containers

Containers in VMs

You still need connections to the outside world:

- Shim offers reaping of processes/VMs similar to normal containers
- Proxy allows serial access into container in VM
- P9fs is the communication channel for storage



gVisor

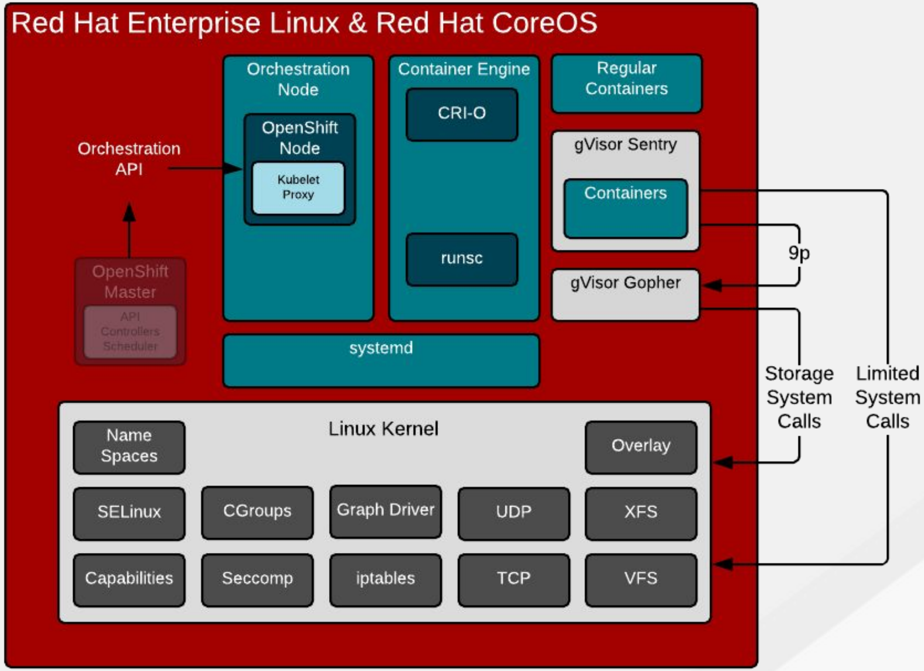
Anybody remember user mode Linux?

gVisor is:

- Written in golang
- Runs in userspace
- Reimplements syscalls
- Reimplements hardware
- Uses 9p for storage

Concerns

- Storage performance
- Limited syscall implementation



KubeVirt

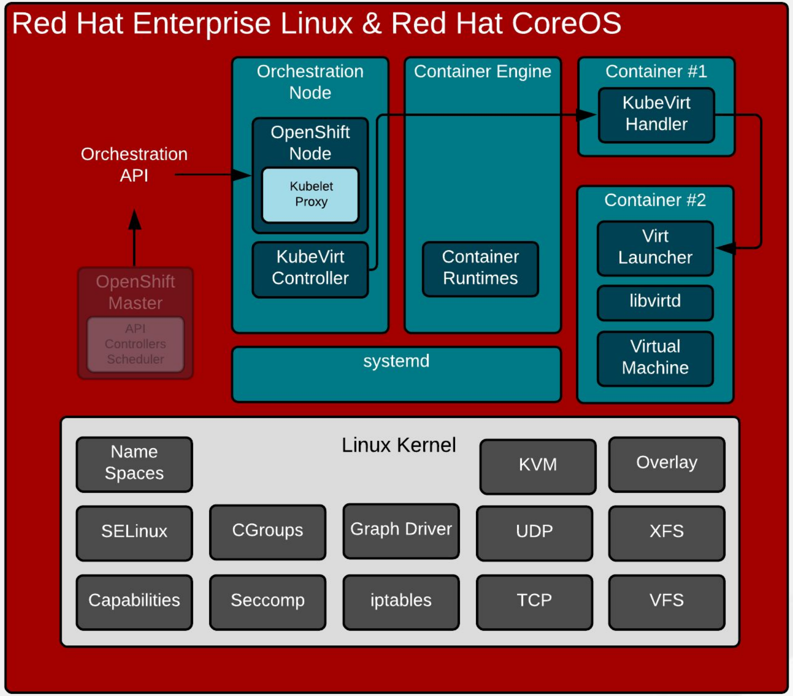
Extension of Kubernetes for running VMs

KubeVirt is:

- Custom resource in Kubernetes
- Defined/actual state VMs
- Good for VM migrations
- Uses persistent volumes for VM disk

KubeVirt is not:

- Stronger isolation for containers
- Part of the Container Engine
- A replacement Container Runtime
- Based on container images



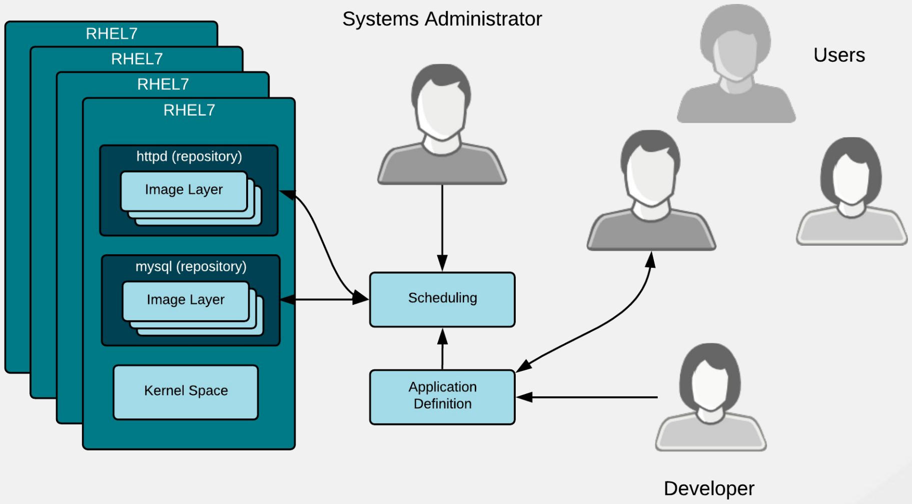
CONTAINER ORCHESTRATION

KUBERNETES & OPENSHIFT

It’s a 10 ton dump truck that handles pretty well at 200 MPH

Two major jobs:

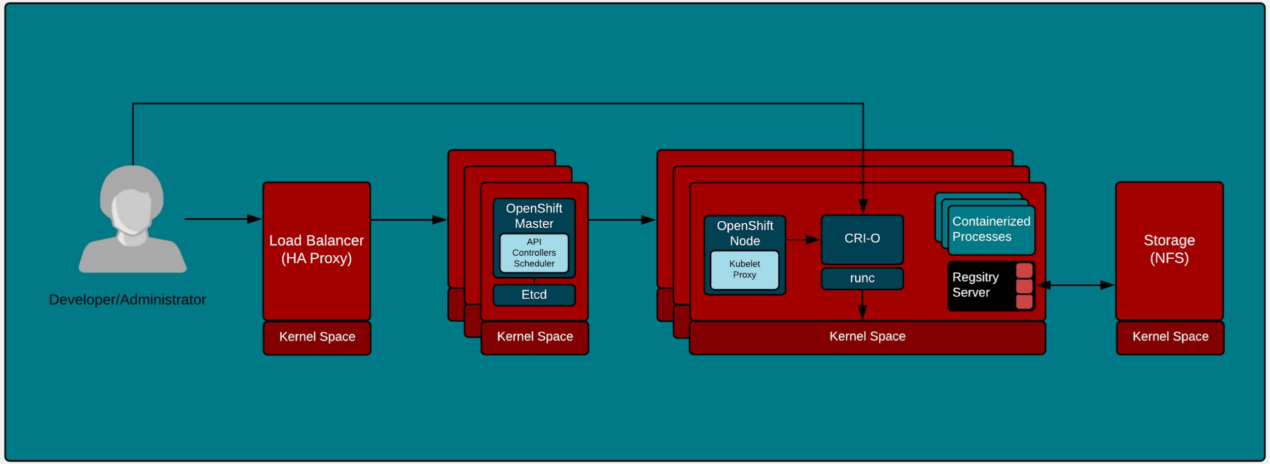
- Scheduling - distributed systems computing. Resolving where to put containers in the cluster and allowing users to connect to them
- Provide an API - can be consumed by users or robots. Defines a model state for the application. Completely new way of thinking.



