SHIPPING CONTAINERS

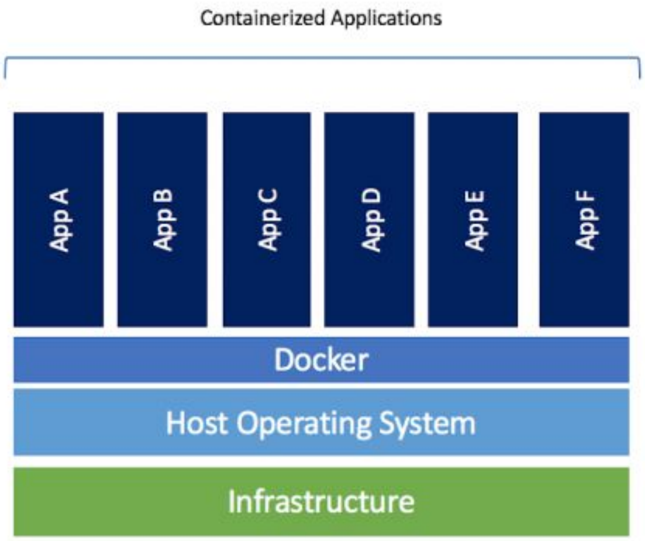
Sachin Dharmapurikar

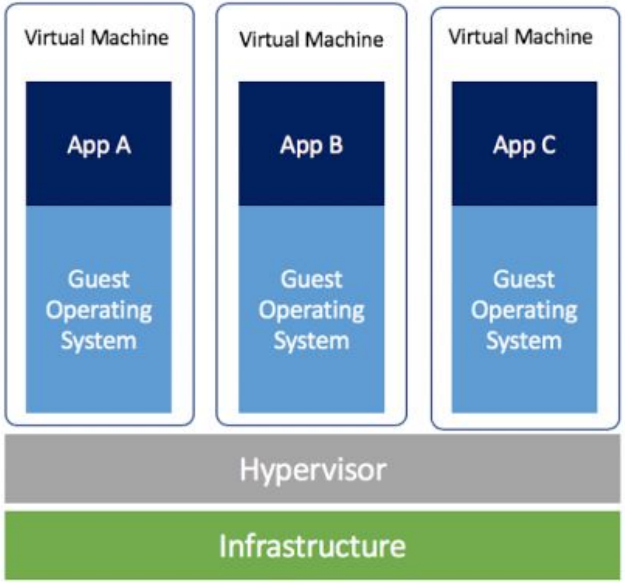
INTRODUCTION

WHAT IS A CONTAINER? (EXECUTIVE SUMMARY)

- A container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another.
- A Docker container image is a lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings.

VM vs Container





HELLO CONTAINER

- `docker run hello-world`
- You just launched a container, it printed text to STDOUT and exited.
- `docker ps -a`

SHOW ME A COMPLEX CONTAINER

- `docker run ubuntu:18.04 echo “Hello from Ubuntu.”`
- `docker run -it ubuntu:18.04`
- `ls /proc`
- You just launched an ubuntu container, and launched bash in interactive mode.

WHAT IS A CONTAINER? (MORE TECHNICAL)

- Containers share the host Kernel
- Containers use the kernel ability to group processes for resource control
- Containers ensure isolation through namespaces
- Containers feel like lightweight VMs (lower footprint, faster), **but are not Virtual Machines!**

THREE LINUXes SAME KERNEL

- `docker run ubuntu:18.04 uname -a`
- `docker run ubuntu:12.04 uname -a`
- `uname -a`
- As per https://wiki.ubuntu.com/SecurityTeam/ESM/12.04 12.04 never go beyond Linux 3.2.x kernel!

HISTORY OF CONTAINERS

- Chroot circa 1982
- FreeBSD Jails circa 2000
- Solaris Zones circa 2004
- Linux OpenVZ circa 2005 (not in mainstream Linux)
- LXC circa 2008
- Docker circa 2013
  - built on LXC
  - moved to libcontainer (March 2014)
  - appC (CoreOS) announced (December 2014)
  - Open Containers standard for convergence with Docker Announced (June 2015)
  - moved to runC (OCF compliant) (July 2015)

TELL ME HOW IT’S DONE

LET’S BUILD A CONTAINER

-
  ```
  [fortune]$ docker build . --tag fortune
  ```

-
  ```
  docker run -t fortune
  ```
- You just built a container from scratch, ran it!

