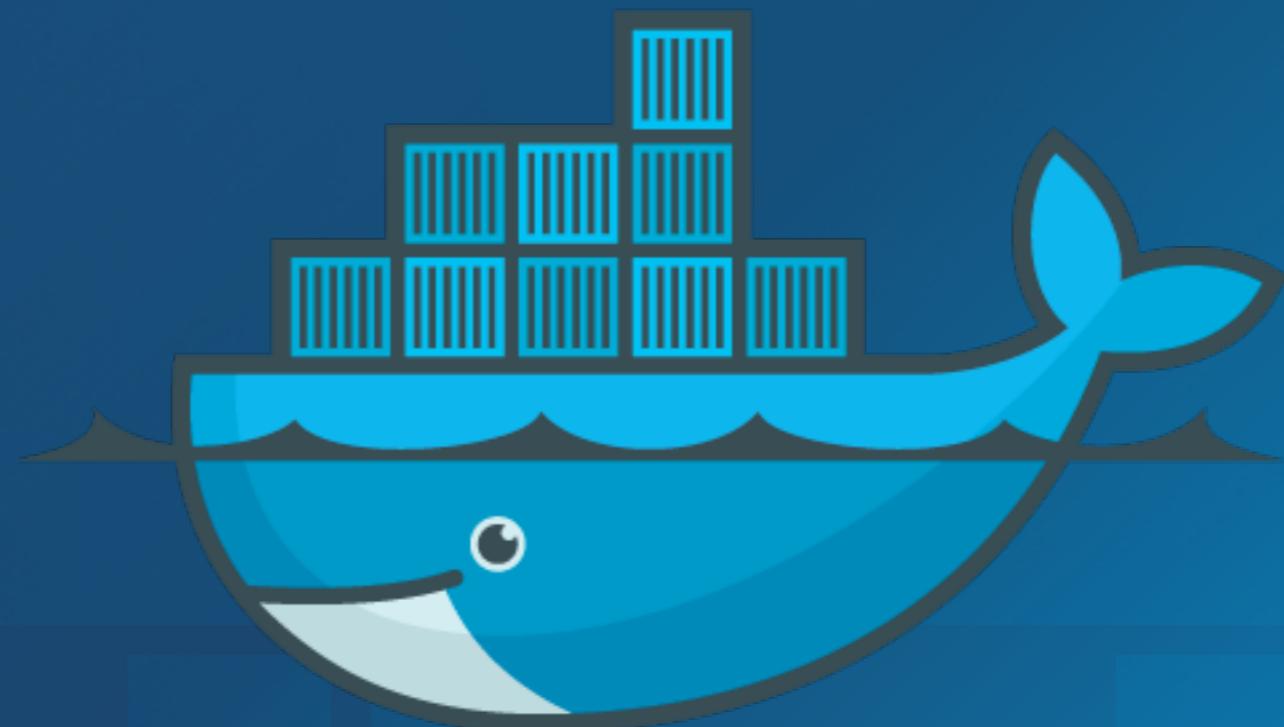
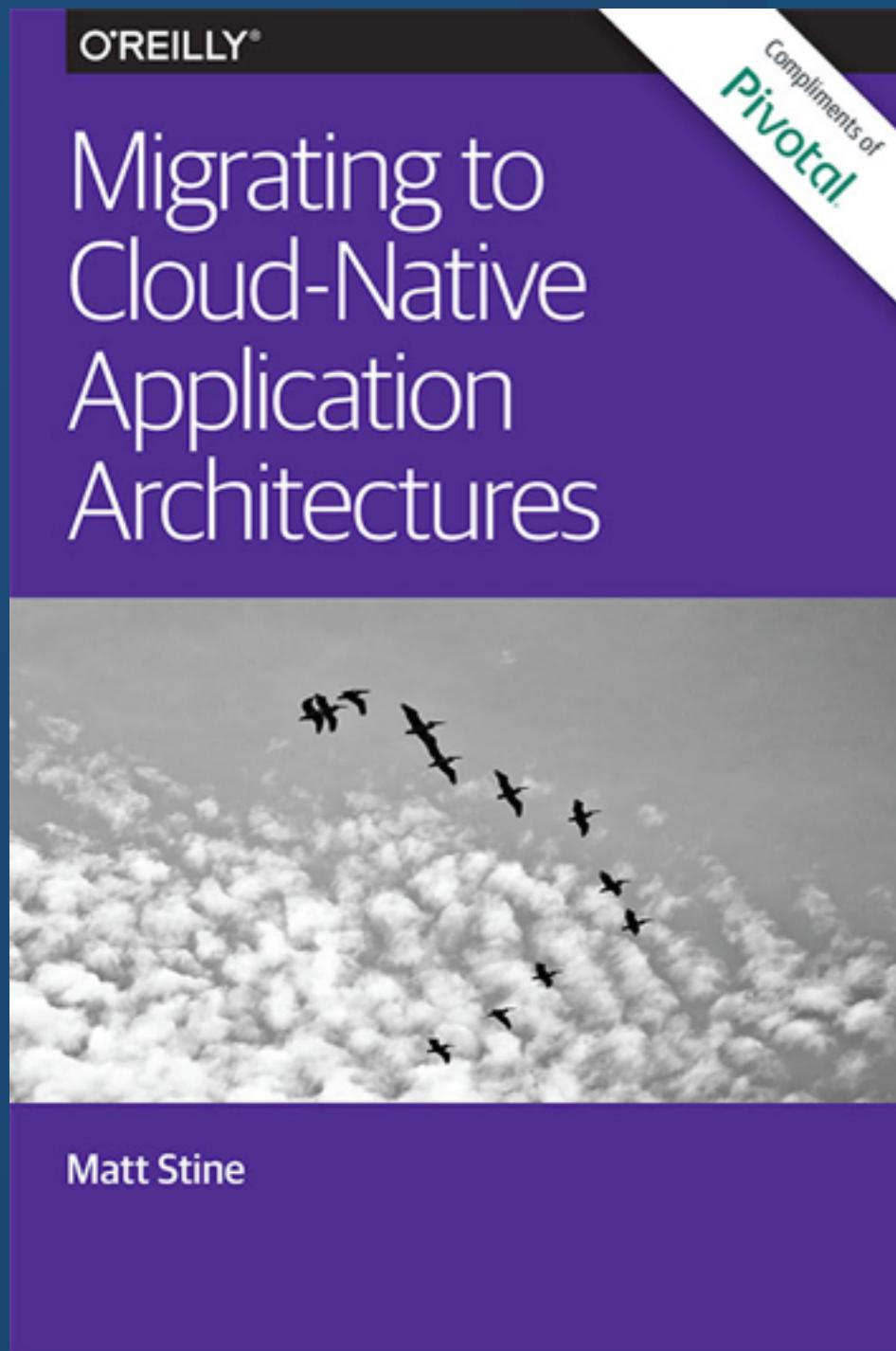