SCHEDULING CONTAINERS

Defining the desired state

- Requires thinking in a completely new way - distributed systems
- Fault tolerance must be designed into the system

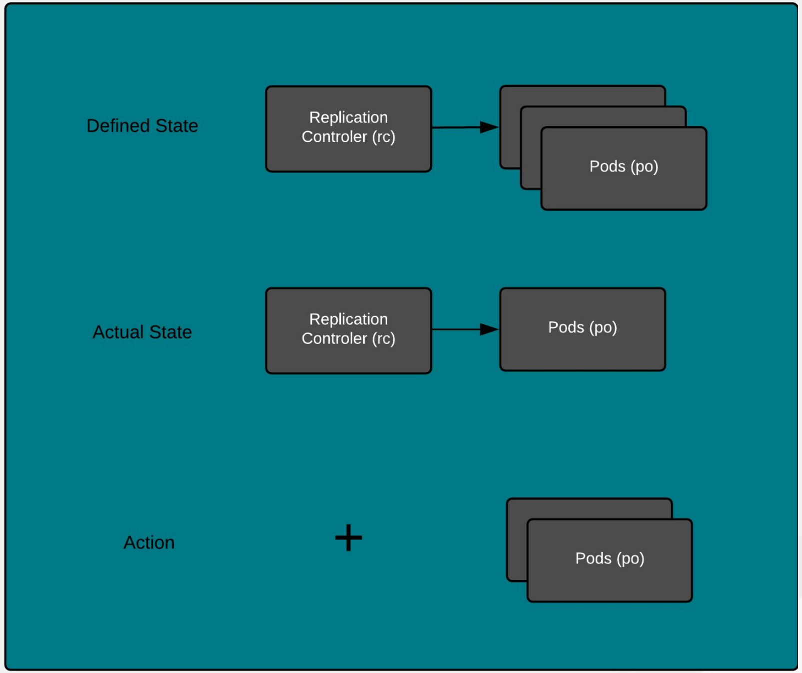


MODELING THE APPLICATION

Defining the desired state

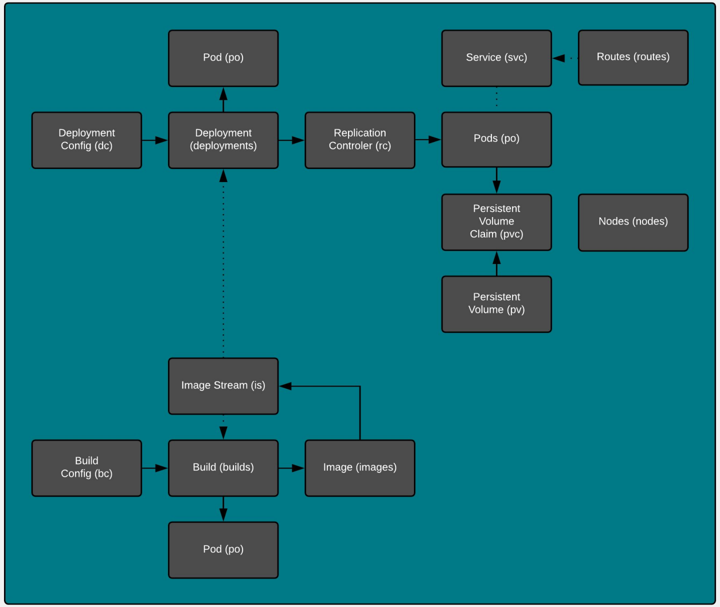
Modeling the application using defined state, actual state. Resolving discrepancies:

- The end user defines the desired state
- The system continuously resolves discrepancies by taking action
- Automation can also modify the desired state - Inception



ADVANCED MODELING

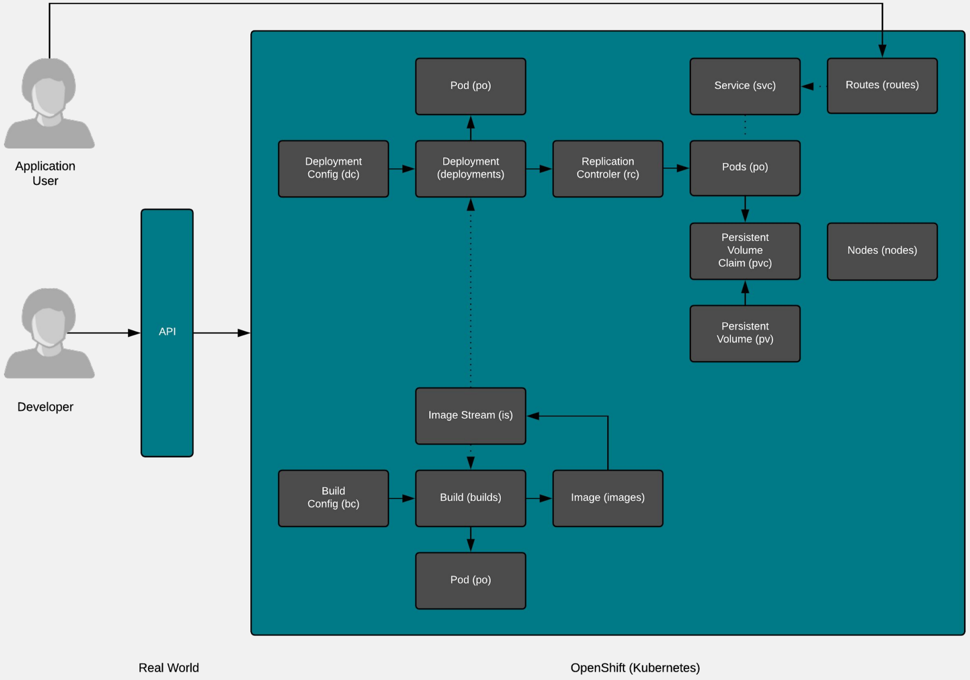
Many other resource can be defined



OpenShift (Kubernetes)

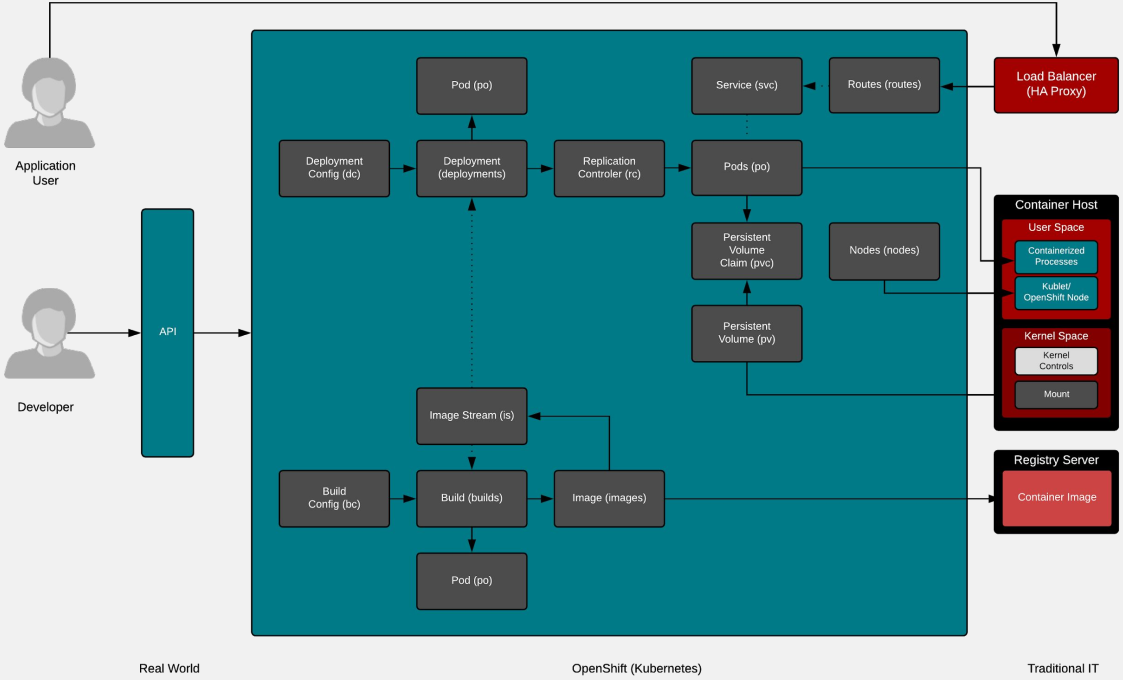
ADVANCED MODELING

Humans interact with these resource through defined state



ADVANCED MODELING

These resources are virtual, but map to real world infrastructure



ADVANCED MODULES

AGENDA

Advanced - Linux Container Internals

Container Standards
Understanding OCI, CRI, CNI, and more

Container Tools Ecosystem
Podman, Buildah, and Skopeo

Production Image Builds
Sharing and collaboration between specialists

Intermediate Architecture
Production environments

Advanced Architecture
Building in resilience

Container History
Context for where we are today

CONTAINER STANDARDS

THE PROBLEM

With no standard, there is no way to automate. Each box is a different size, has different specifications. No ecosystem of tools can form.

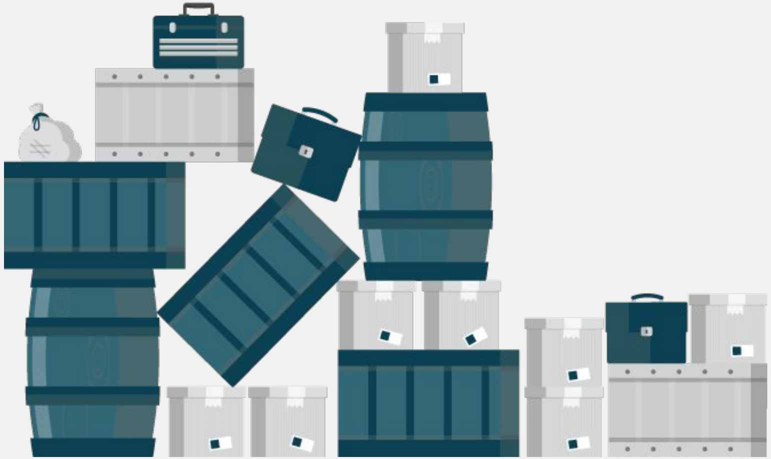


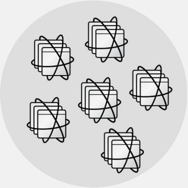
Image: Boxes manually loaded on trains and ships in 1921

WHY STANDARDS MATTER TO YOU

Click to add subtitle

Protect customer investment

The world of containers is moving very quickly. Protect your investment in training, software, and building infrastructure.



Enable ecosystems of products and tools to to form

Cloud providers, software providers, communities and individual contributors can all build tools.

