Docker 101

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What are containers?

Introducing containers and Docker

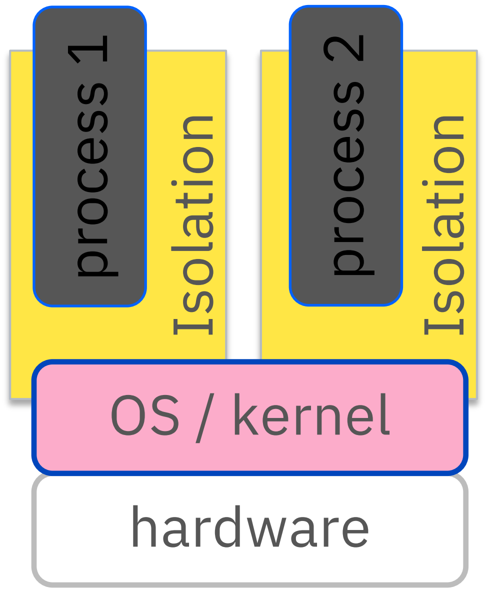
Containers – not a new idea

- chroot ('80s) process spawned in isolated file space
- FreeBSD jails
- OS-level virtualization (user-mode-linux, virtuozzo)
- Solaris Containers
- LinuX Containers (LXC)
- Cloud Foundry (Warden, Garden)

More efficient than VMs but less mindshare…

Docker – ecosystem approach transformed perception

- Building application-centric containers
- Mechanism for sharing images (Docker Registry)
- Open-source enabled



What are Containers?

Similar to VMs but managed at the **process level**

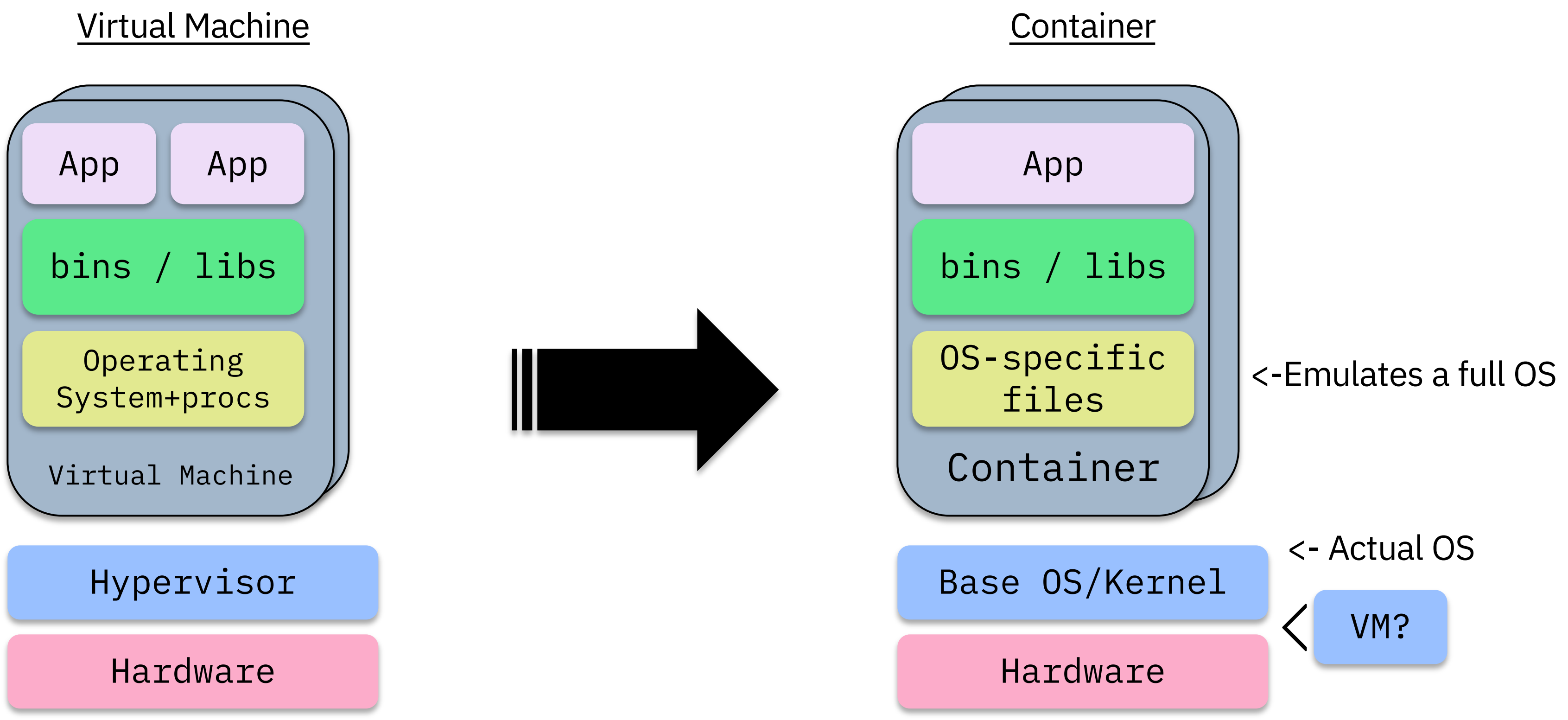
"VM-like” isolated achieved by set of "**namespaces**" (isolated view)