# Intro to Containers



Matt Stine (@mstine)  
Senior Product Manager, Pivotal  
[matt.stine@gmail.com](mailto:matt.stine@gmail.com)  
<http://www.mattstine.com>

# I wrote a little cloud book...



FREE - Compliments of Pivotal

Available at Pivotal booth

or

<http://bit.ly/cloud-native-book>

# Agenda

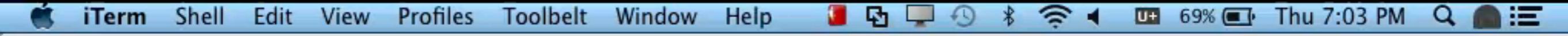
- ♣ Who/What/Where/When?
- ♣ Zero to Hello World
- ♣ Background
- ♣ Continuous Delivery and DevOps
- ♣ Container Lifecycle
- ♣ Building Containers
- ♣ Case Study: A Continuous Delivery Pipeline
- ♣ Comparison to Other Solutions
- ♣ Resources

# Docker

- ❖ OSS project to pack/ship/run any app as a lightweight container
- ❖ First presented by Solomon Hykes  
PyCon - March 2013
- ❖ Hykes = dotCloud = Public PaaS Provider
- ❖ Docker = Go rewrite of dotCloud's internal Python orchestration around LXC
- ❖ June 9, 2014 = Docker 1.0
- ❖ <http://docker.com>



# Hello World



iTerm Shell Edit View Profiles Toolkit Window Help

69% Thu 7:03 PM

1. tmux (tmux)

2

pivotal@turkey ~ <ruby-1.9.3>

\$

Session: 0 1 1

1:~\*

06 Mar 19:02

# What Just Happened?

- ❖ Generated a new LXC container
- ❖ Allocated a file system
- ❖ Mounted read/write layer
- ❖ Allocated a network interface
- ❖ Set an IP address
- ❖ Set up NATing
- ❖ Kicked off the “echo” process inside the container
- ❖ Captured the output from the process
- ❖ Streamed the output to my console

IN

< 1

SECOND

# From the process' perspective...



Let's try that...

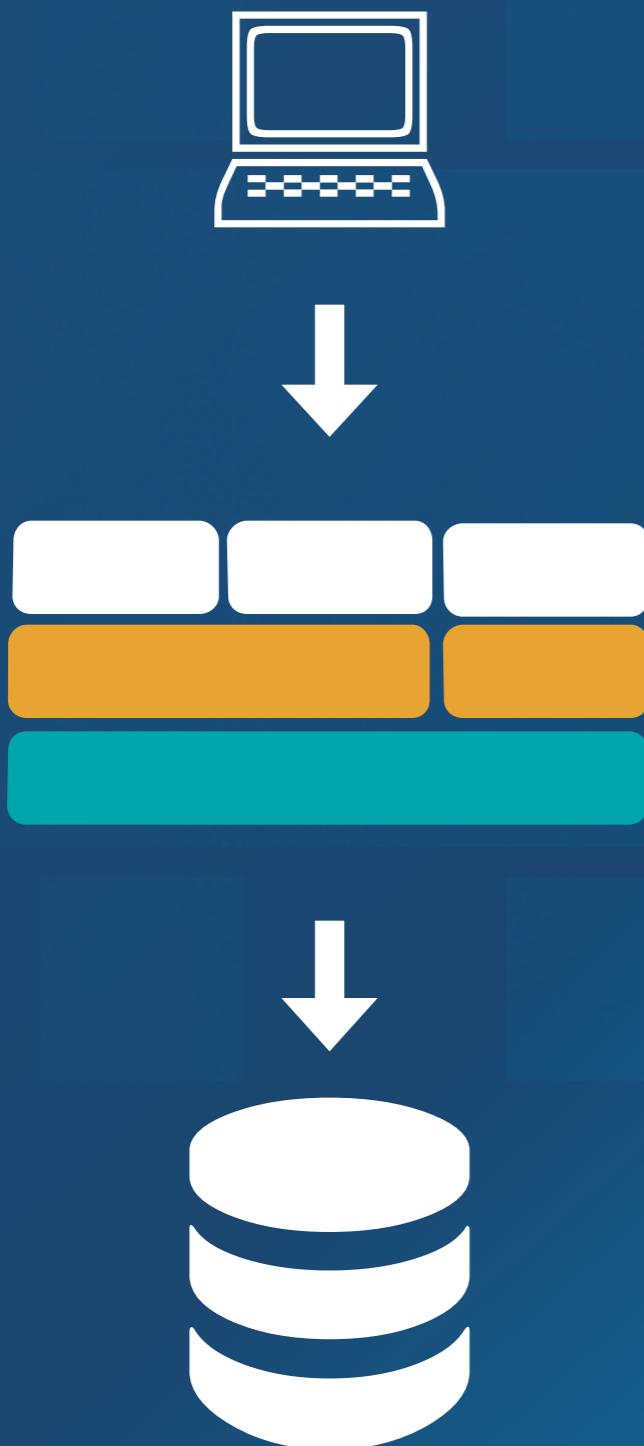


1. tmux (tmux)  
pivotal@turkey ~ <ruby-1.9.3>  
\$ ssh -i ~/.ssh/inception.pem ubuntu@ec2-54-81-232-120.compute-1.amazonaws.com

