What the containers?

Arun Gupta, @arungupta

Docker Captain

Java Champion

JavaOne Rock Star (4 years)

NetBeans Dream Team

Silicon Valley JUG Leader

Author

Runner

Lifelong learner

Malcom McLean

Father of Containerization

Intermodalism

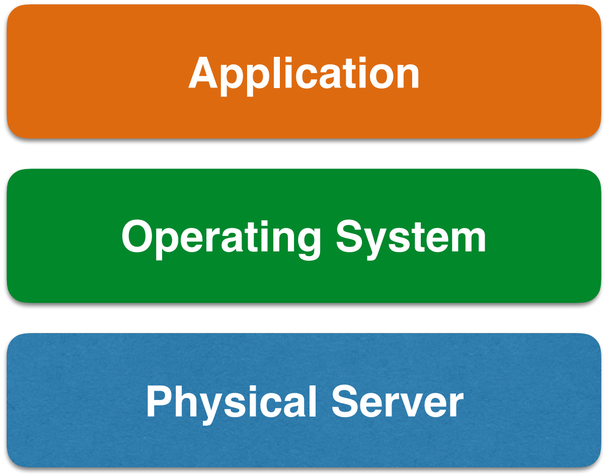
"pertaining to or suitable for transportation involving ***more than one form of carrier"***


MSC OSCAR
MAERSK
MAERSK SEALAND

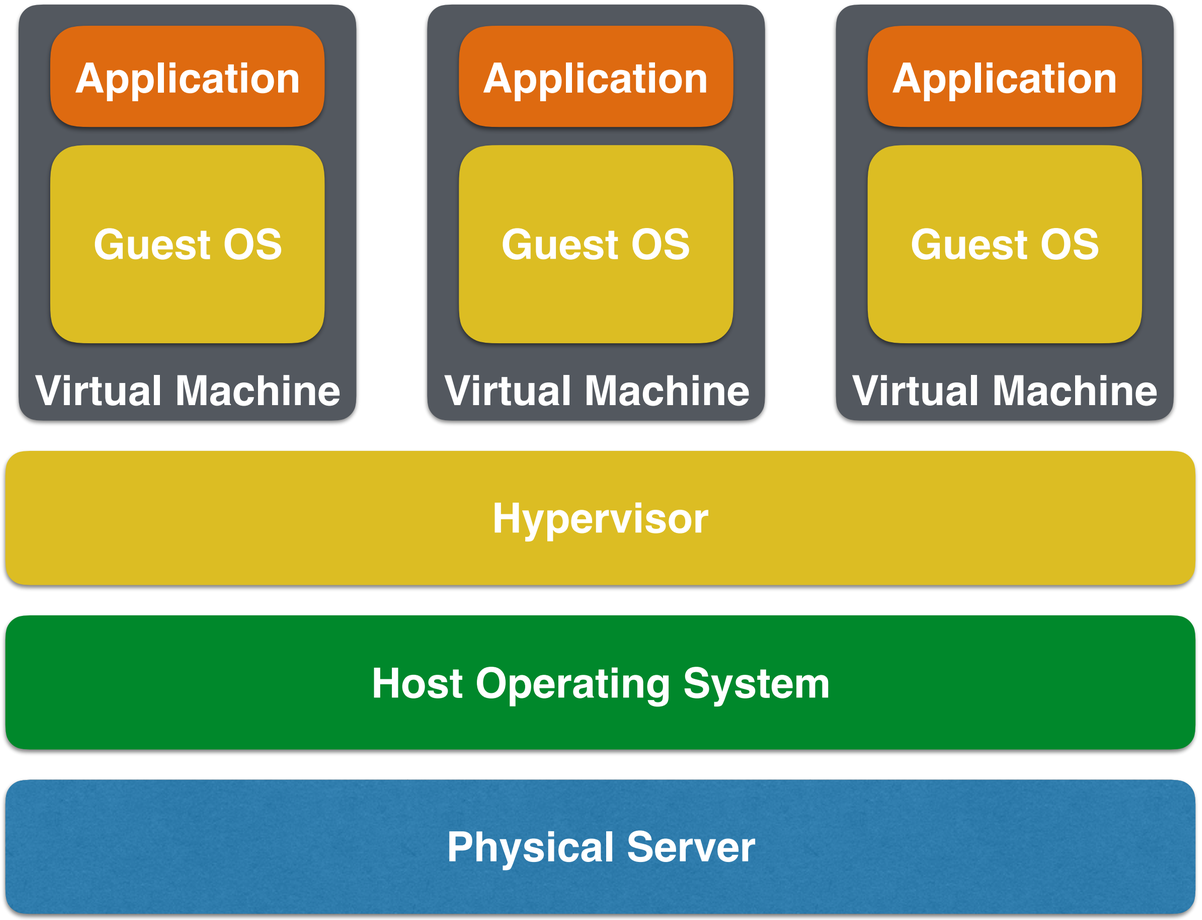
Advantages of Containerization

- Standard transport product
- Flexibility of usage
- Economies of scale
- Speed
- Security
- Lower labor costs
- Efficient stacking
- Boom in international trade