- PID –isolated view of process IDs
- USER- user and group IDs
- UTS - hostname and domain name
- NS - mount points
- NET - Network devices, stacks, ports
- IPC - inter-process communications, message queues

cgroups - controls limits and monitoring of resources

The key statement: **A container is a process(es) running in isolation**

VM vs Container



Each VM has its own OS

Containers share the same base Kernel

What is Docker?

Containers is the technology, Docker is the **tooling** around containers
Without Docker, containers would be **unusable** (for most people)
Docker **simplified** container technology to enable it for the masses
Added value: Lifecycle support, setup file system, etc

For extra confusion: Docker is also a company, which is different then Docker the technology…

Our First Container

```
$ docker run ubuntu echo Hello World
Hello World
```

What happened?

– Docker created a directory with a "ubuntu" filesystem (image)

– Docker created a new set of namespaces

– Ran a new process: echo Hello World

  - Using those namespaces to isolate it from other processes
  - Using that new directory as the "root" of the filesystem (chroot)

– That's it!

  - Notice as a user I never installed "ubuntu"

– Run it again - notice how quickly it ran

"ssh-ing" into a container

```
$ docker run -ti ubuntu bash
root@62deec4411da:/# pwd
/
root@62deec4411da:/# exit
$
```

- Now the process is "bash" instead of "echo"
- But its still just a process
- Look around, mess around, its totally isolated
  - rm /etc/passwd – no worries!
  - MAKE SURE YOU'RE IN A CONTAINER!

A look under the covers

```
$ docker run ubuntu ps -ef
UID          PID    PPID  C STIME TTY          TIME CMD
root           1       0  0 14:33 ?        00:00:00 ps -ef
```

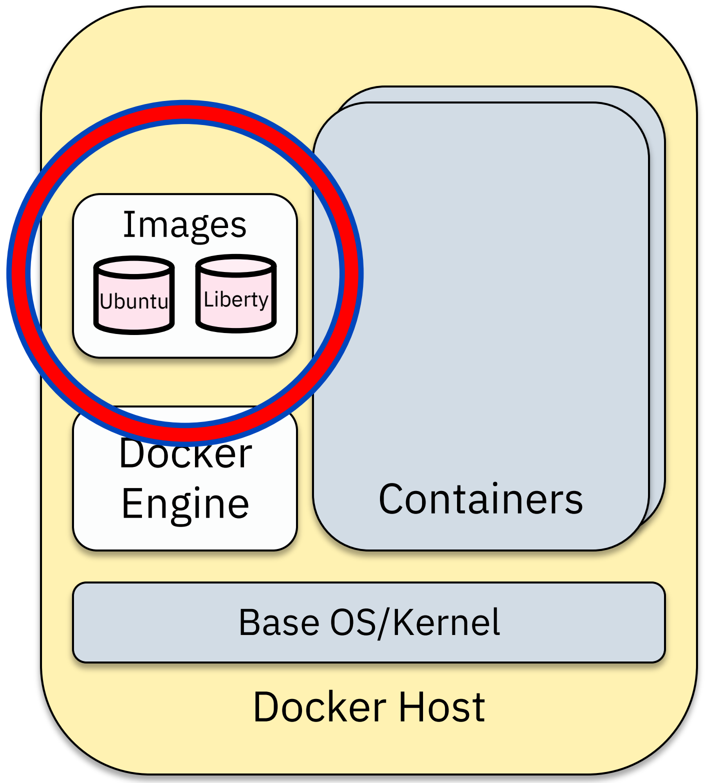
Things to notice with these examples:

- Each container only sees its own process(es)
- Each container only sees its own filesystem
- Running as "root"
- Running as PID 1

Docker Images

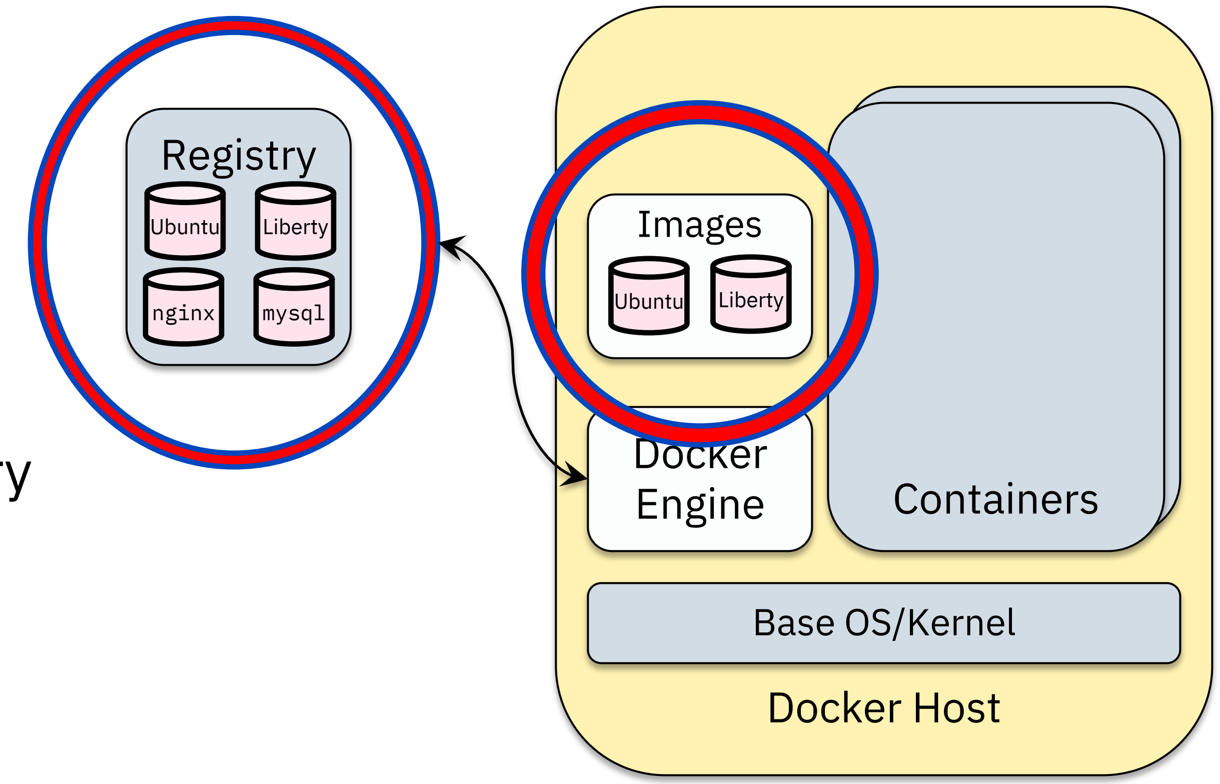
- Tar file containing a container's filesystem + metadata

- For sharing and redistribution
  - Global/public registry for sharing: DockerHub



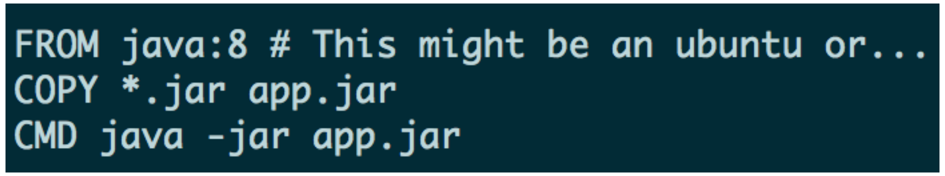
Docker Registry

- DockerHub (https://hub.docker.com)
- Public registry of Docker Images
- The central place for sharing images with friends or coworkers!
- Also useful to find prebuilt images for web servers, databases, etc
- Enterprises will want to find a private registry to use (such as Artifactory)



Build your own image with a Dockerfile!