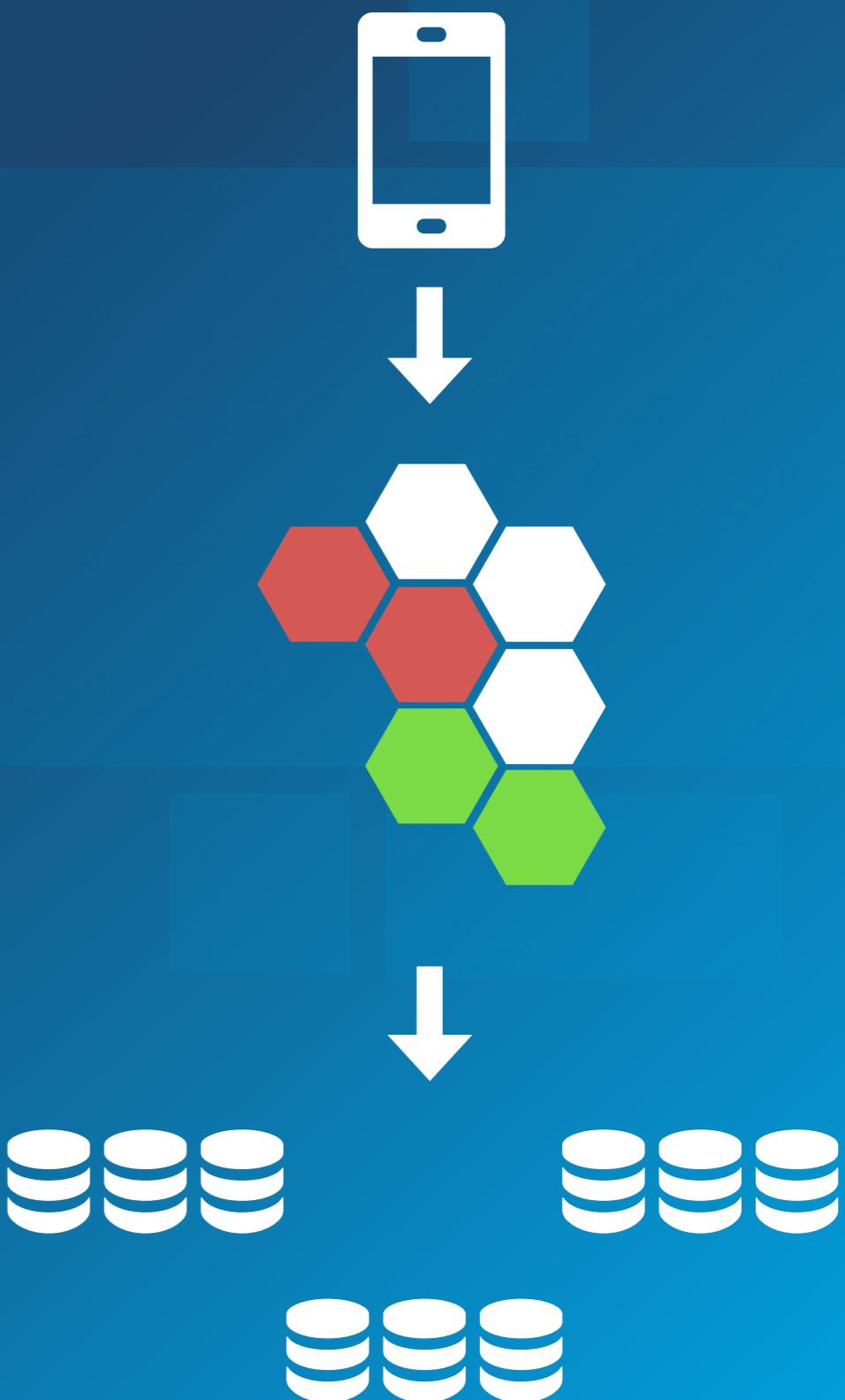


# Evolution of IT

1995



2015



# The Cross Product



# The Matrix

Static website	?	?	?	?	?	?	?	?
Web frontend	?	?	?	?	?	?	?	?
Background workers	?	?	?	?	?	?	?	?
User DB	?	?	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?	?	?
Queue	?	?	?	?	?	?	?	?
	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor Laptop	Customer Servers	

# World of Shipping

# Pre-1960



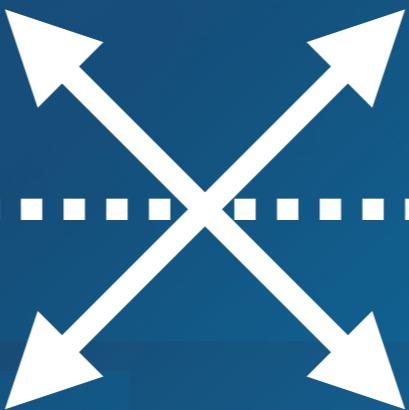
# The Cross Product



Multiplicity  
of  
Goods

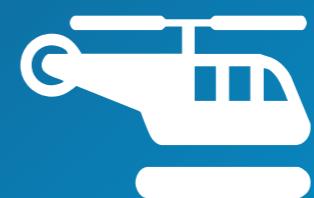


Multiplicity of  
Methods for  
Transport/Storage



Appropriate  
Good  $\rightleftharpoons$  Good  
Interaction

Quick and Smooth  
Transportation???



9 9

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9

SEA 7

**WESTFALIA EXPRESS**  
**LONDON**

IMO 9233832





# Problem Solved!



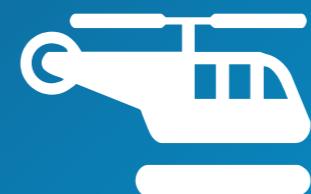
Multiplicity  
of  
Goods



Multiplicity of  
Methods for  
Transport/Storage



Appropriate  
Good ⇔ Good  
Interaction



Quick and Smooth  
Transportation???