Allow communities with competing interests to work together

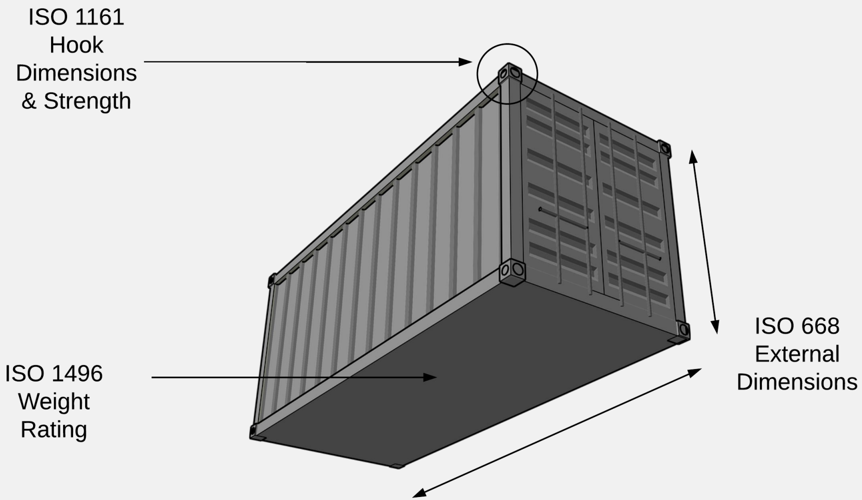
There are many competing interests, but as a community we have common goals.

SIMILAR TO REAL SHIPPING CONTAINERS

Standards in different places achieve different goals

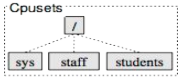
The analogy is strikingly good. The importance of standards is critical:

- Failures are catastrophic in a fully automated environments, such as port in Shanghai (think CI/CD)
- Something so simple, requires precise specification for interoperability (Files & Metadata)
- Only way to protect investment in equipment & infrastructure (container orchestration & build processes)



How did we get here?

- 1979: UNIX — CHROOT SYSCALL ADDED
- 2000: JAILS ADDED TO FREEBSD
- 2001: LINUX -VSERVER PROJECT
- 2003: SELINUX ADDED TO LINUX MAINLINE
- 2005: FULL RELEASE OF SOLARIS ZONES



- 2006: PROCESS CONFINEMENT
- 2007: GPC RENAMED CGROUPS
- 2008: KERNEL & USER NAMESPACES
- 2008: LINUX CONTAINER PROJECT (LXC)

- 2013: DOTCLOUD PYCON LIGHTNING TALK
- 2013: DOTCLOUD BECOMES DOCKER
- 2013: RED HAT ENTERPRISE LINUX
- 2014: GOOGLE KUBERNETES

1979 2000 2005 2010

redhat

Where are we going?

2015:
OPENSHIFT by Red Hat
RED HAT CONTAINER PLATFORM 3.0

2015:
STANDARDS VIA OCI AND CNCF

TECTONIC by CoreOS
2015:
Tectonic Announced

2016:
Skopeo project launched under the name OCID

docker
2016:
Docker engine 1.12 adds swarm

2016:
CRI-O project launched under the name OCID

2016:
Containerd project launched

2017:
Moby project Announced

2017:
V1.0 of image & runtime spec

2017:
Buildah released and ships in RHEL

docker
2017:
Docker includes the new containerd

2017:
Kata merges Clear & RunV projects

2018:
V1.0 of distribution spec

2018:
CRI-O is GA and powers OpenShfit Online

2018:
Podman released and ships in RHEL

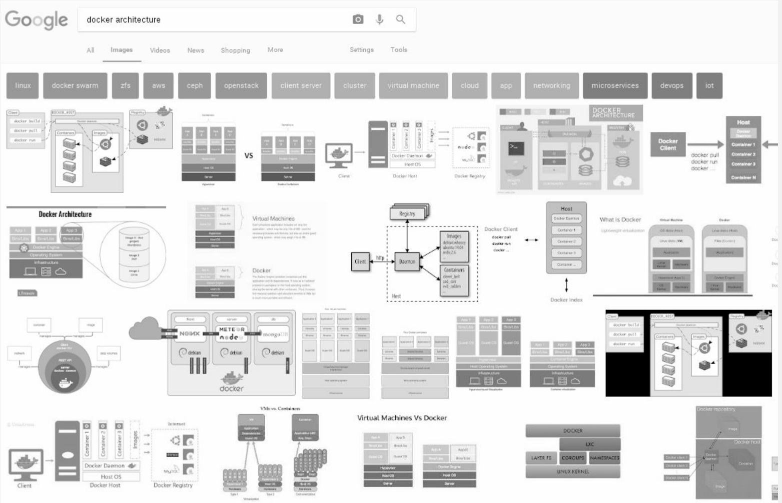
2015 2016 2017 2018

ARCHITECTURE

The Internet is WRONG :-)

Important corrections

- Containers do not run ON docker. Containers are processes - they run on the Linux kernel. Containers are Linux.
- The docker daemon is one of the many user space tools/libraries that talks to the kernel to set up containers



Containers Are Open

Established in June 2015 by Docker and other leaders in the container industry, the OCI currently contains three specifications which govern, building, running, and moving containers.

Standards Are Well Governed

- Governed by The Linux Foundation
- Ecosystem includes:
    - Vendors
    - Cloud Providers
    - Open Source Projects

OVERVIEW OF THE DIFFERENT STANDARDS

Vendor, Community, and Standards Body driven

- **Open Containers Initiative (OCI) Image Specification**
- **Open Containers Initiative (OCI) Distribution Specification**
- **Open Containers Initiative (OCI) Runtime Specification**
- **Container Runtime Interface (CRI)**
- **Container Network Interface (CNI)**

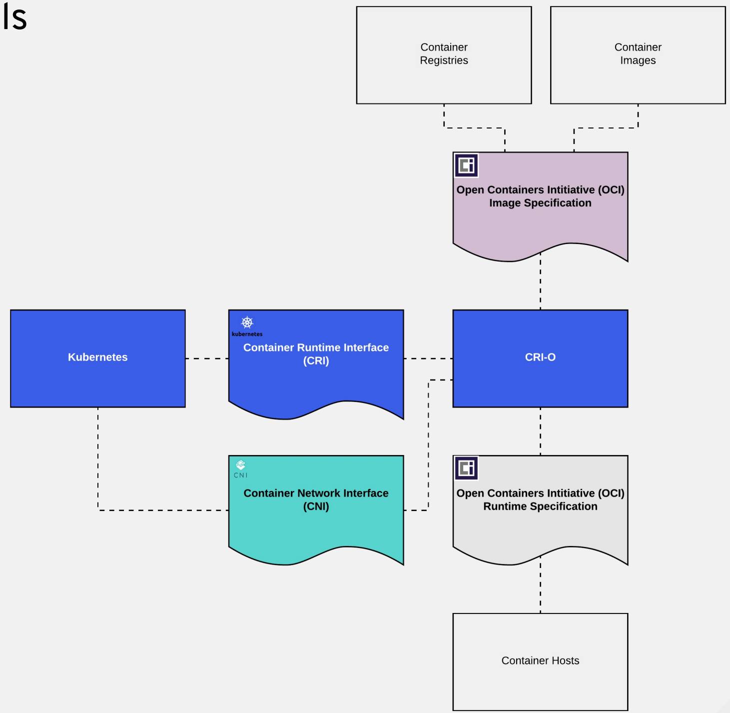
Many different standards

WORKING TOGETHER

Standards in different places achieve different goals

Different standards are focused on different parts of the stack.

- Container Images & Registries
- Container Runtimes
- Container Networking



WHAT ARE CONTAINERS ANYWAY?

Data and metadata

Container images need to express user's intent when built and run.

- How to run
- What to run
- Where to run

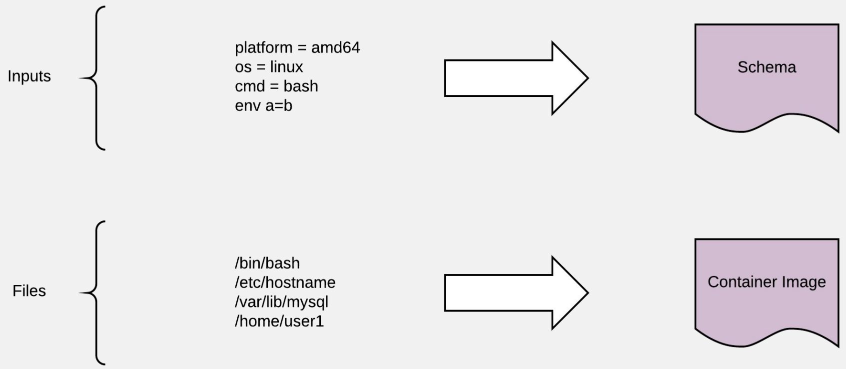
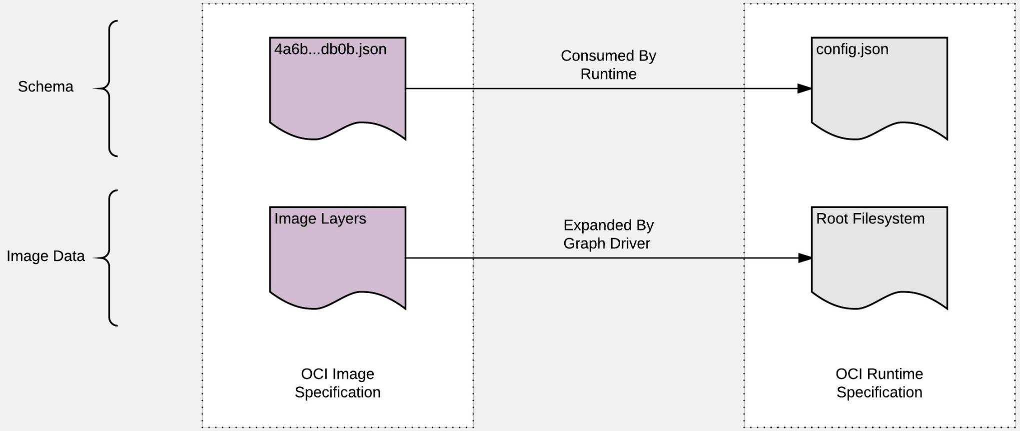