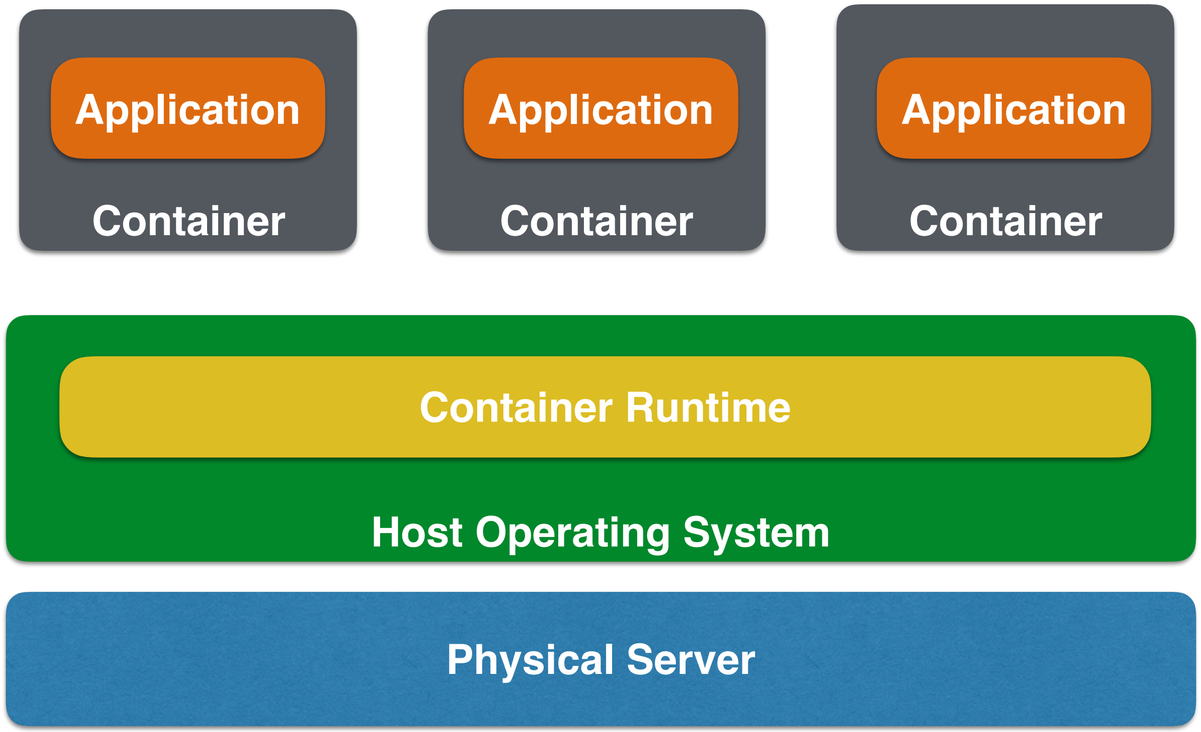
Bare Metal



Virtual Machines

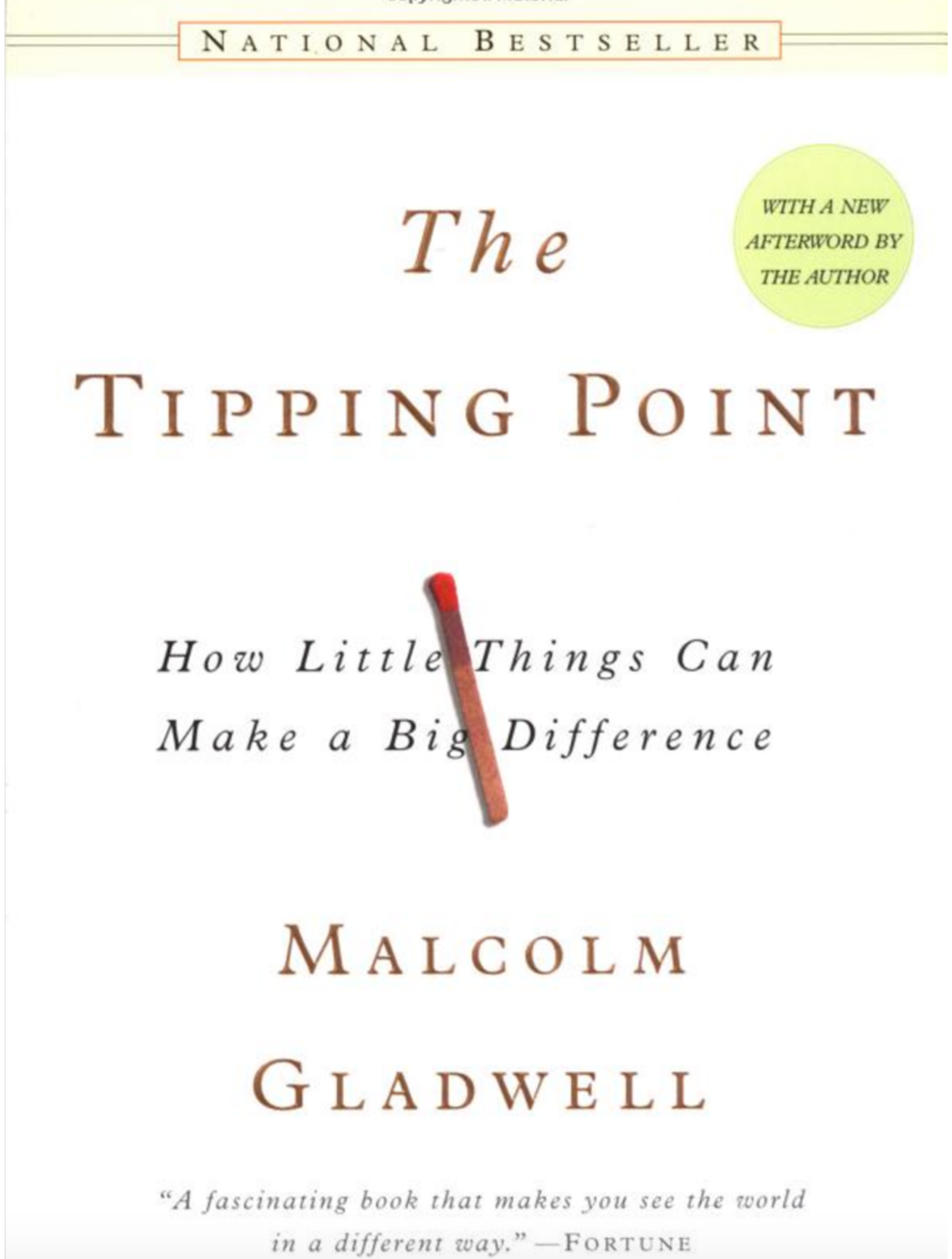


Containers



Advantages of Containerization

- Standard transport product
- Flexibility of usage
- Economies of scale
- Speed
- Security
- Lower labor costs
- Efficient stacking
- Boom in international trade
- Standard packaging
- Application agnostic
- High density
- Faster deployment
- Security sandbox
- Easy portability
- Orchestration frameworks
- Tipping point