# Containers for Code



Multiplicity  
of  
Services



Multiplicity of  
Hardware  
Environments

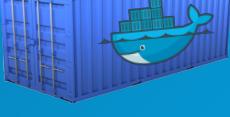


Appropriate  
Service  $\rightleftarrows$  App  
Interaction

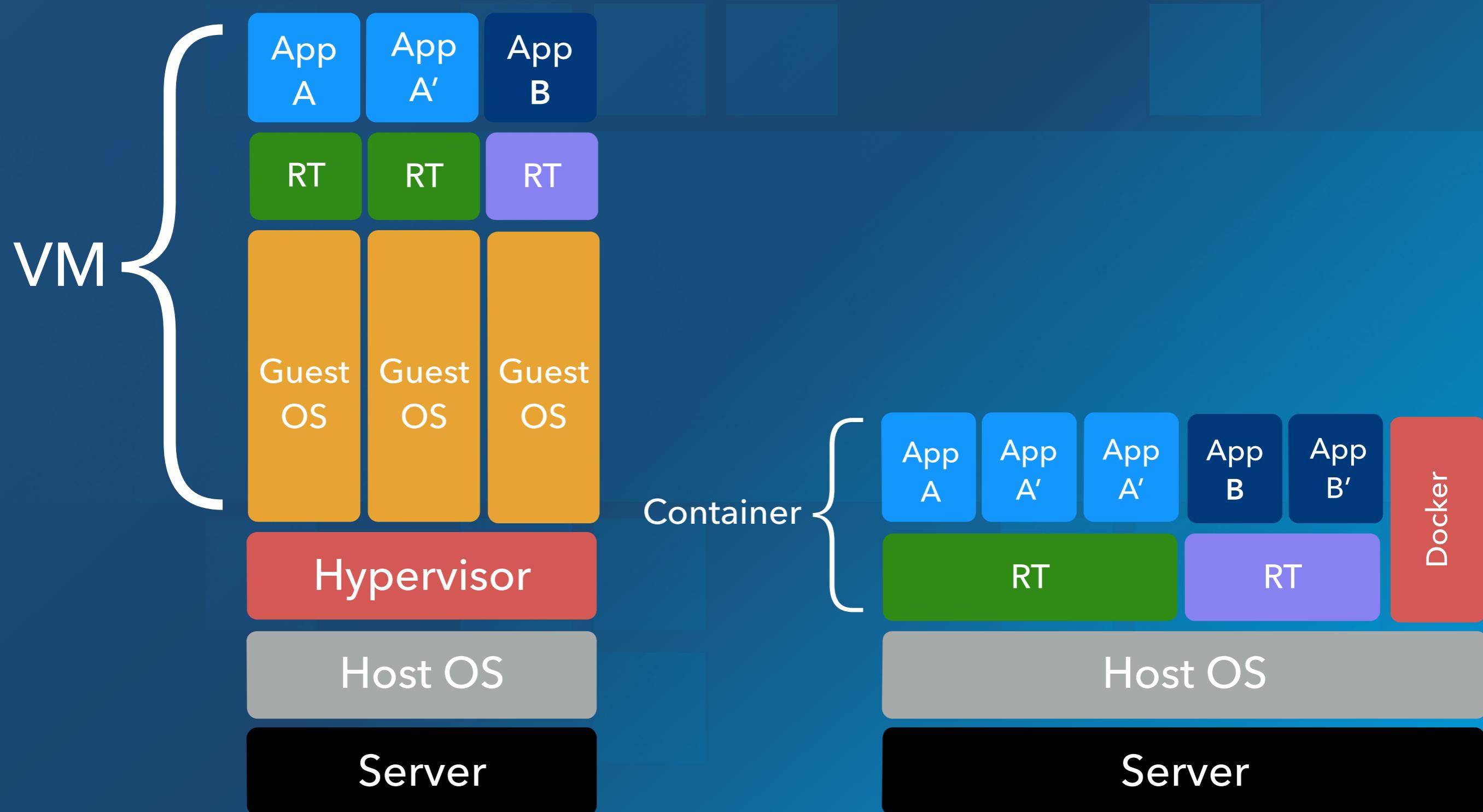
Quick and Smooth  
Migration???



# The Matrix Reloaded

	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor Laptop	Customer Servers
Static website							
Web frontend							
Background workers							
User DB							
Analytics DB							
Queue							