Step 1) Create Dockerfile to script how you want the image to be built



```
FROM java:8 # This might be an ubuntu or...
COPY *.jar app.jar
CMD java -jar app.jar
```

Step 2) **docker build** to build an image

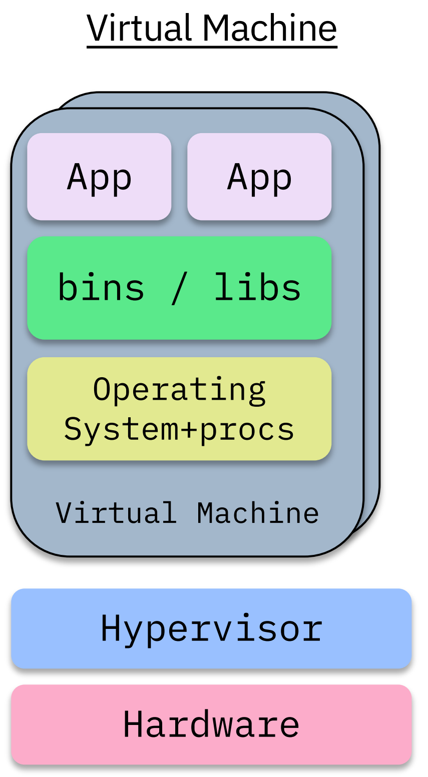
Step 3) **docker push** to push to registry

Step 4) From another location, **docker pull** to download an image

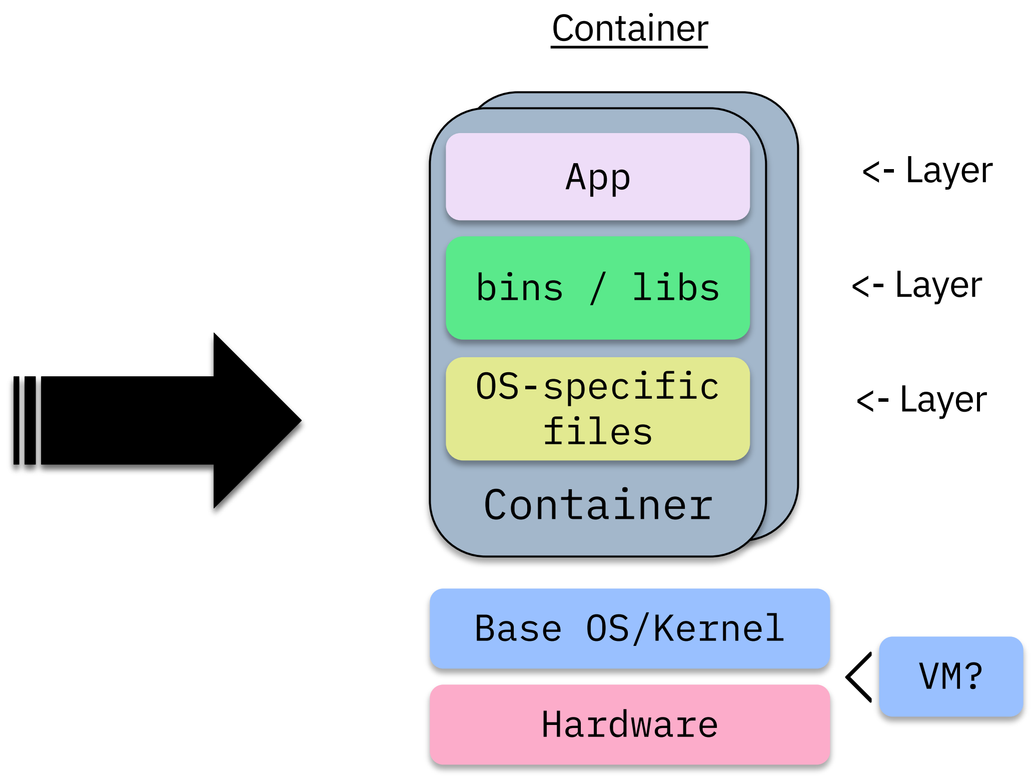
Docker special sauce: Layers

Let's compare VMs and Containers one more time…

VM vs Container: Notice the layers!