IMAGE AND RUNTIME SPECIFICATIONS

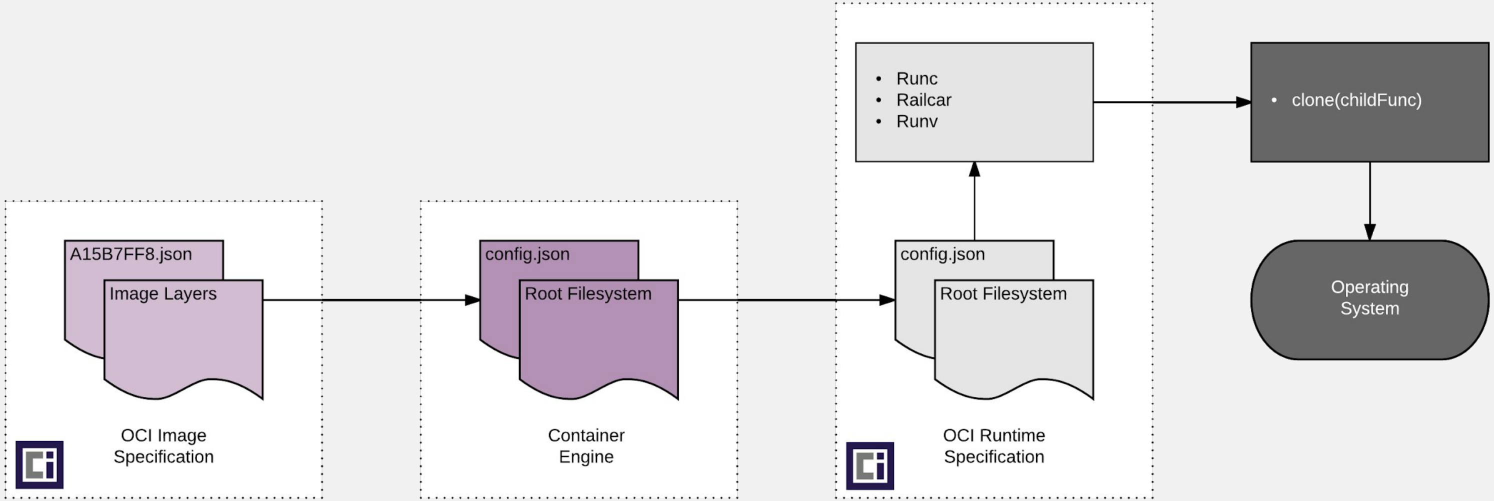
Powerful standards which enable communities and companies to build best of breed tools



Fancy files and fancy processes

WORKFLOW OF CONTAINERS

The building blocks of how a container goes from image to running process



Allows users to build container images with any tool they choose. Different tools are good for different use cases.

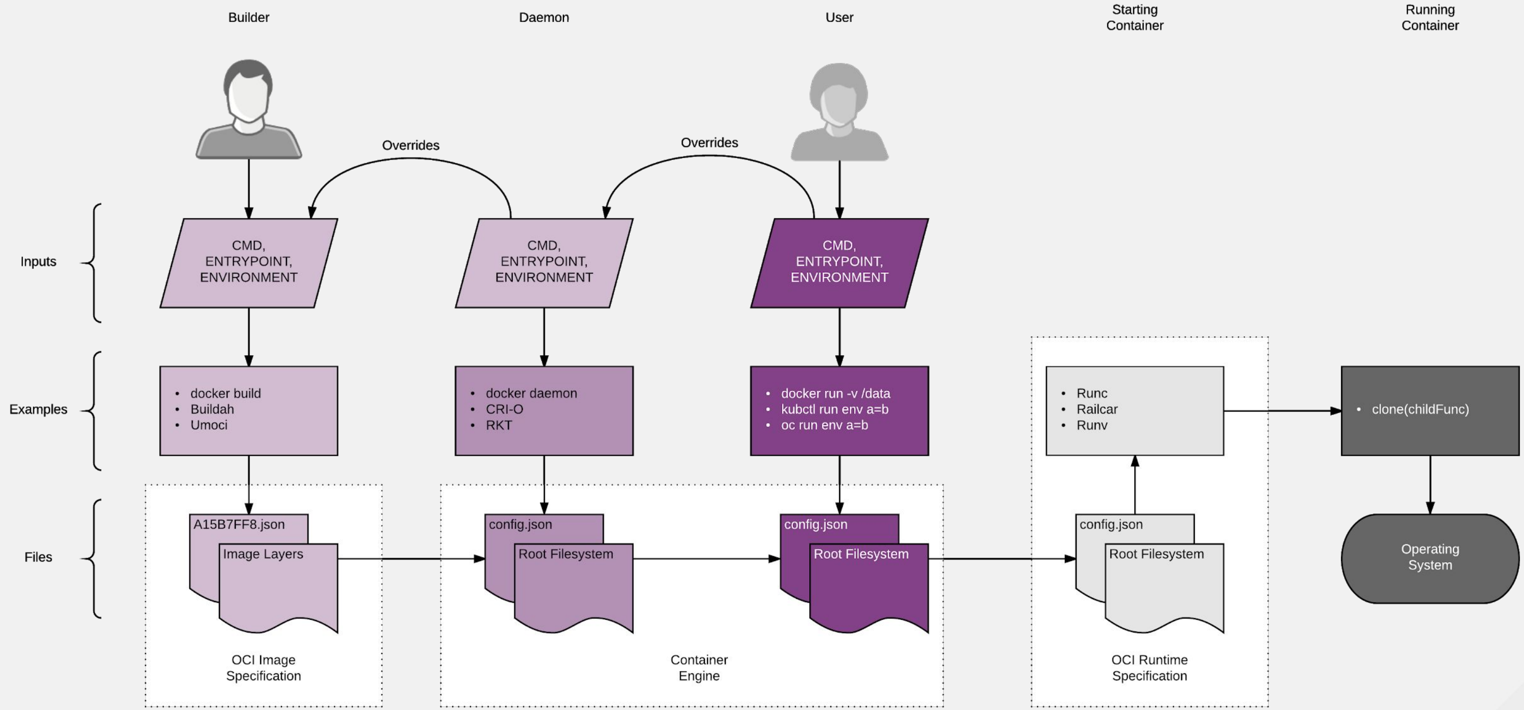
The container engine is responsible for creating the config.json file and unpacking images into a root file system.

OCI compliant runtimes can consume the config.json and root filesystem, and tell the kernel to create a container.

OCI compliant runtimes can be built for multiple operating systems including Linux, Windows, and Solaris

TYING IT ALL TOGETHER

These standards are extremely powerful

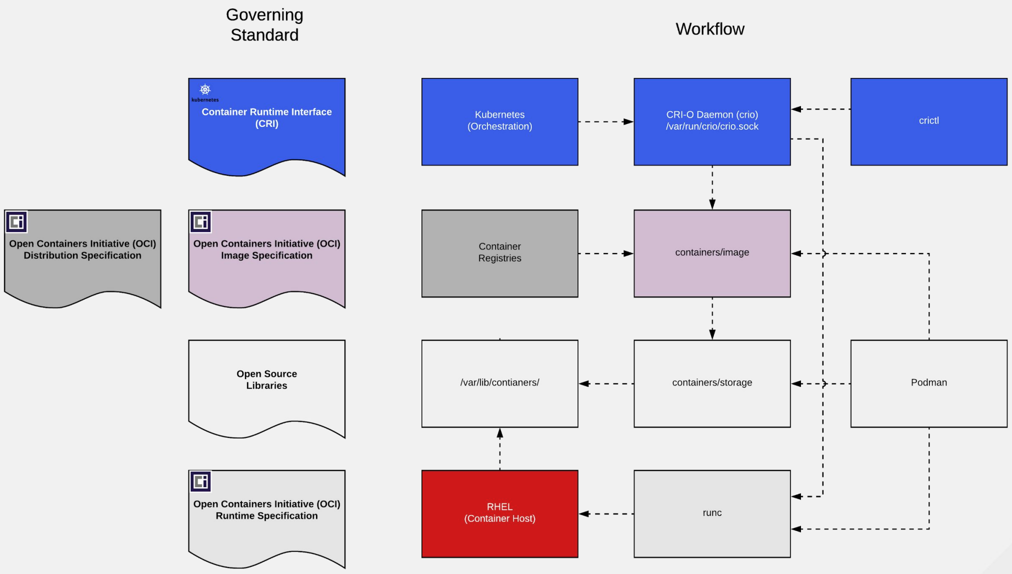


WORKING TOGETHER

Technical example

Different standards are focused on different parts of the stack.