# Containers vs. VMs



# How Does This Work?

## LXC - Linux Containers

Userspace tools for the Linux kernel containers

<http://linuxcontainers.org/>

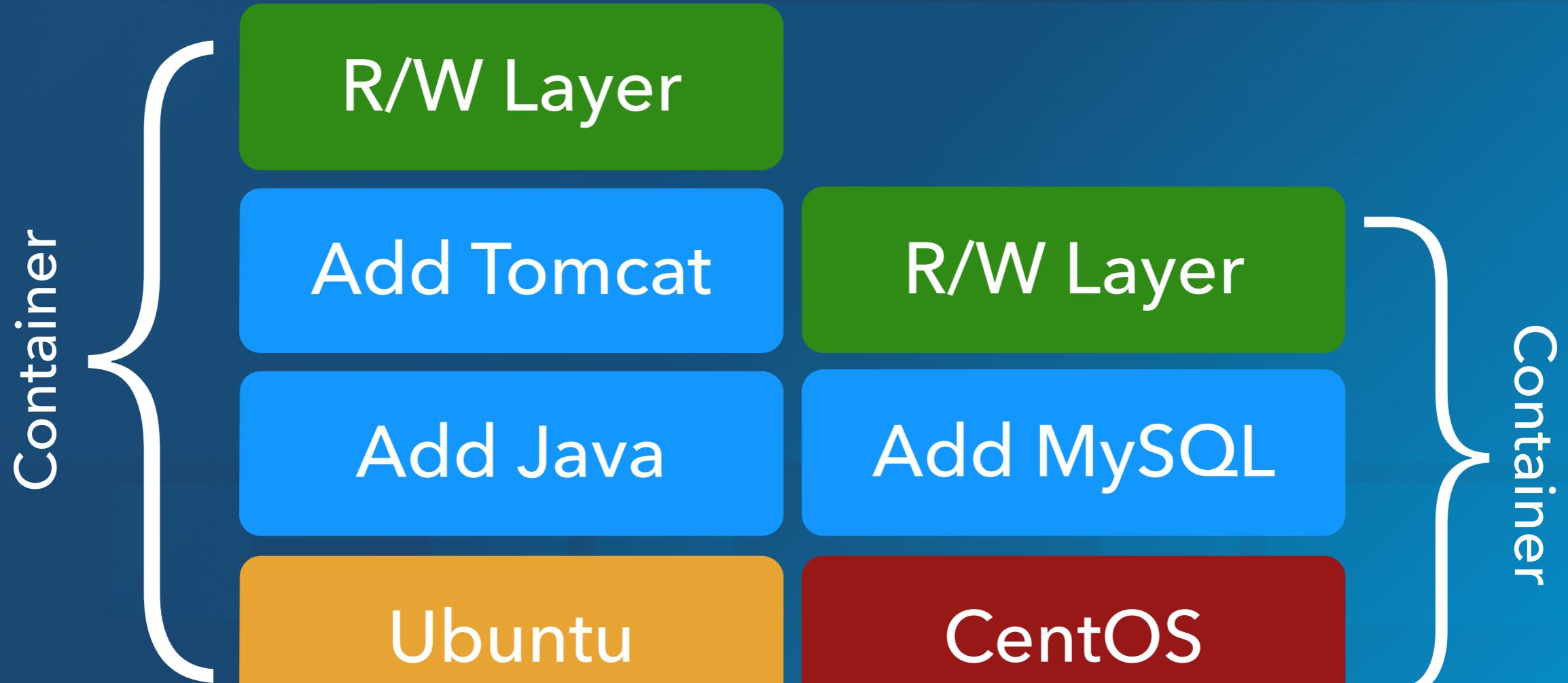
# Control Groups (cgroups)

- ❖ Measure/limit resource usage for groups of processes
- ❖ Manipulated via cgroup filesystem
- ❖ Subsystems:
  - ❖ blkio - limits I/O access to/from block devices
  - ❖ cpu - provides access to CPU slices
  - ❖ cpuacct - generates automatic reports on CPU resources used
  - ❖ cpuset - assigns individual CPUs/memory nodes
  - ❖ memory - limits and generates automatic reports on memory usage

# Namespaces

- ❖ pid - process numbering hierarchy
- ❖ net - network interfaces, IPs, ports
- ❖ ipc - interprocess communication  
(PostgreSQL)
- ❖ mnt - mountpoints/filesystems

# Union File System



*Host File System*

# Docker 0.9

- ❖ Execution Driver API

- ❖ Allows container execution environment customization
  - ❖ Can develop drivers to support any isolation tool (e.g. lxc, libvirt, warden, BSD Jails, Solaris Zones, and even good old chroot!)

- ❖ New Default Driver: *libcontainer*

- ❖ Accesses cgroups/namespaces directly
  - ❖ Pure Go library
  - ❖ Remove LXC dependency / add stability!

Docker isn't a  
container technology!

It's a container  
description format and  
orchestration API!

*The Addison-Wesley Signature Series*



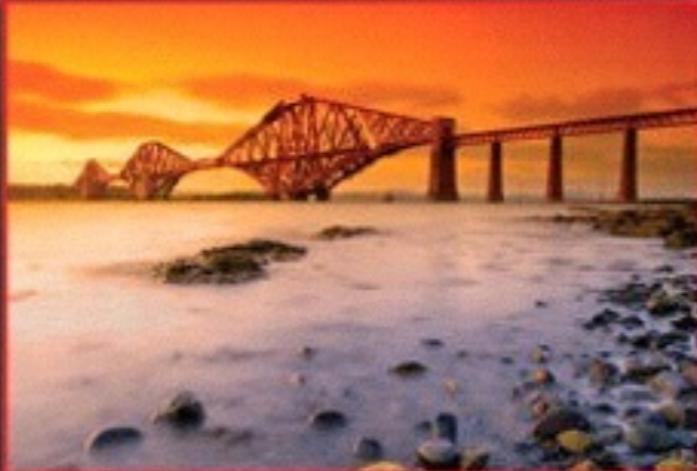
A MARTIN FOWLER  
BOOK SIGNATURE

# CONTINUOUS DELIVERY

RELIABLE SOFTWARE RELEASES THROUGH BUILD,  
TEST, AND DEPLOYMENT AUTOMATION

---

JEZ HUMBLE  
DAVID FARLEY



*Foreword by Martin Fowler*

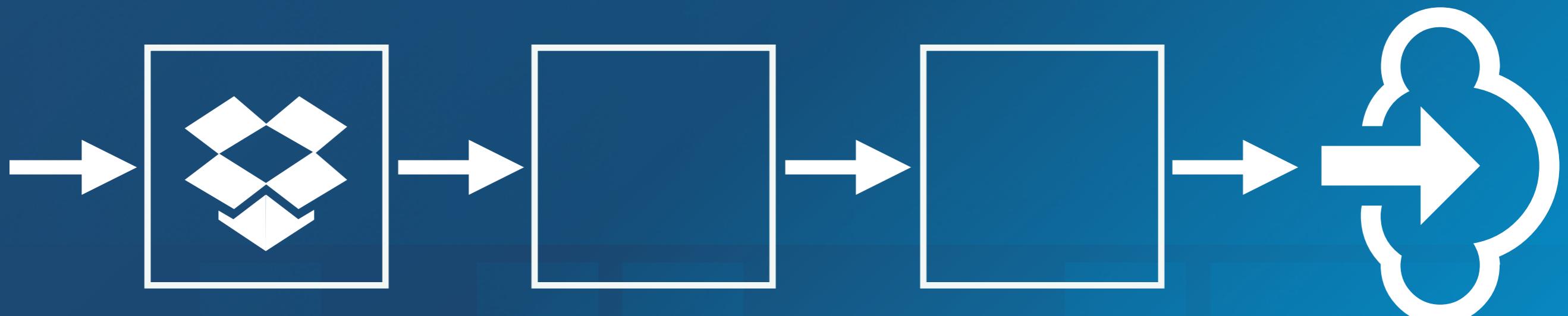
# Every Commit a Candidate for Deployment