Each VM has its own OS



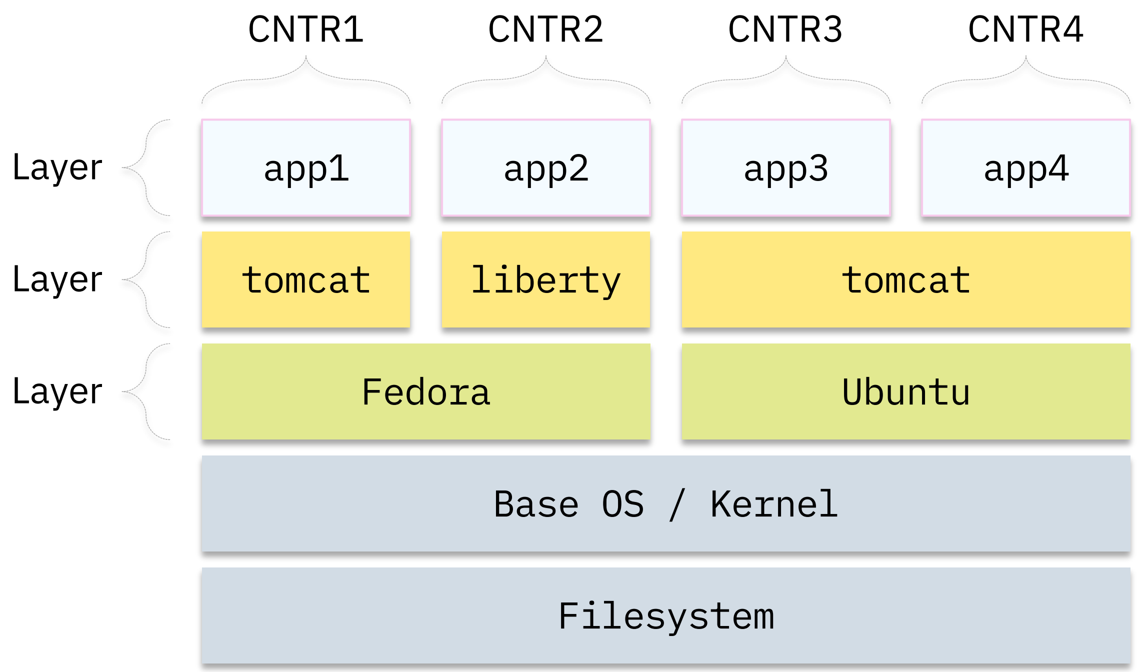
Containers share the same base Kernel

Shared/Layered/Union Filesystems

- Docker re-uses common layers between containers and images
- A single writeable layer is added on the top every time a new layer is created
- Layers are “smushed” with **union file system** (think transparencies on a projector)
- Files are copied up when writes need to be made (copy-on-write)

Bottom Line

- More containers per host
- Faster downloads and uploads
- Faster container startups



Summary

- Docker is just a tool to manage containers
  - Key concepts: Containers, Engine, Images, Registry

- Docker value-add:
  - An excellent User Experience
  - Image Layers
  - Easily shared images - DockerHub

- Why? When compared to VMs:
  - Better resource utilization - CPU, Memory, Disk
  - Faster start-up times
  - Easier tooling/scripting

- Discussion / Questions?

Quiz!

What's the difference between a container and an image?

Answer:

- An image is a tar of a filesystem
- A container is a filesystem + a set of processing running in isolation