- Tools like crictl use the CRI standard
- Tools like Podman use standard libraries
- Tools like runc are widely used

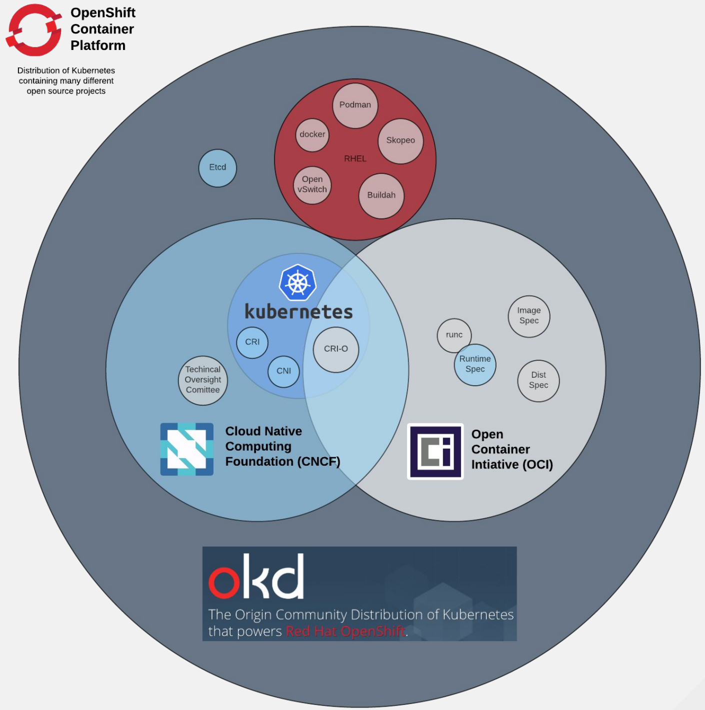


THE COMMUNITY LANDSCAPE

Open Source, Leadership & Standards

The landscape is made up of committees, standards bodies, and open source projects:

- Docker/Moby
- Kubernetes/OpenShift
- OCI Specifications
- Cloud Native Technical Leadership



redhat.

CONTAINER ECOSYSTEM

AN OPEN SOURCE SUPPLY CHAIN

One big tool, or best of breed Unix like tools based on standards

BASIC CONTAINERS ARE SIMILAR TO PDF?

Find, Run, Build, and Share. Collaboration with any reader/writer

==

MINIMUM TO BUILD OR RUN A CONTAINER?

Standards and open source code

- A standard definition for a container at rest
  - OCI Image Specification - includes image and metadata in a bundle
- A standard mechanism to pull the bundle from a container registry to the host
  - OCI Distribution Specification - specifies protocol for registry servers
  - github.com/containers/image
- Ability to uncompress and map the OCI image bundle to local storage
  - github.com/containers/storage
- A standard mechanism for running a container
  - OCI Runtime Specification - expects only a root file system and config.json
  - The default runc implementation of the Runtime Spec (same tool Docker uses)

WHAT ELSE DOES KUBERNETES NEED?

Standards and open source code

- The minimum to build or run a container

AND

- A standard way for the Kublet to communicate with the Container Engine
  - Container Runtime Interface (CRI) - the protocol between the Kubelet and Engine
- A daemon which communicates with CRI
  - gRPC Server - a daemon or shim which implements this server specification
- A standard way for humans to interface with the gRPC server to troubleshoot and debug
  - cri-ctl - a node based CLI tool that can list images, view running containers, etc

THERE ARE NOW ALTERNATIVES

Moving to Podman in RHEL 8 and CRI-O in OpenShift 4

docker

podman

cri-o

OPEN CONTAINER INITIATIVE

THE UNDERLYING ECOSYSTEM

Many tools and libraries

containers

podman

buildah

cri-o

skopeo

OpenSCAP

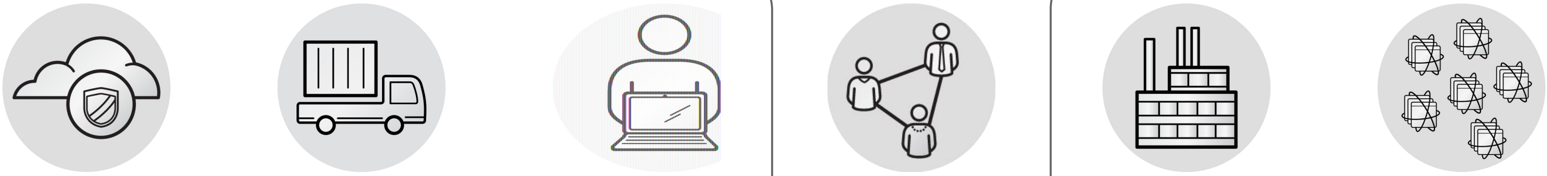
CRIU

CREATING DOWNSTREAM PRODUCTS

Release timing is critical to solving problems

THE JOURNEY

Can start anywhere



Traditional Development

Cloud Native

FIND RUN BUILD SHARE INTEGRATE DEPLOY

RHEL (Podman/Buildah/Skopeo)

Quay

OpenShift (Kubernetes)

CUSTOMER NEEDS

Mapping customer needs to solutions

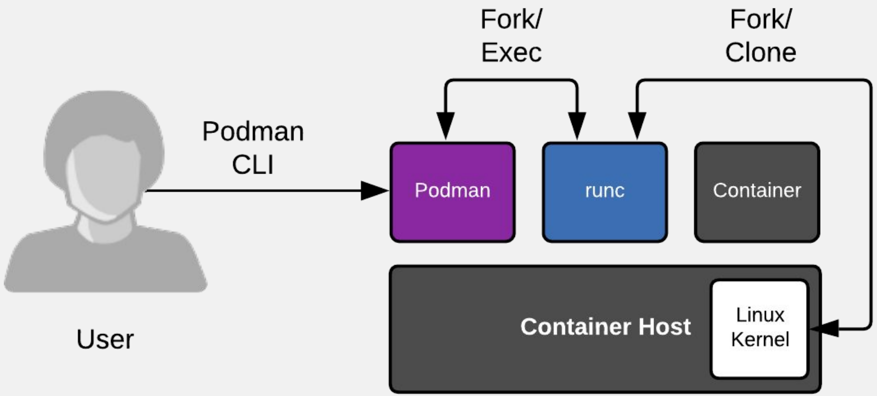
Capability	Platform	Product	Container Engine
Single Node	Linux & Container Tools	Red Hat Enterprise Linux	Podman
Multi Node	Linux & Kubernetes	OpenShift	CRI-O

Red Hat Enterprise Linux 8

The container tools module

PODMAN ARCHITECTURE

Find, Run, Build, and Share. Collaboration with any reader/writer



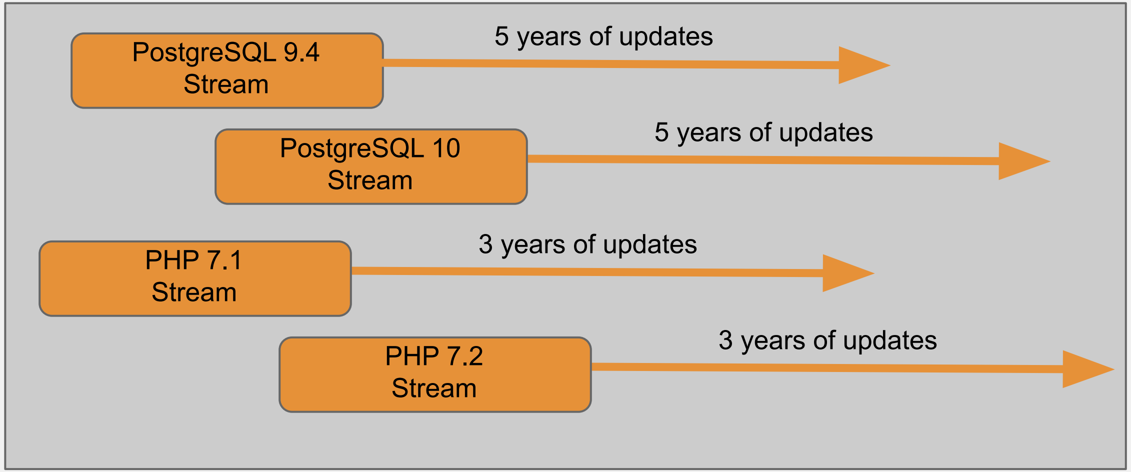
How containers run with a container engine

APPLICATION STREAMS USE MODULES

Modules are the mechanism of delivering multiple streams (versions) of software within a major release. This also works the other way round, a single stream across multiple major releases.

Modules are collections of packages representing a logical unit e.g. an application, a language stack, a database, or a set of tools. These packages are built, tested, and released together.

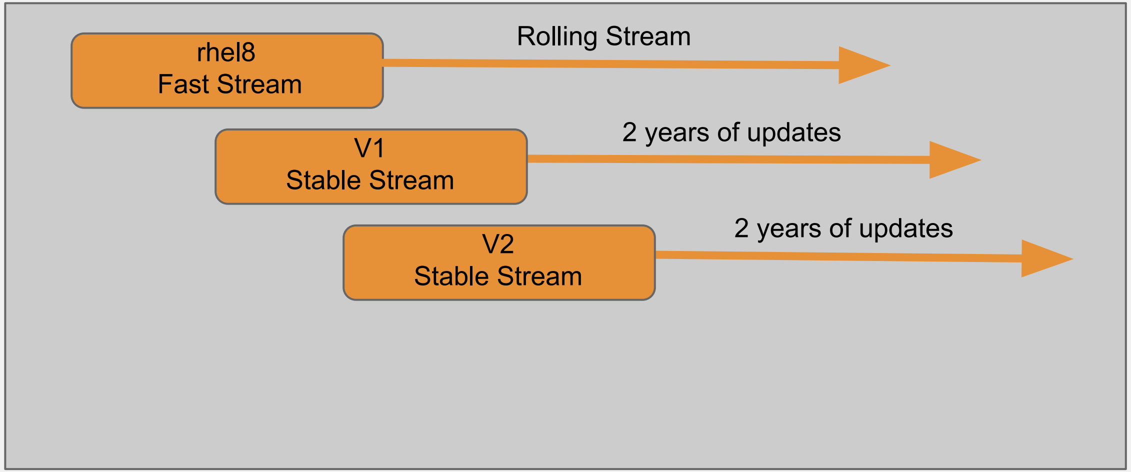
Each module defines its own lifecycle which is closer to the natural life of the app rather than the RHEL lifecycle.