# Build a Deployable Artifact



# Same Artifact Goes Through Entire Pipeline



# If you make it to the end...



**Carl Caum**  
@cccaum

 Follow

Continuous Delivery doesn't mean every change is deployed to production ASAP. It means every change is proven to be deployable at any time

3:25 AM - 28 Aug 2013

---

212 RETWEETS 61 FAVORITES



[twitter.com/cccaum/statuses/372620989257232384](https://twitter.com/cccaum/statuses/372620989257232384)

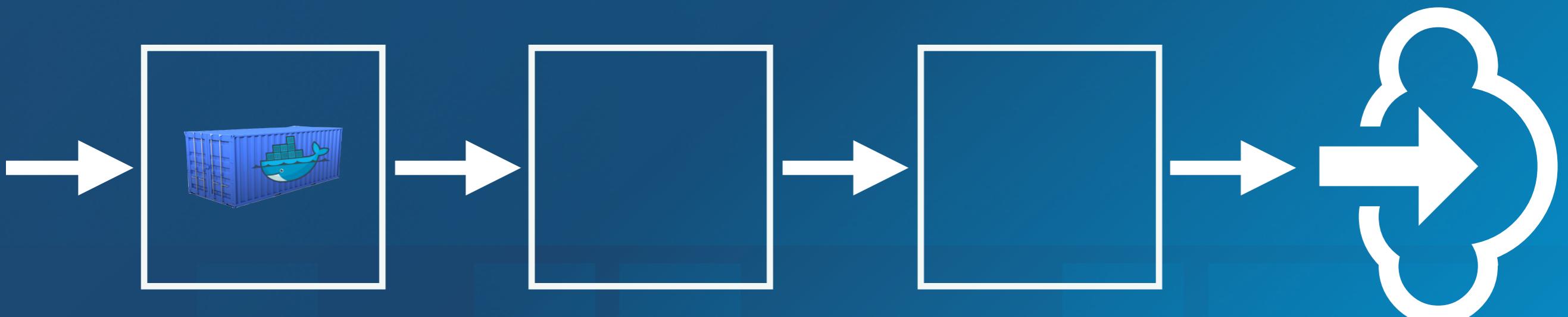
# How does Docker help?