- Cloud-native
- Microservices
- DevOps
- Docker

CLOUD NATIVE
COMPUTING FOUNDATION

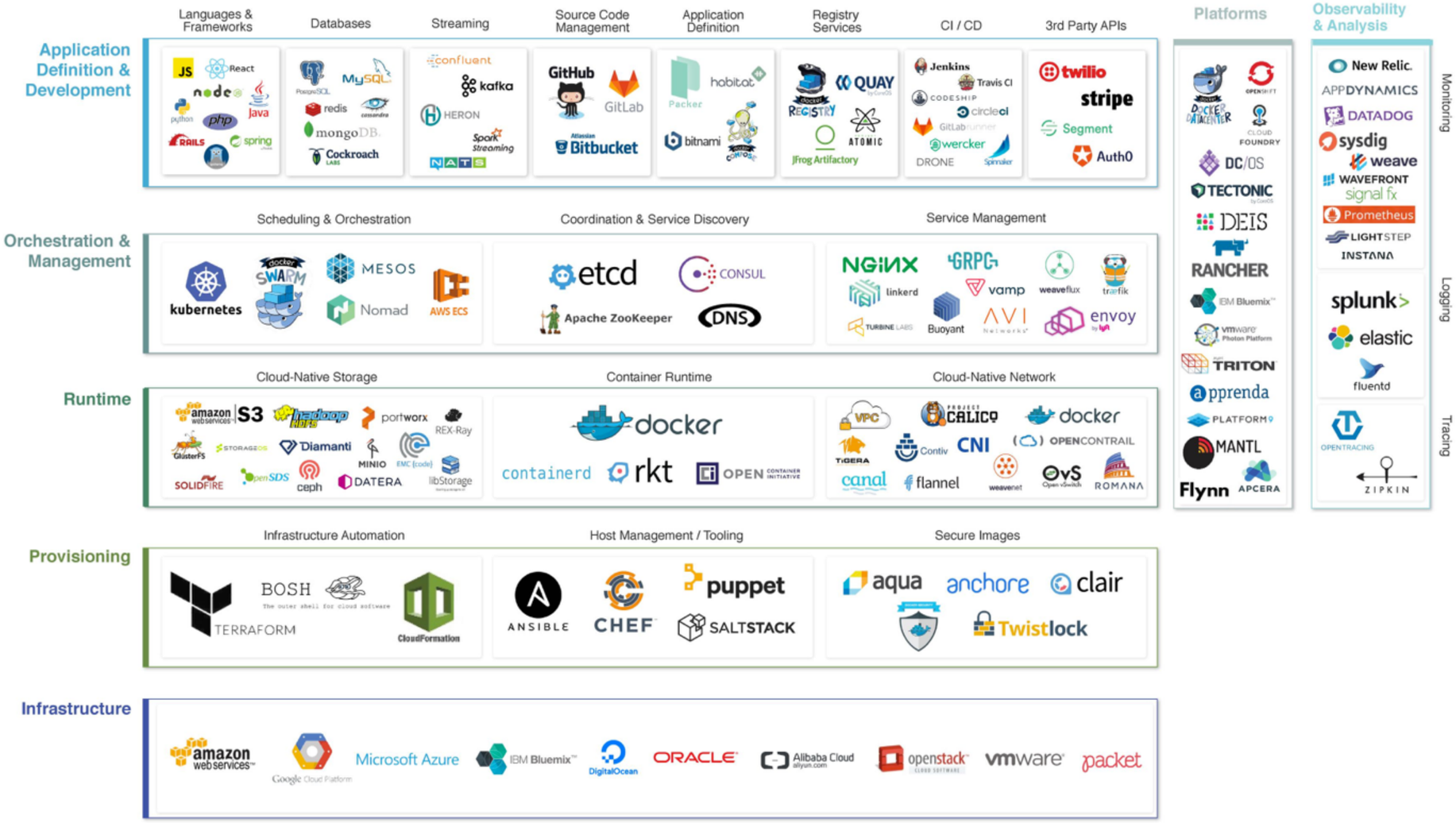
Create and drive adoption of computing paradigm optimized for distributed systems capable of scaling to tens of thousands of self-healing multi-tenant nodes

CLOUD NATIVE
COMPUTING FOUNDATION

- Uses an open source software stack to
  - deploy applications as **microservices**
  - package each part into its own **container**
  - dynamically **orchestrate containers** for optimum resource utilization