THE CONTAINER TOOLS RELEASES

One **Module** delivered with multiple Application Streams based on different use cases:

- The rhel8 stream delivers new versions for developers
- The versioned, stable streams provide stability for operations
  - Created once a year, supported for two years
  - Only backports of critical fixes

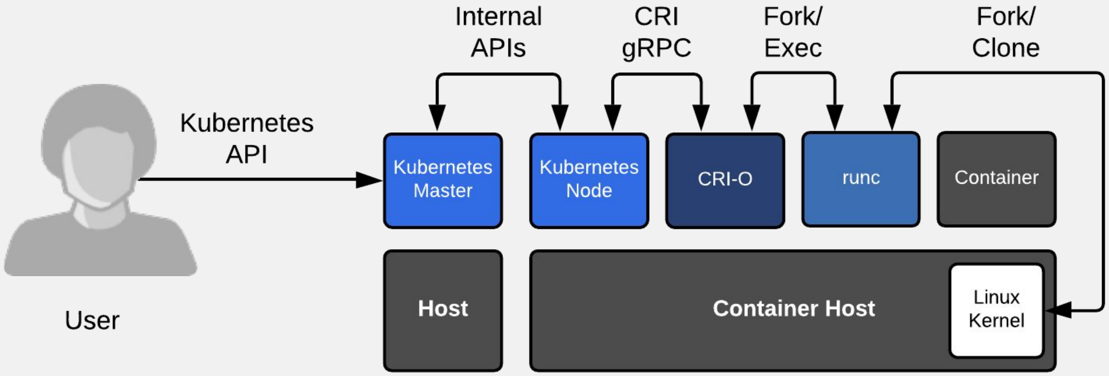


OpenShift 4

CRI-O and Buildah as a library

CRI-O ARCHITECTURE

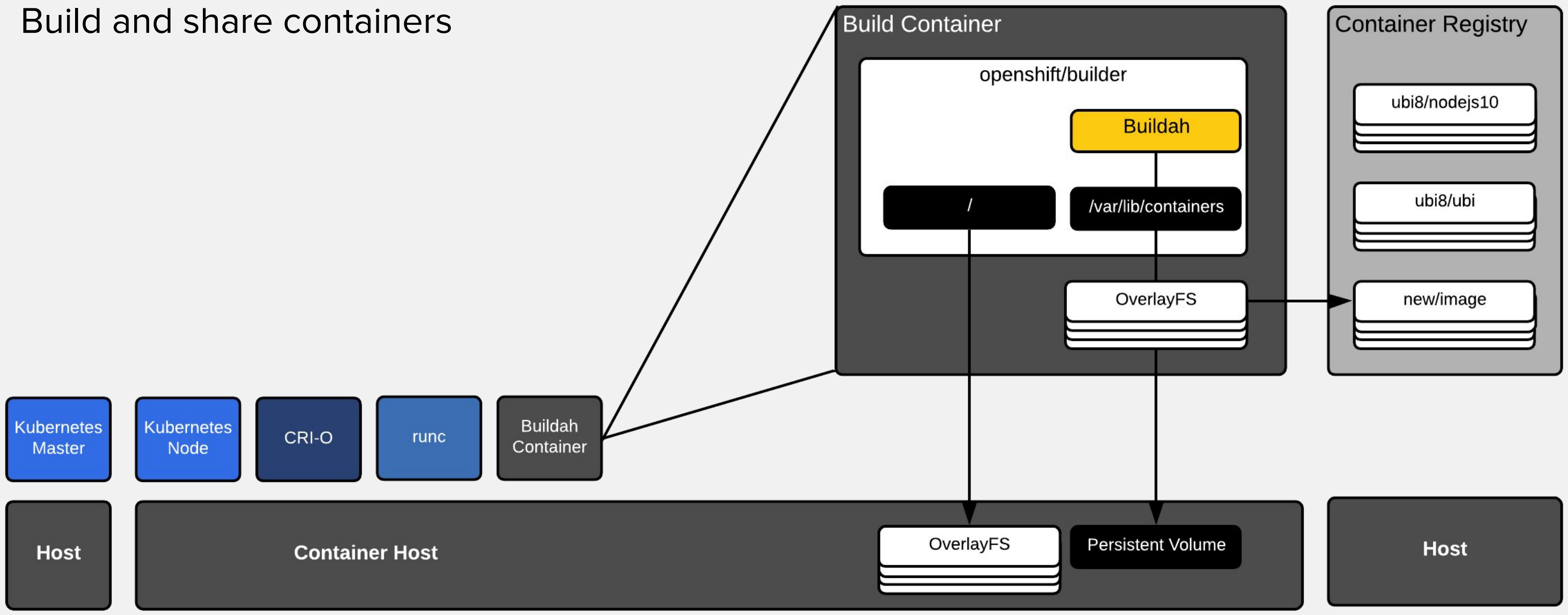
Run containers



How containers run in a Kubernetes cluster

BUILDAH ARCHITECTURE

Build and share containers

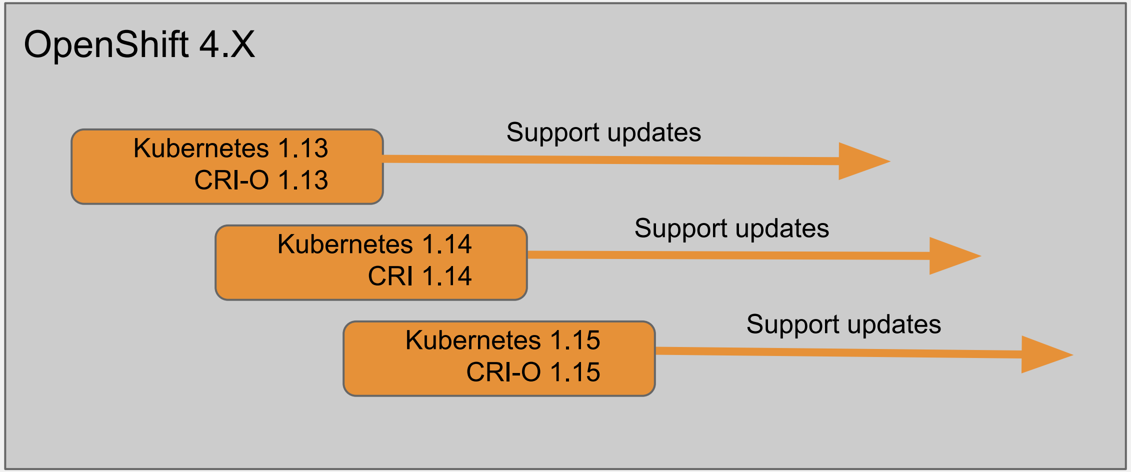


Building when all you can do is run containers

IN LOCKSTEP WITH KUBERNETES

All components for running containers released, tested, and supported together for reliability:

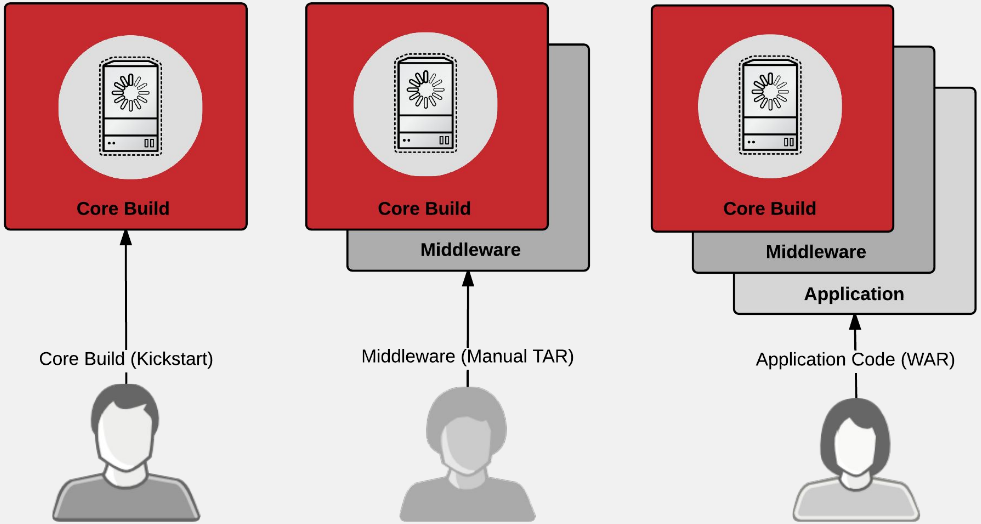
- CRI-O moves in lock-step with the underlying Kubernetes
- The runc container runtime is delivered side by side
- Buildah delivered as a library specifically for OpenShift. No commands for users.