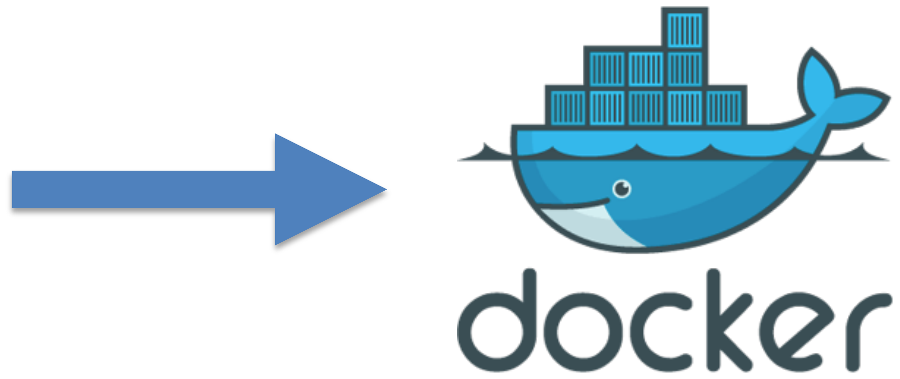
In a Traditional Deployment…

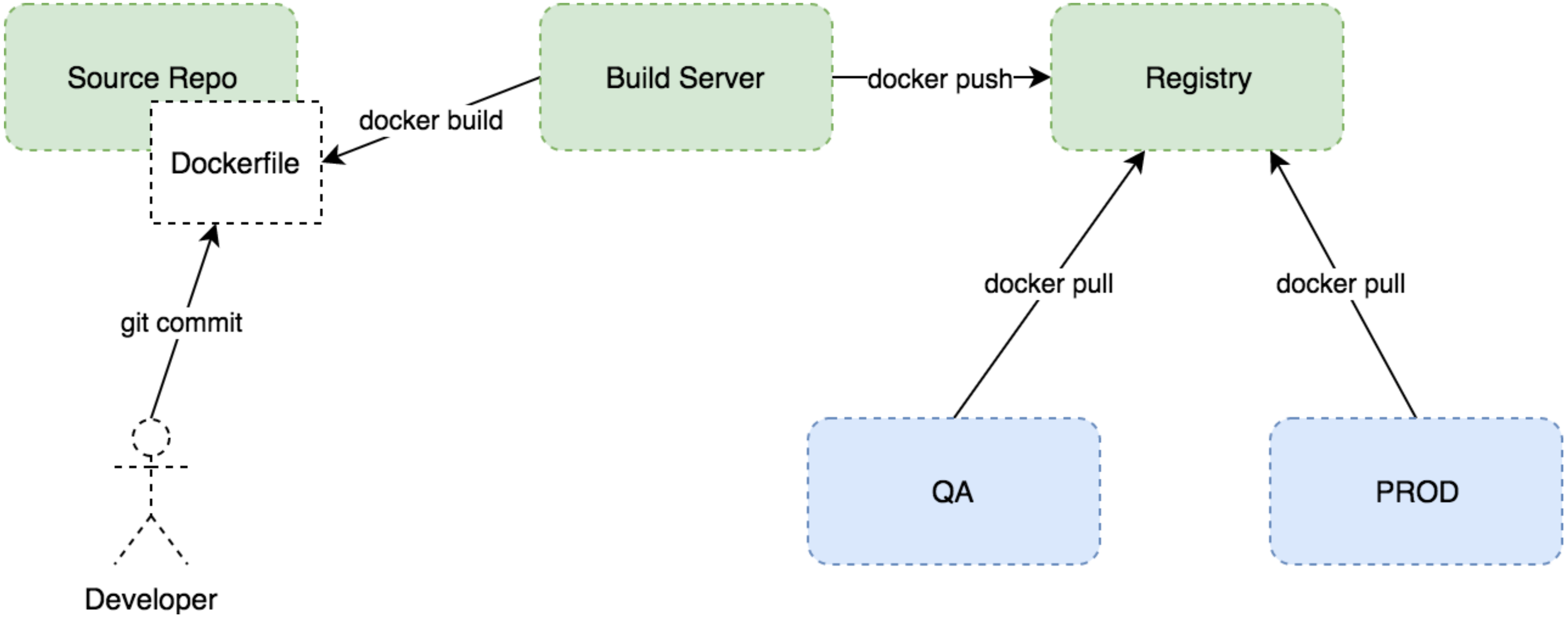
Are you testing these on ever commit?

- Code (packages archive) ✓
- App server ✗
- Runtime versions ✗
- System libraries and versions ✗

Container = Code + Dependencies

- Code (packages archive)
- App server
- Runtime versions
- System libraries and versions




Source Repo
Dockerfile
docker build
Build Server
docker push
Registry
git commit
docker pull
docker pull
Developer
QA
PROD

Lab Time