Cloud Native Landscape v0.9.3

Redpoint | Amplify Partners | Cloud Native Computing Foundation



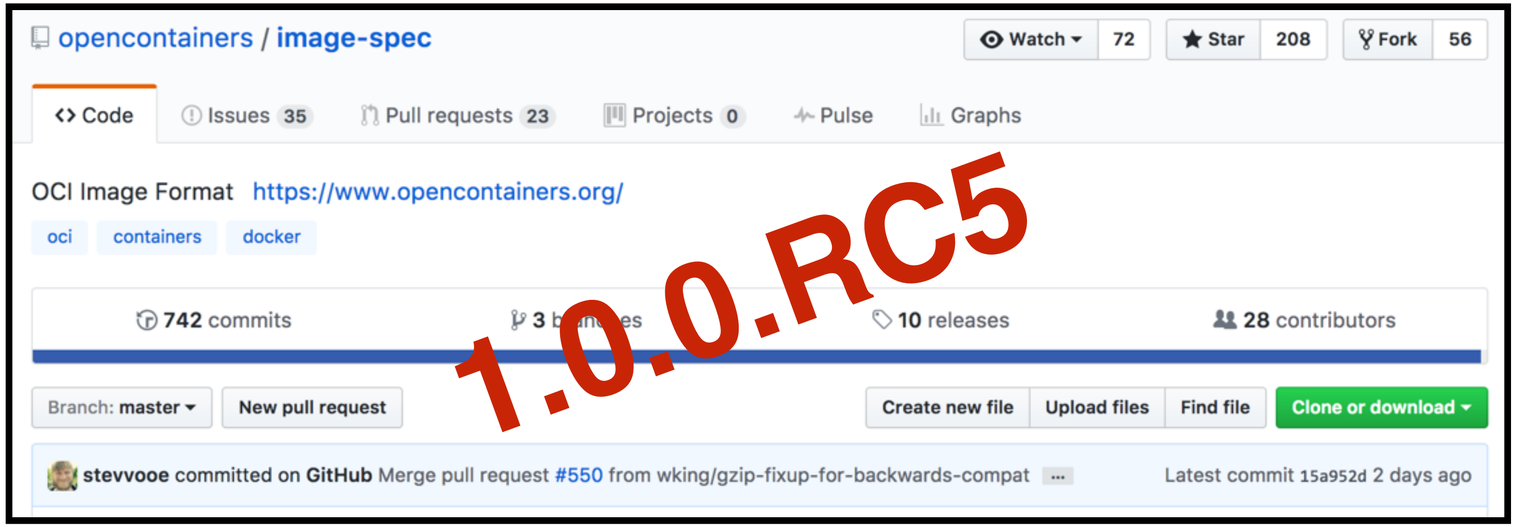
http://github.com/cncf/landscape

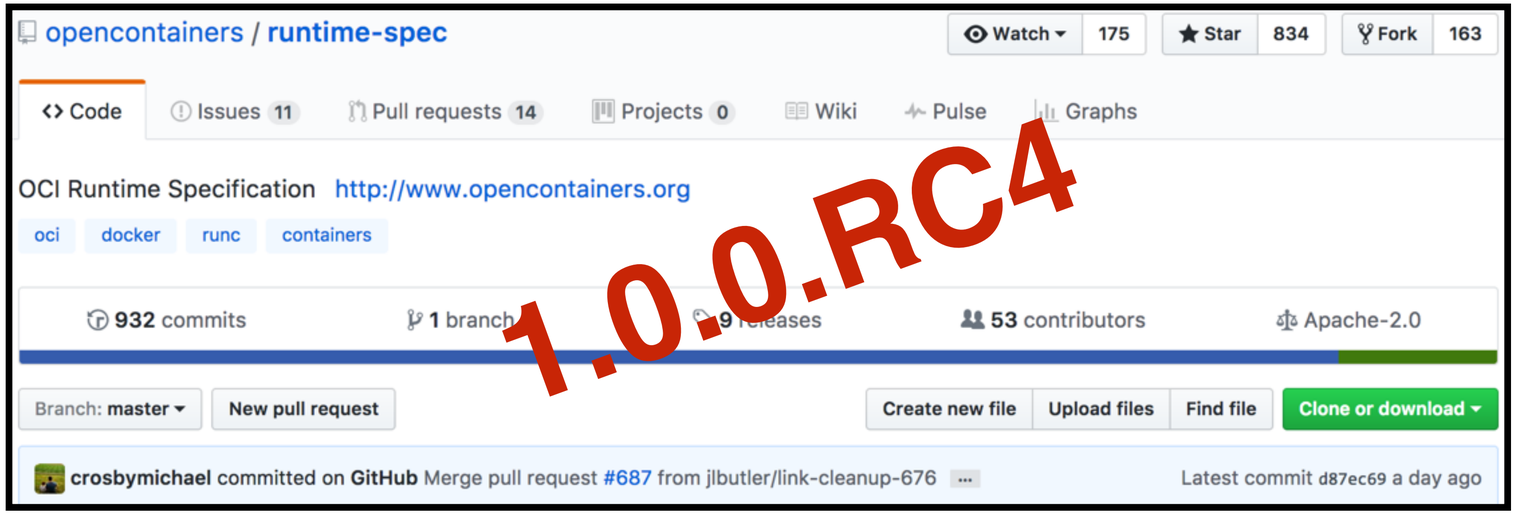
@dankohn1 @lennypruss @sraney

OPEN CONTAINER INITIATIVE

promote a set of common, minimal, open standards and specifications around container technology

OCI Projects





OCI Image Spec

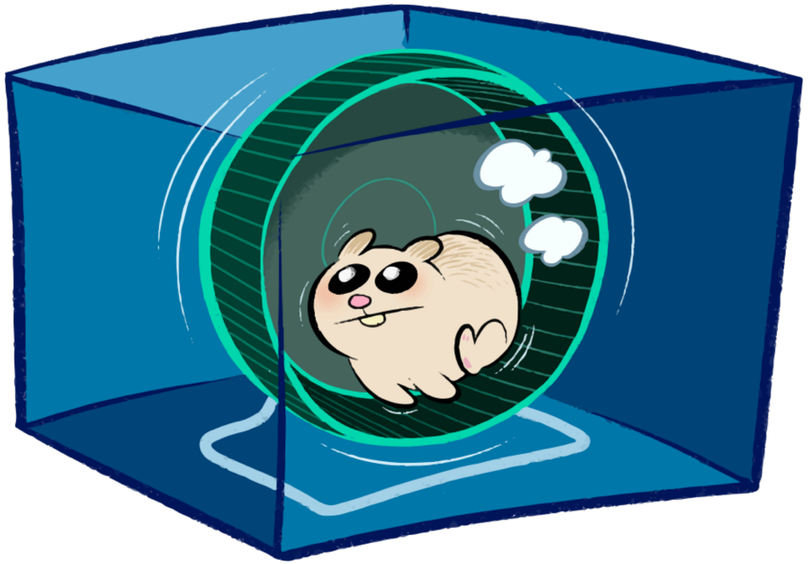
- Image format
  - Docker - **`docker save`** and **`load`**
- Registry
  - rkt - supports pull only
  - AWS ECR - push and pull OCI images
- Tools to generate OCI image
  - acbuild: github.com/containers/build
  - umoci: github.com/openSUSE/umoci

OCI Runtimes

https://github.com/opencontainers/runtime-spec/blob/master/implementations.md

runC

- Reference Implementation of the OCI runtime specification
  - Donated by Docker
  - Based on original *libcontainer* project
    - Interfaces with *cgroups* and *namespaces*
  - Manage the lifecycle of container
  - Lockstep with OCI specifications major version



opencontainers / runc

Watch 320 | Star 3,574 | Fork 557

Code | Issues 68 | Pull requests 39 | Projects 0 | Wiki | Pulse | Graphs

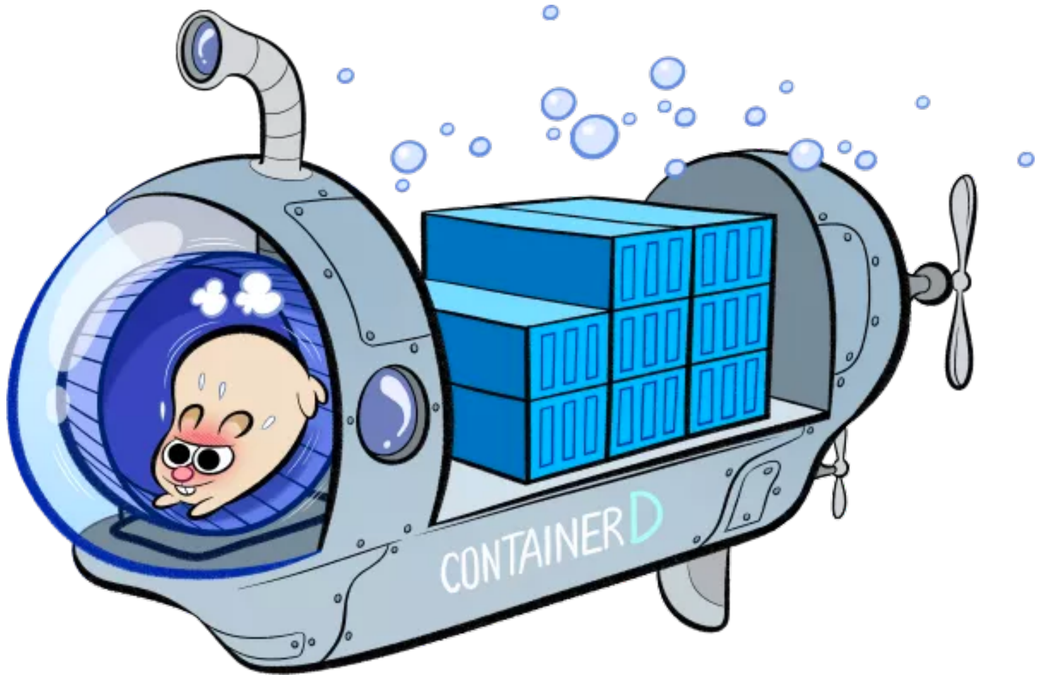
RC2

CLI tool for spawning and running containers according to the OCI specification https://www.opencontainers.org/

containers docker oci

containerd

- Daemon that uses runC to manage containers
- Exposes its functionality over gRPC
- Docker Engine uses API to run containers
  - Adds volumes, networks, images etc
  - Exposes a full-blown REST API