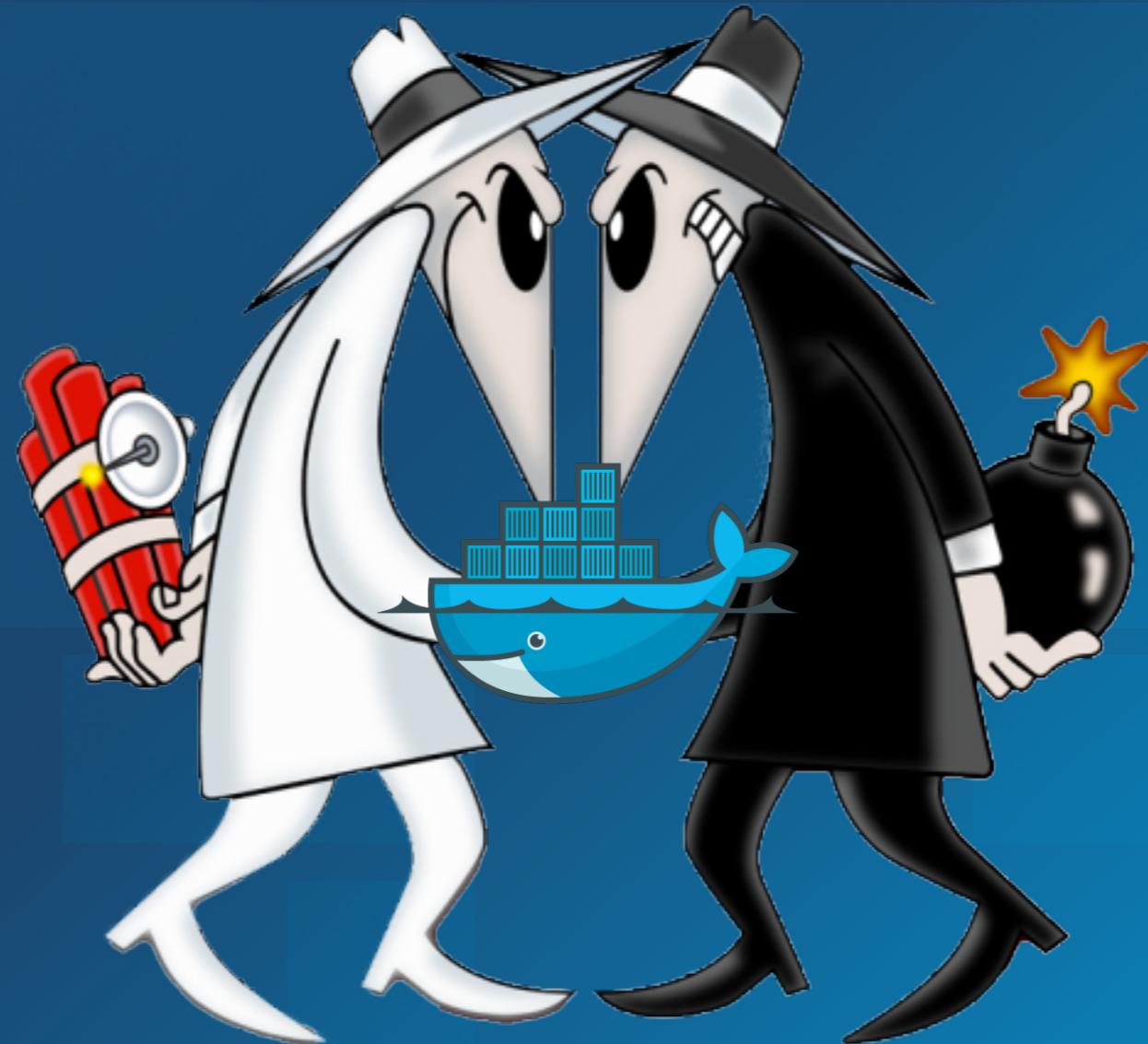
# Build a Container



# Same Container Goes Through Entire Pipeline



# DevOps



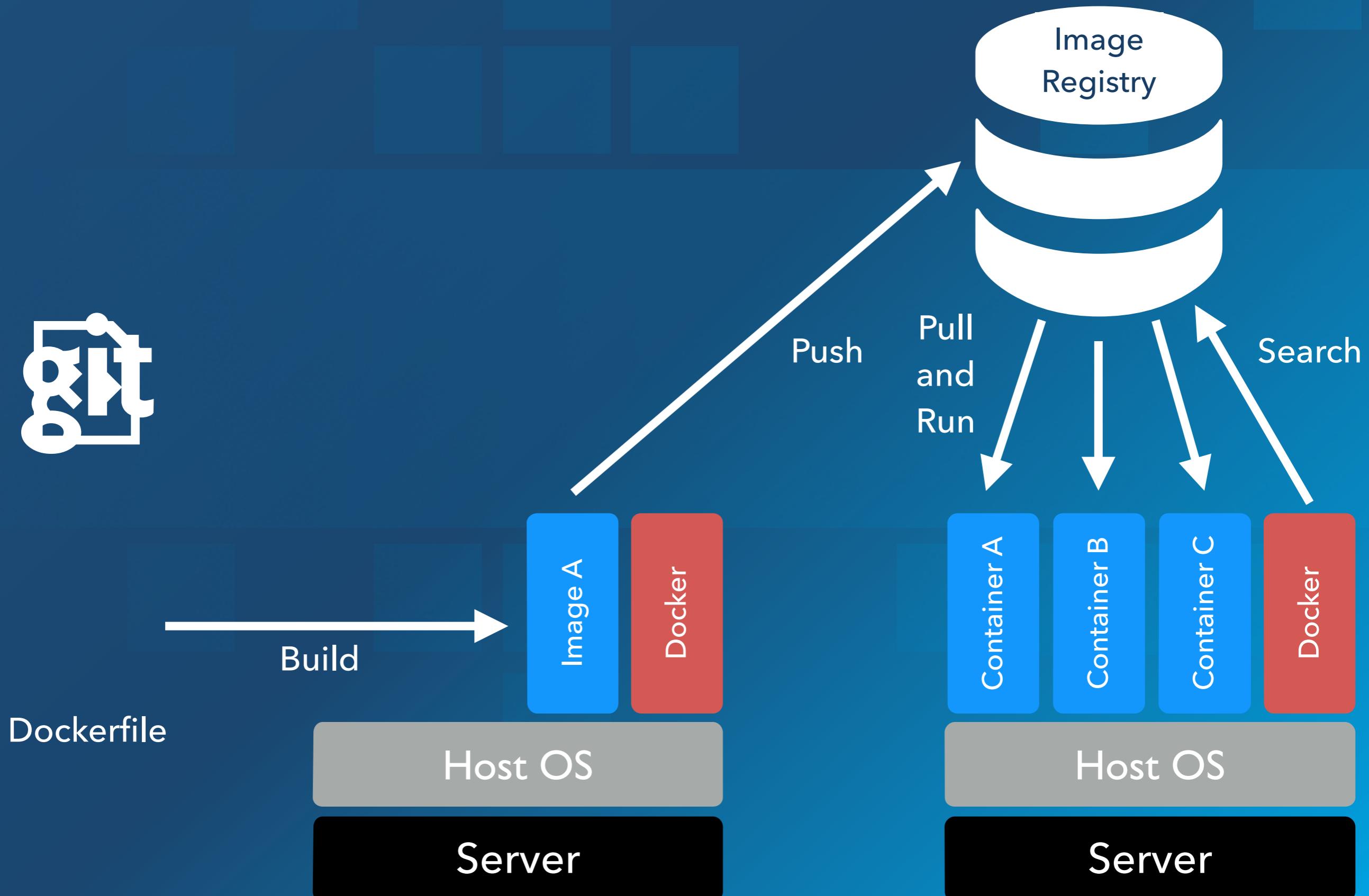


# Development

# Operations



# Container Lifecycle





## Official Repositories

**redis****ubuntu**

The Official Ubuntu base image



Popular open-source relational database management system

**mongoDB**

Document-oriented NoSQL database

**WORDPRESS**

WordPress is a free and open source blogging tool and a content management system

**NGINX**

High performance reverse proxy server



Relational database management system



Node.js is a platform for scalable server-side and networking applications

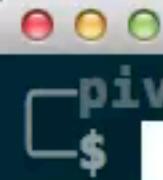
**CentOS**

Official CentOS base image

<https://registry.hub.docker.com/>

# Building Containers

# Manually



1. tmux (tmux)

pivotal@turkey ~ &lt;ruby-1.9.3&gt;

\$

# Dockerfiles

# FROM

```
FROM dockerfile/java
```

Specifies the base image

# MAINTAINER

**MAINTAINER** Matt Stine [mstine@gopivotal.com](mailto:mstine@gopivotal.com)

Specifies the name and email of the Dockerfile  
author/maintainer

# RUN

```
RUN apt-get update
```

Execute any command on the current image and  
commit the results

# ADD

```
ADD ./build/libs/app.jar /home/app/app.jar
```

Copies files from `src` and add them to the container filesystem at path `dest`, then commits the results.