LET’S BUILD A COMPLEX CONTAINER

```
[webserver]$ docker build . --tag demo-server
docker run --name demoserver -d demo-server
docker ps
docker inspect demoserver|grep IPAddress
docker run --name demoserver_2 -p 80:80 -d demo-server
```

DOCKER COMPOSE TO THE RESCUE

DEMO: SAP

WHAT HAPPENS UNDER THE HOOD?

CGROUPS - SECRET BEHIND DOCKER

- `cgroups` (Control Groups) is a feature of Kernel that limits, accounts for, and isolates the resource usage (CPU, memory, disk I/O, network, etc.) of a collection of processes.
- Two engineers at Google started developing this in 2006. It was first merged in Linux mainline kernel in 2008.
- Second revision of `cgroups` was merged in Linux mainline in 2016. It is focused on process discrimination rather than threads.

CGROUPS CONT.

- `Memory`
  - Hard Limit - If a process requests more memory than this limit, the entire group is killed.
  - Soft limit - If a process requests more memory than this limit, it is allowed but eventually all memory is exhausted.
- `CPU`
  - Allows to set weights. Not limits.
  - On idle host with low shares, a process is allowed to use 100% CPU!
- Other limits are `Disk, I/O, Network` etc.

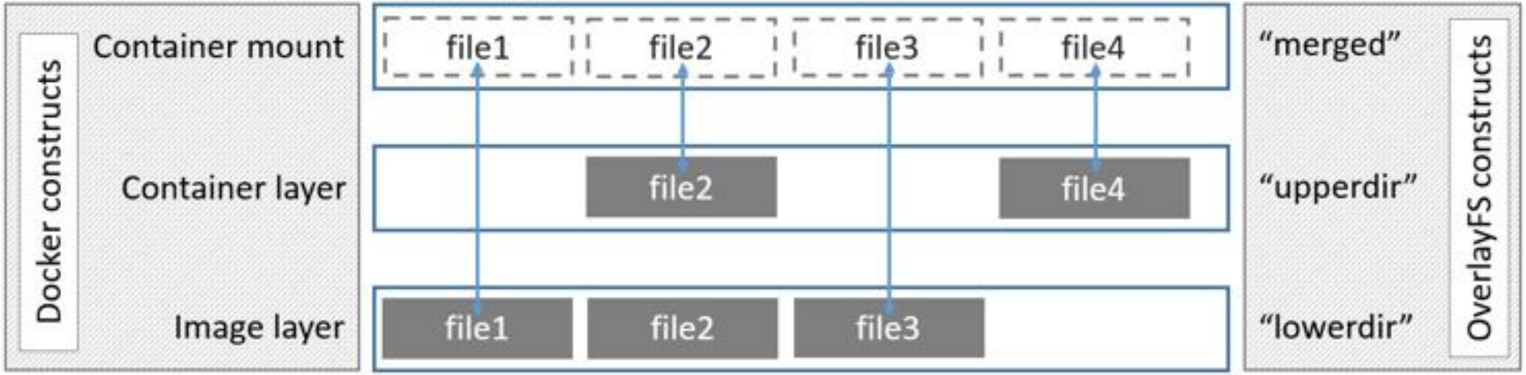
LIFECYCLE OF A CONTAINER

```
t0=$(date "+%Y-%m-%dT%H:%M:%S")

docker run --name=ephemeral -t dharmapurikar/cowsay 'Hello Kodelounge!'

t1=$(date "+%Y-%m-%dT%H:%M:%S")

docker events --since $t0 --until $t1
```

WHAT HAPPENS TO MY FILESYSTEM

- Docker creates the filesystem in the form of layers. Every layer contains set of files added, removed or modified. Previous layers are unaffected by the changes in current layer.
- Each container starts from a layer and continues creating new layers.
- Docker uses **copy-on-write** method to form layers. A thin RW layer is created when container is launched. Every file which is written or modified from layers below is copied and modified.
- Top most layer of the docker is ephemeral if container is not saved or exported. Upon removing container, it will lose all of its data.

LAYERED FILE SYSTEMS



LAYERED FILE SYSTEMS

```
[original]$ docker build . --tag layer:1

[extended]$ docker build . --tag layer:2

docker history layer:2

docker history layer:1
```

CLOSING THOUGHTS

FEW THINGS TO REMEMBER

- Docker is now Xerox. There are other container technologies available.
- Virtual Machines are more secure by design.
- Use containers because they are light and can package a piece of software component well.
- Containers are only native to Linux.

FIN.

https://github.com/dharmapurikar/docker-talk