docker / containerd

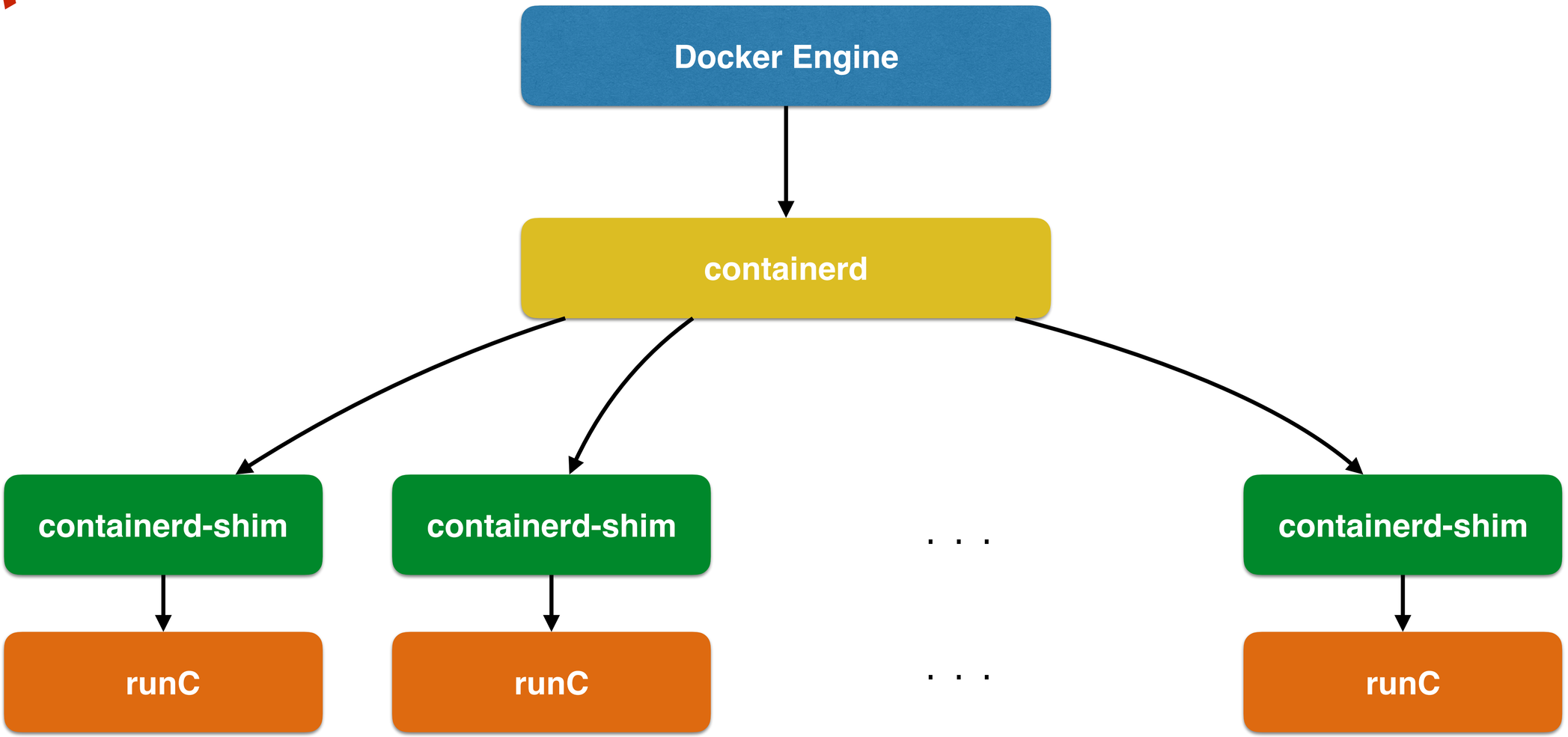
Watch 141 | Star 1,238 | Fork 216

Code | Issues 36 | Pull requests 11 | Projects 0 | Wiki | Pulse | Graphs

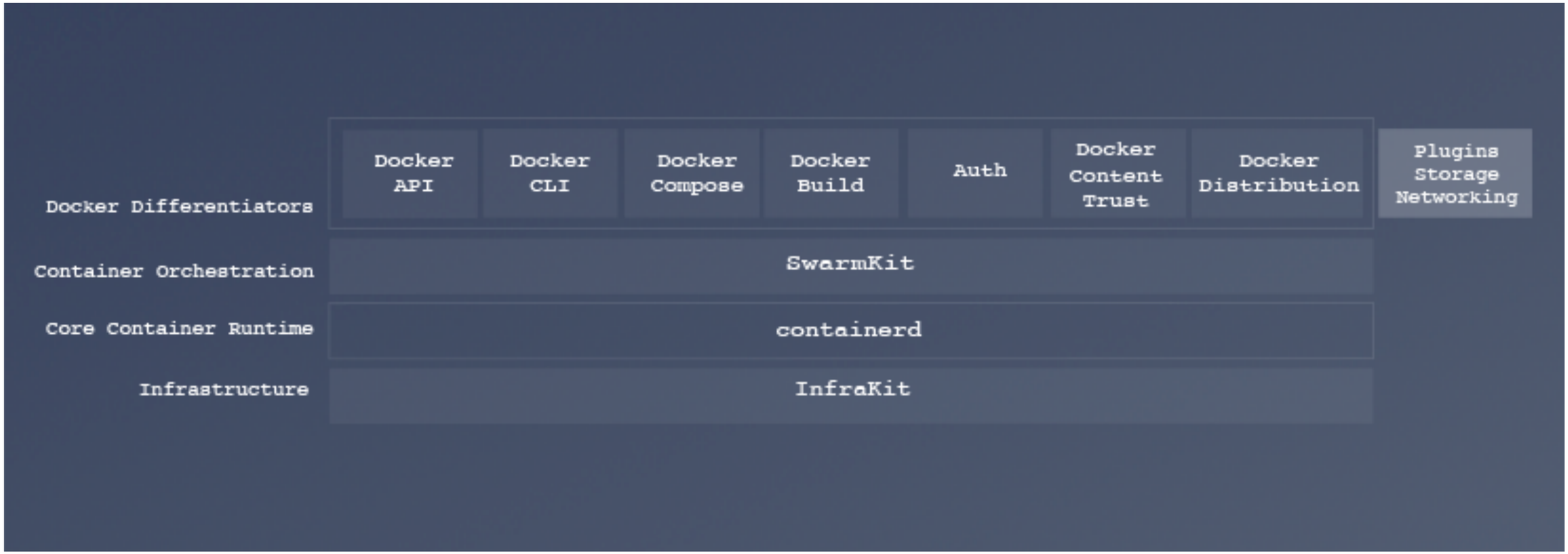
0.2.5

An open and reliable container runtime, by Docker https://containerd.io

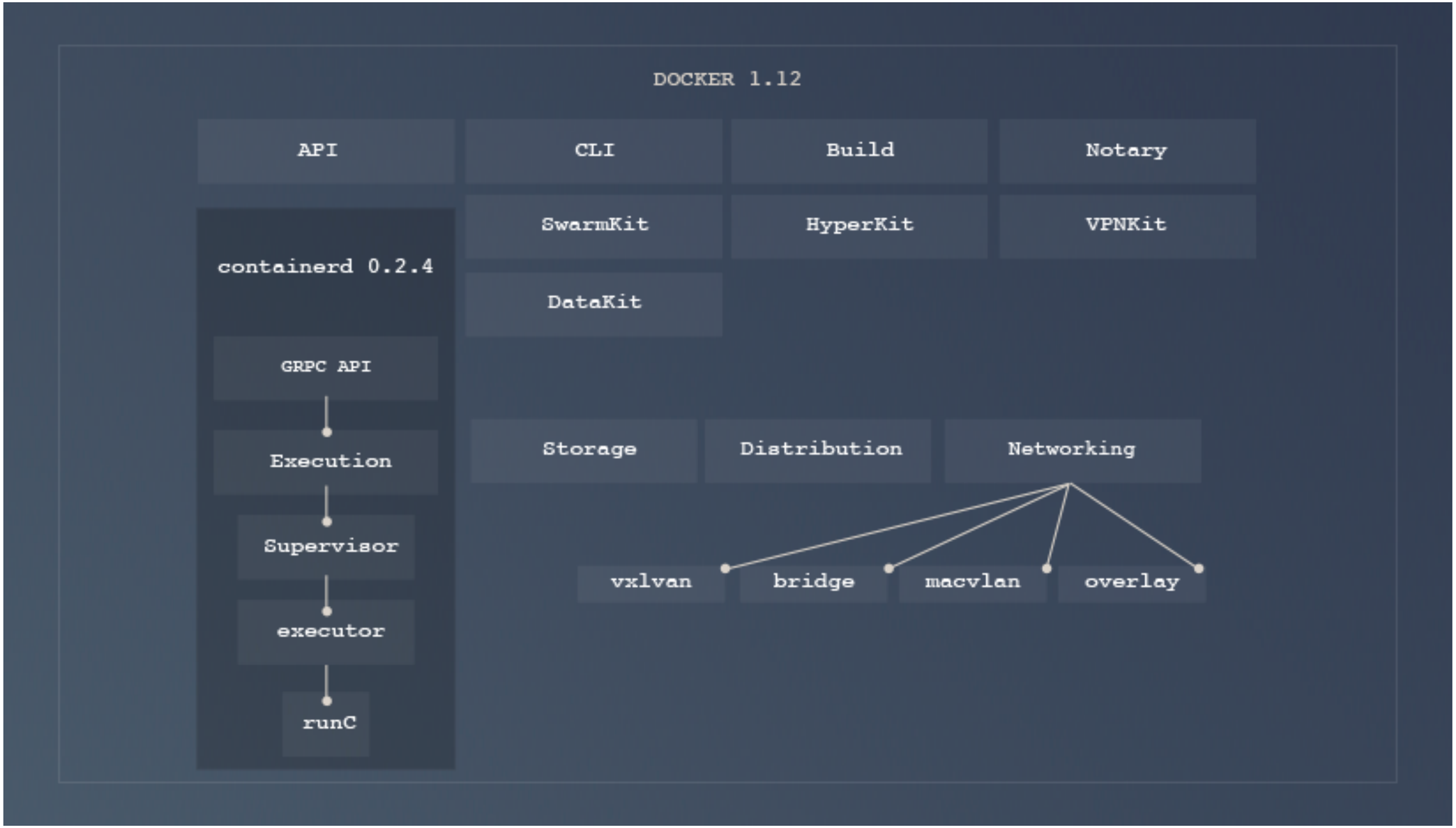
TODAY



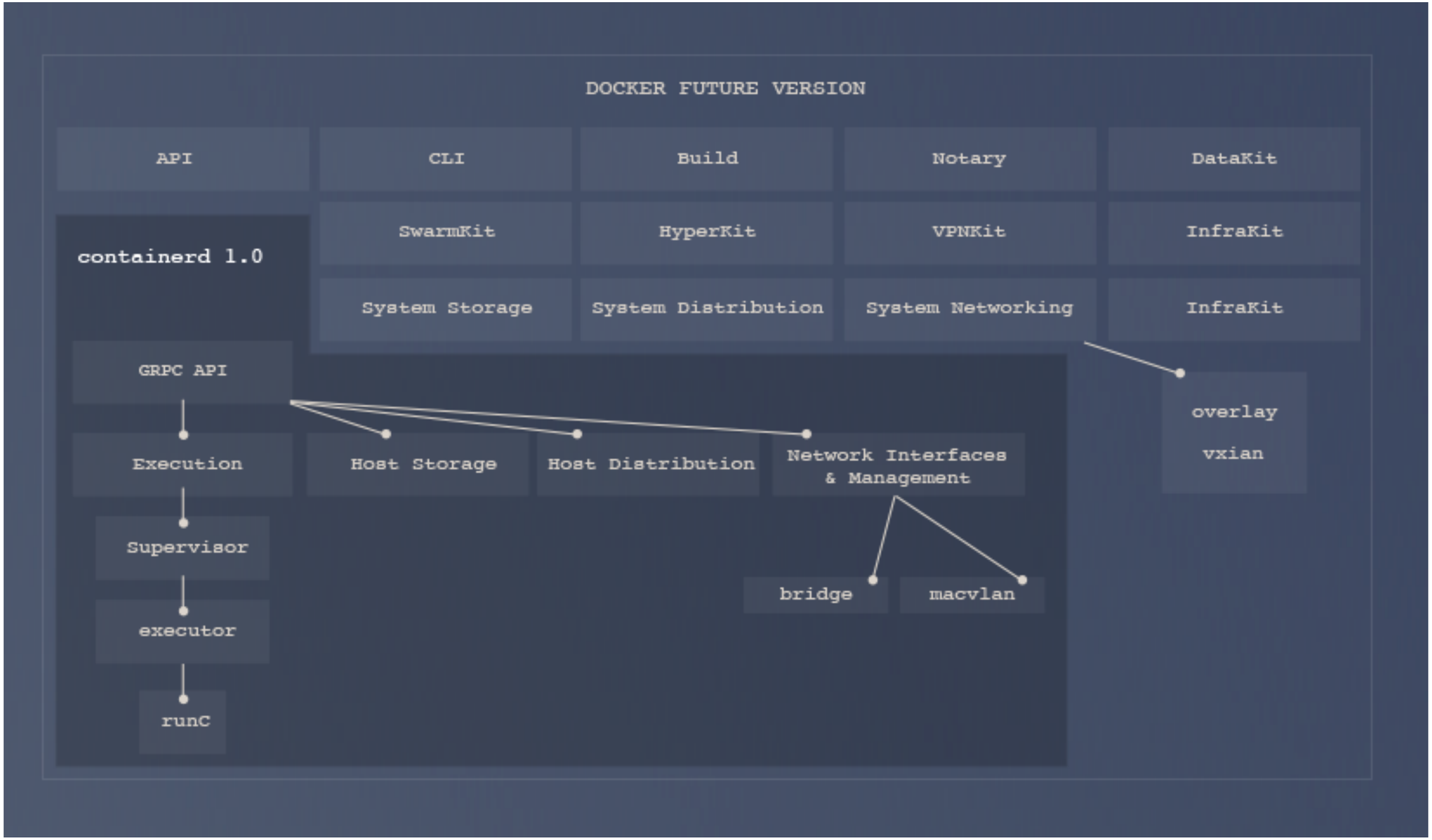
Containerd and Docker



TODAY