PRODUCTION IMAGE BUILDS

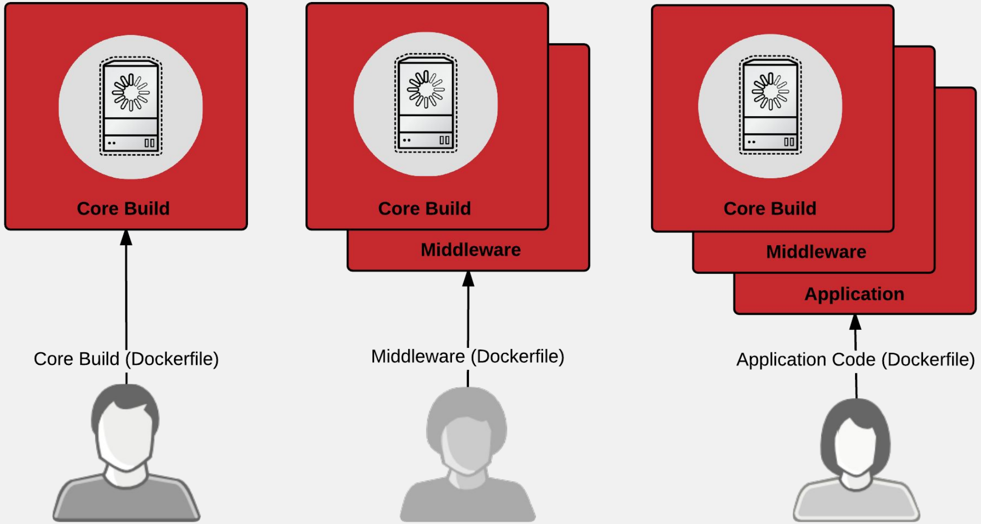
Fancy Files

How do we currently collaborate in the user space?



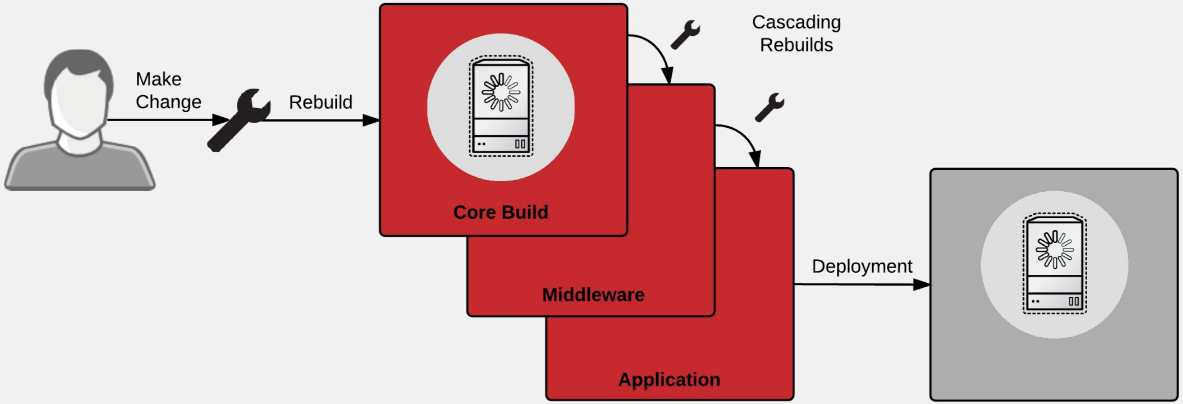
Fancy Files

The future of collaboration in the user space....



Fancy Files

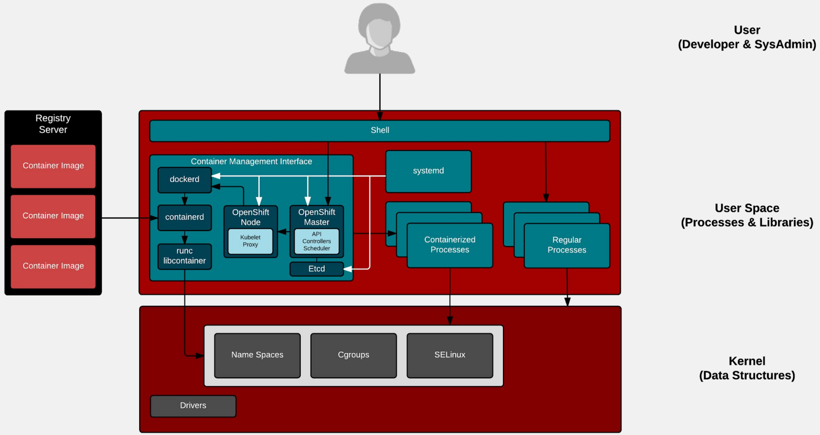
The future of collaboration in the user space….



INTERMEDIATE ARCHITECTURE

THE ORCHESTRATION TOOLCHAIN

On Multiple Hosts

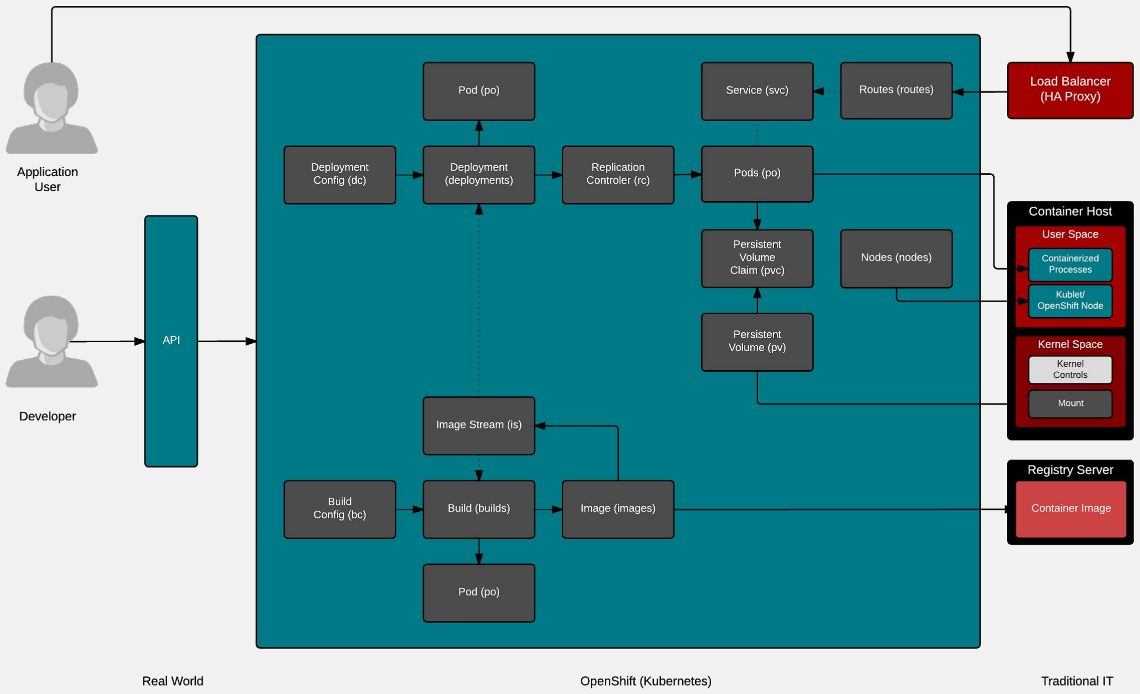


The orchestration toolchain adds the following:

- More daemons (it’s a party) :-)
- Scheduling across multiple hosts
- Application Orchestration
- Distributed builds (OpenShift)
- Registry (OpenShift)