# ENTRYPOINT

```
ENTRYPOINT ["java","-jar","/home/app/app.jar"]
```

Sets the default command for the image (will be triggered on container start)

# USER

USER app

Specifies the user to use when running the image

# ENV

```
ENV key value  
ENV key=value
```

Sets the environment variable(s) key equal to value.

# EXPOSE

**EXPOSE 8080**

Specifies ports to be exposed (for creating links)  
when running the image

# VOLUME

```
VOLUME /data
```

Creates a mountpoint with the specified name and marks it as holding externally mounted volumes from the native host or other containers.

# A Dockerfile

```
FROM centos:6.4
RUN rpm -Uvh http://download.fedoraproject.org/
pub/epel/6/i386/epel-release-6-8.noarch.rpm
RUN yum install -y npm
ADD . /src
RUN cd /src; npm install
EXPOSE 8080
ENTRYPOINT ["node", "/src/index.js"]
```

# Dockerfiles

- ❖ Each line results in a newly committed image
- ❖ Iterating only incorporates deltas into the final image
- ❖ More instructions: <http://docs.docker.io/en/latest/reference/builder/>

1. tmux (tmux)  
pivotal@turkey ~/workspace/docker/redis <ruby-1.9.3>  
\$

# Other Container Solutions

# Cloud Foundry Garden

- ❖ Production-ready CF container orchestration service
- ❖ Designed to support multiple containerization backends
- ❖ <https://github.com/cloudfoundry-incubator/garden-linux>
- ❖ <https://github.com/cloudfoundry-incubator/garden-windows>
- ❖ Based on original Ruby-based Warden: <https://github.com/cloudfoundry/warden>



# Standards?



<https://github.com/coreos/rocket>

<https://github.com/coreos/rocket/blob/master/app-container/SPEC.md>

# Standards!

## LINUX FOUNDATION COLLABORATIVE PROJECTS



Announcing a new project, supported by users and industry leaders around the world, to bring open standards to software containers.

## OPEN CONTAINER PROJECT

<https://www.opencontainers.org/>

<https://github.com/opencontainers/specs>



Announcing **runc** - a lightweight universal runtime container.



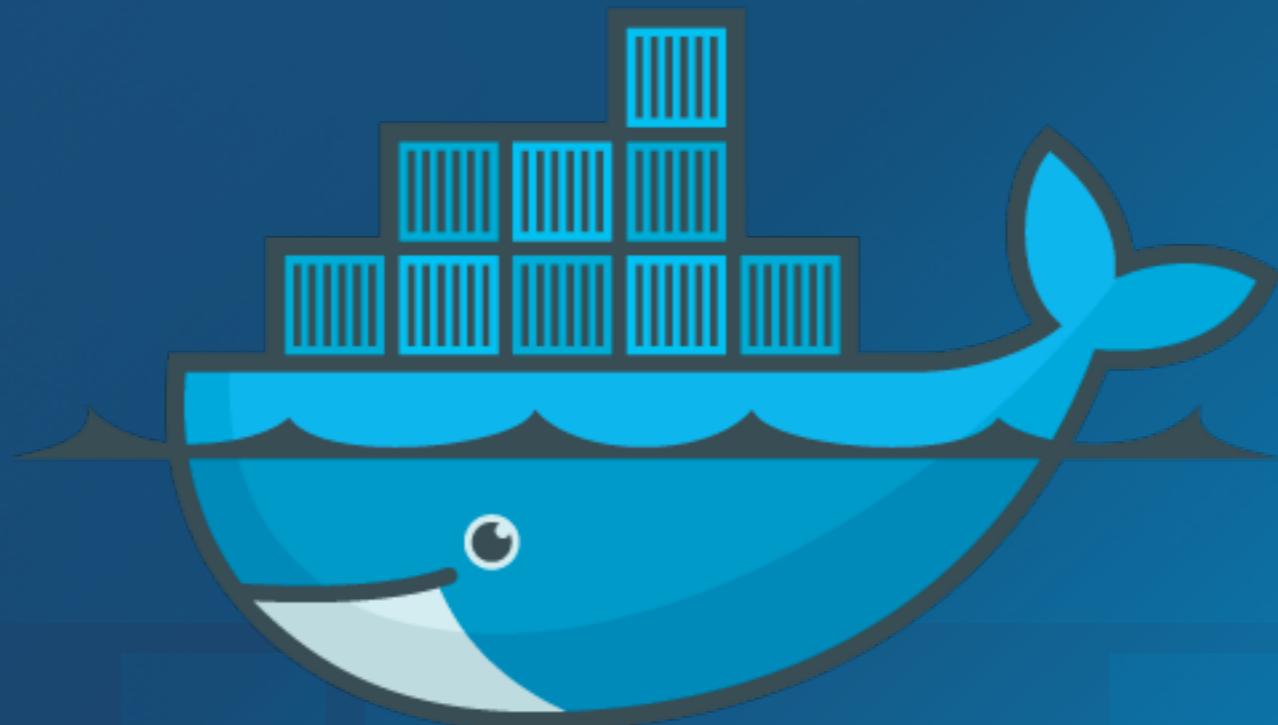
<https://runc.io>

<https://github.com/opencontainers/runc>

# Resources

- ❖ Getting Started Tutorials:
  - ❖ <http://docs.docker.com/mac/started>
  - ❖ <http://docs.docker.com/windows/started>
- ❖ Order the Docker Book: <http://www.dockerbook.com/>
- ❖ Follow @docker on Twitter
- ❖ DockerCon 2015 Videos here: <http://bit.ly/dockercon-2015>

# Thank you!



Matt Stine (@mstine)  
Senior Product Manager, Pivotal  
[matt.stine@gmail.com](mailto:matt.stine@gmail.com)  
<http://www.mattstine.com>