THE LOGIC

Bringing it All Together

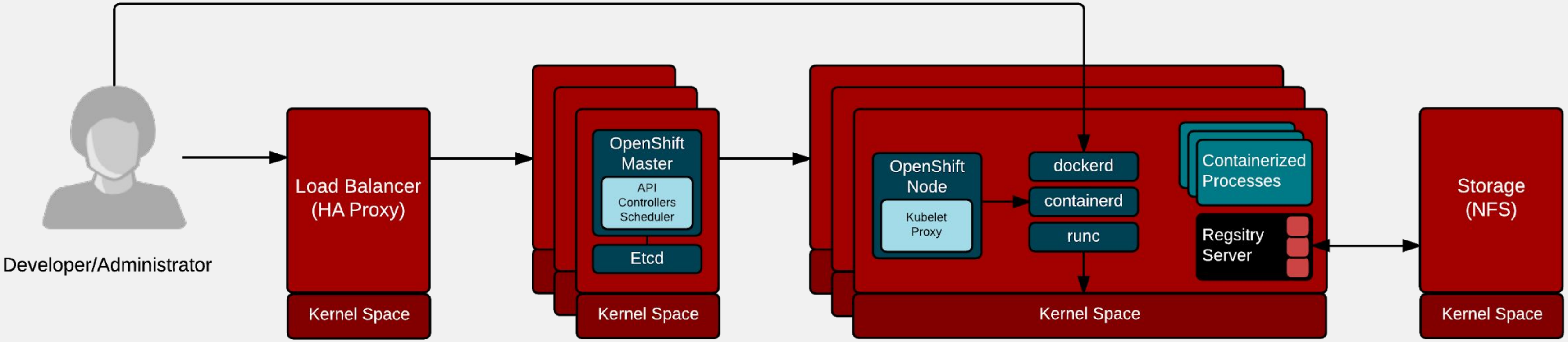


ADVANCED ARCHITECTURE

TYPICAL ARCHITECTURE

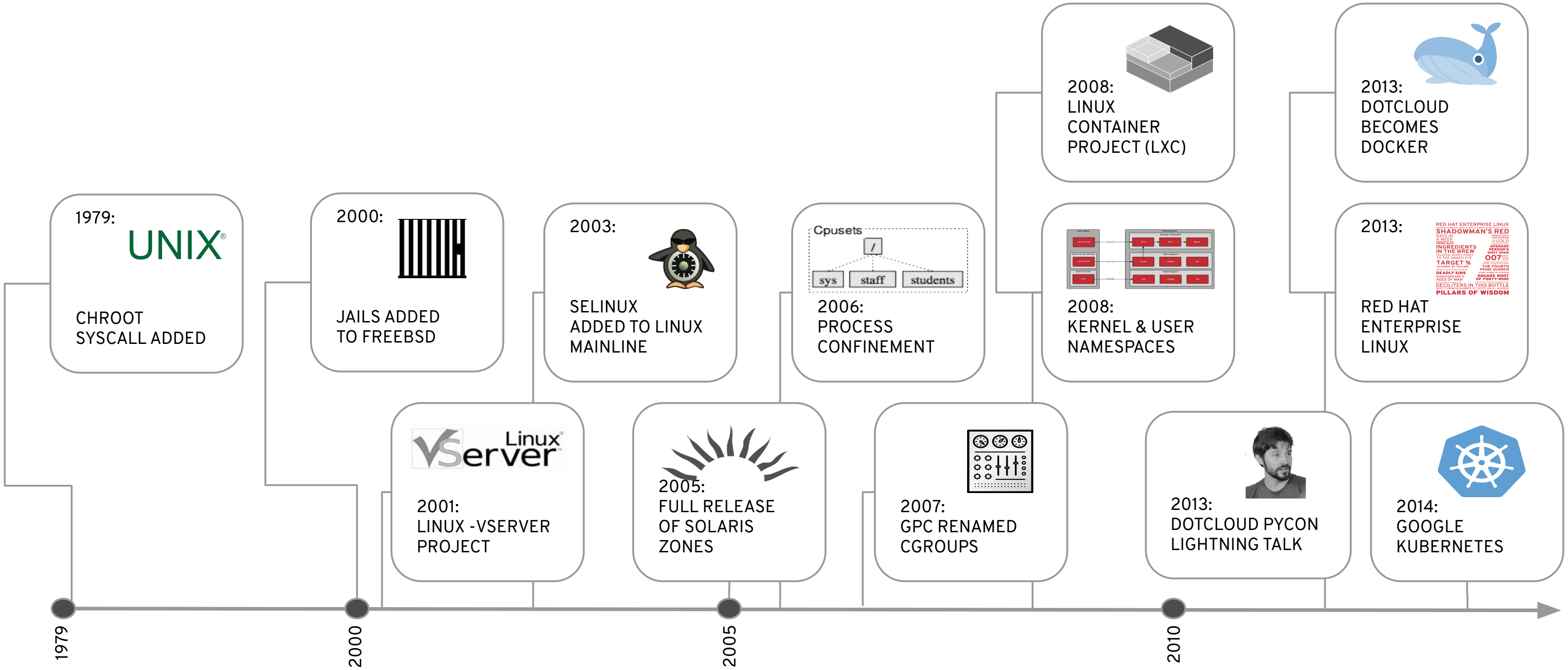
Bringing it All Together

In distributed systems, the user must interact through APIs

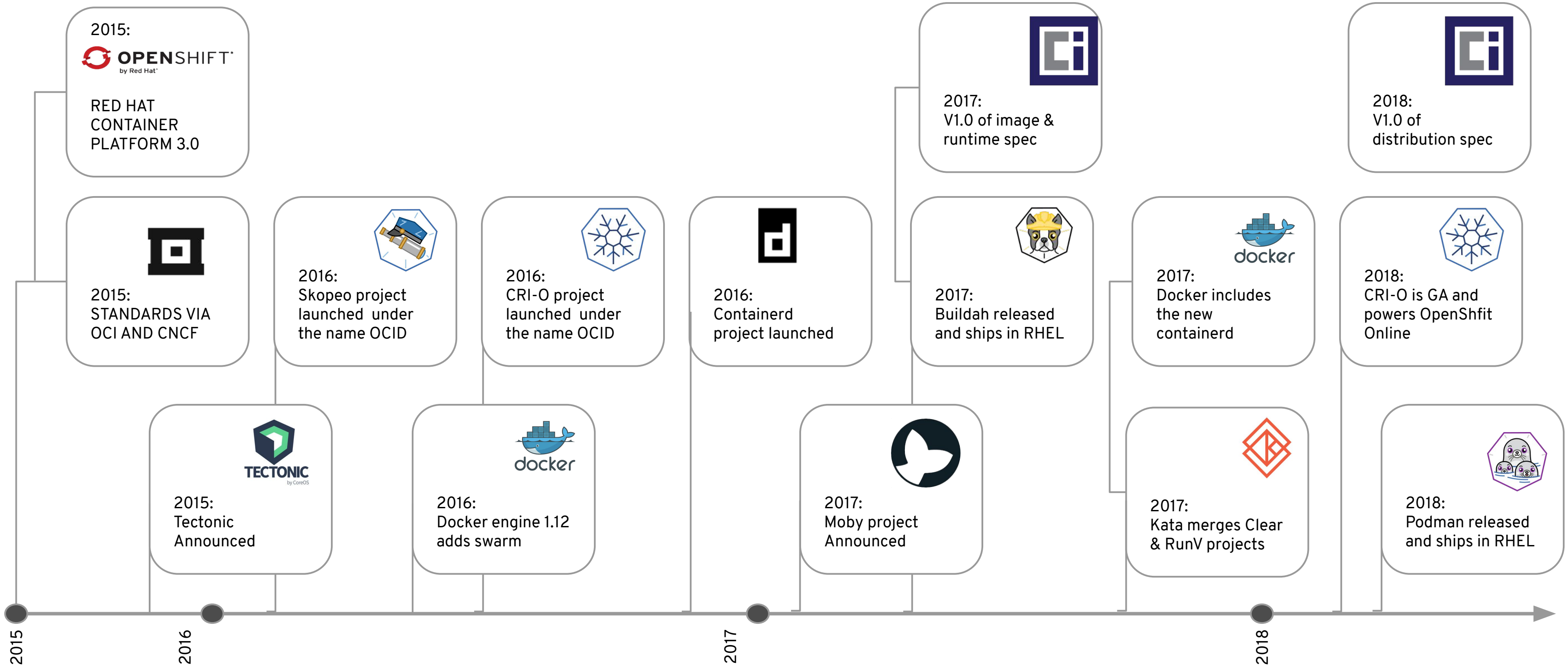


HISTORY

THE HISTORY OF CONTAINERS



CONTAINER INNOVATION IS NOT FINISHED



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linkedin.com/company/red-hat

youtube.com/user/RedHatVideos

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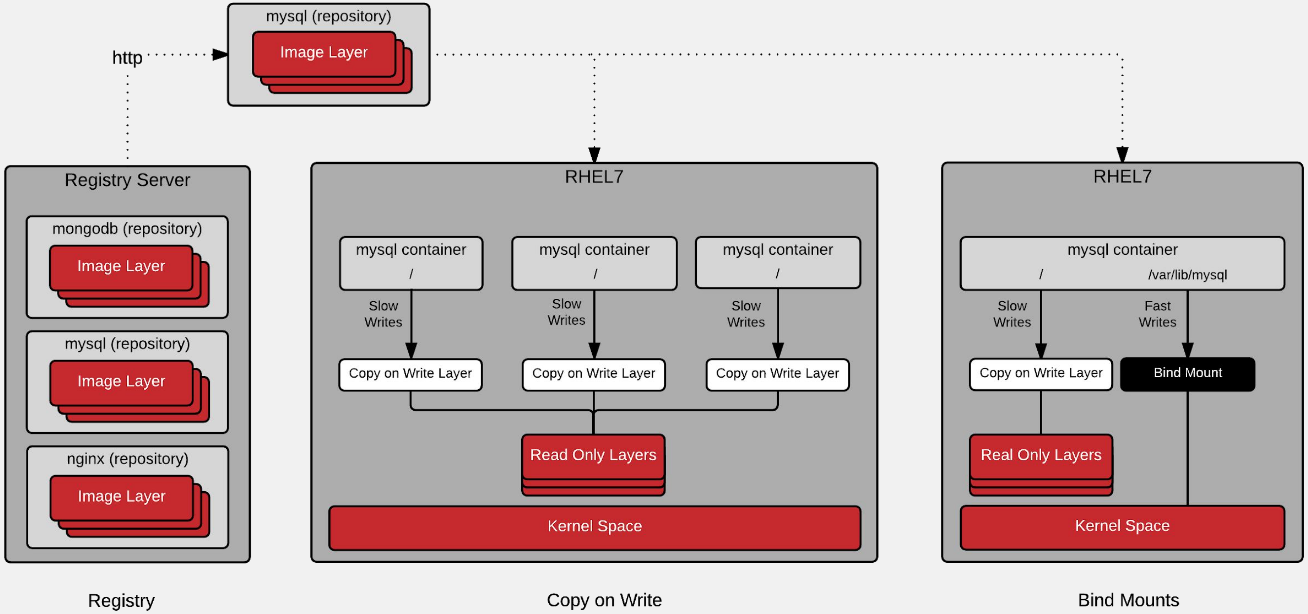
Mounts

Copy on write vs. bind mounts



AGENDA

L103118 - Linux container internals

10:15AM—10:25AM
INTRODUCTION

10:25AM—10:40AM
ARCHITECTURE

10:40AM—11:05AM
CONTAINER IMAGES

11:05AM—11:35PM
CONTAINER HOSTS

11:35AM—12:05PM
CONTAINER ORCHESTRATION

12:05PM—12:15PM
CONCLUSION

Materials

The lab is made up of multiple documents and a GitHub repository

- Presentation (Google Presentation): http://bit.ly/2pYAI9W
- Lab Guide (this document): http://bit.ly/2mIEIPG
- Exercises (GitHub): http://bit.ly/2n5NtPI

CONTACT INFORMATION

We All Love Questions

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