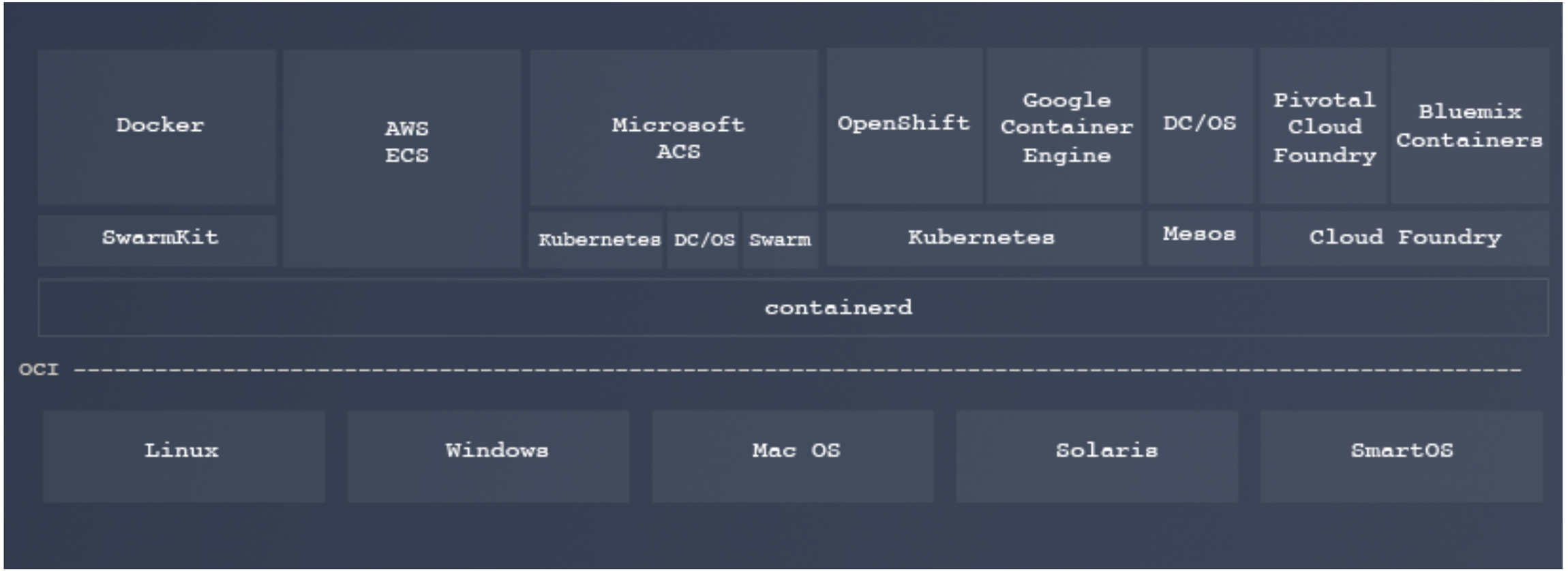


FUTURE

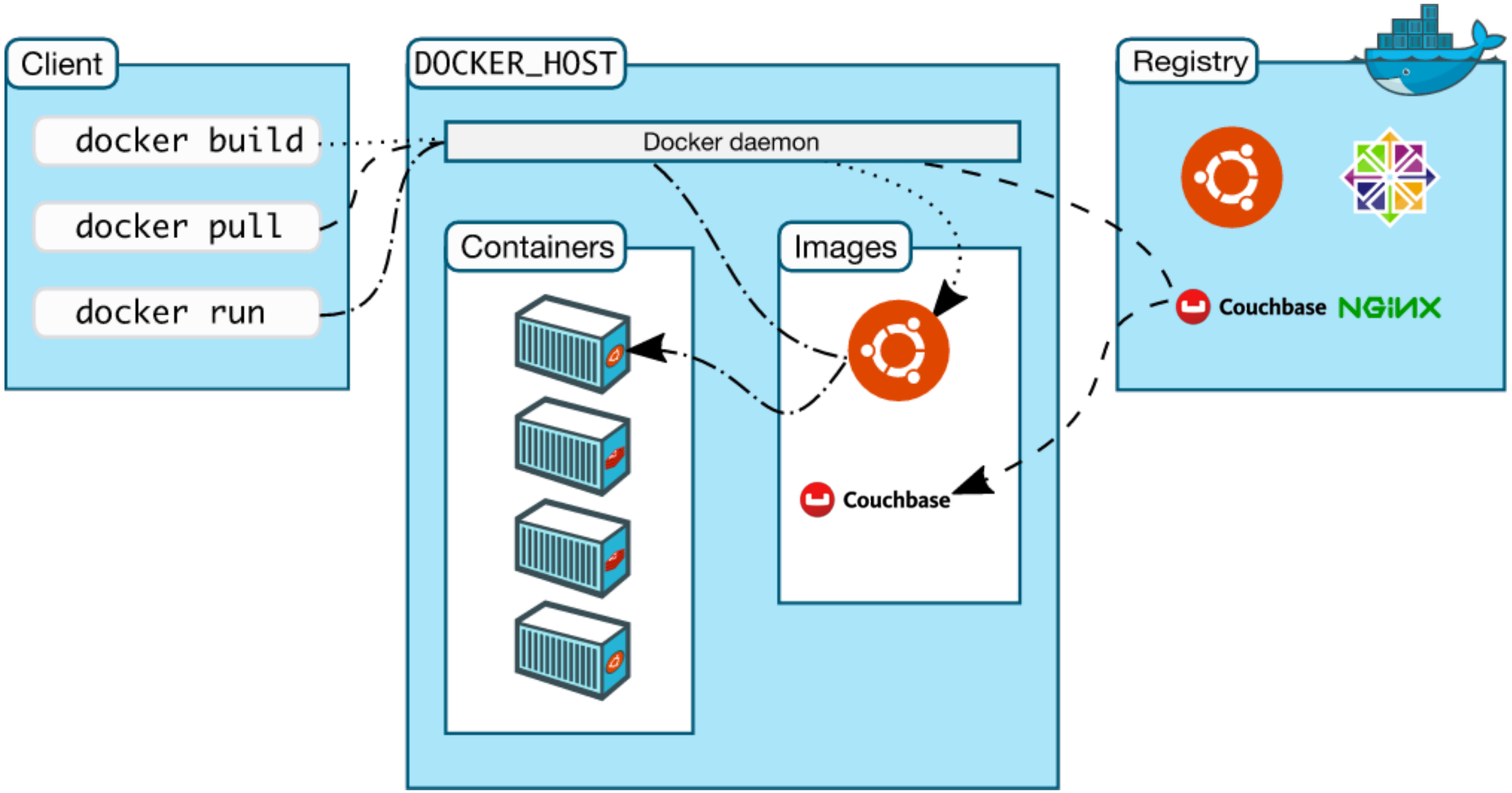


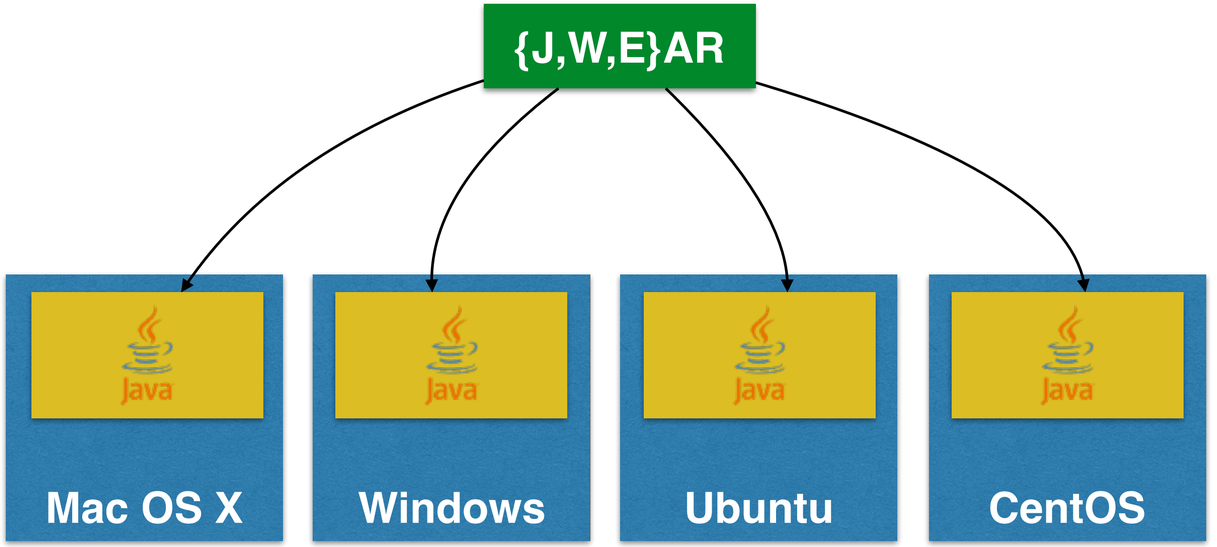
FUTURE

Containerd and Orchestration Frameworks

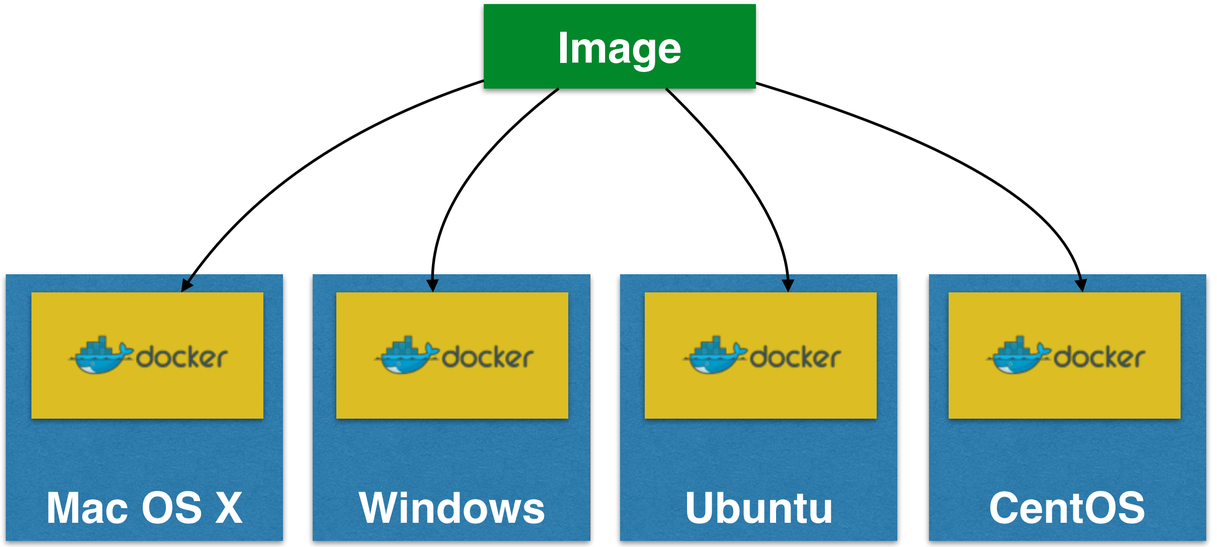


Container Workflow





WORA = Write Once Run Anywhere

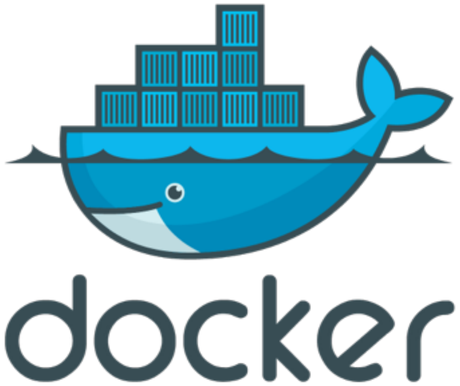


PODA = Package Once Deploy Anywhere

Orchestration Frameworks

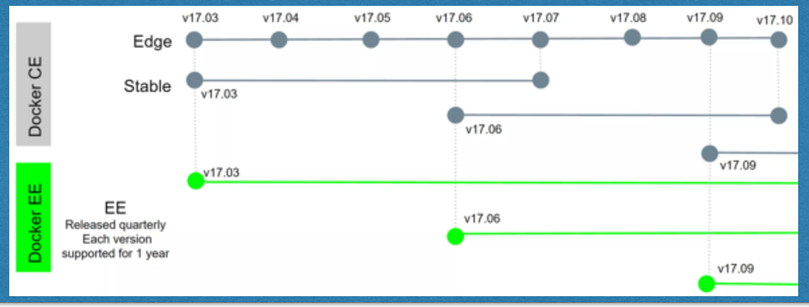
- Local development
- Core concepts
- Declarative state
- Schedule containers
- Service discovery
- Load balancing
- System monitoring
- Persistent Volumes
- Multi-host networking
- Multiple master
- Rolling Update
- Rules and constraints
- Cloud/commercial support

Orchestration Frameworks



Local Development

- Docker Community Edition
  - Docker for Mac/Windows/Linux
  - Monthly edge and quarterly stable
  - Native desktop or cloud provider experience

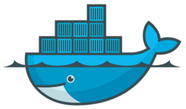


- Single-node cluster
  - Minikube
- Multi-node cluster
  - kops (AWS)
  - kube-aws (CoreOS + AWS)
  - kube-up (deprecated)
  - GCE, Azure, Tectonic, …

- Vagrant image
- Cloud
  - AWS CloudFormation templates
  - Azure Resource Manager templates
  - Digital Ocean using Terraform
  - GCE (using scripts)

- Amazon Web Services

Core Concepts



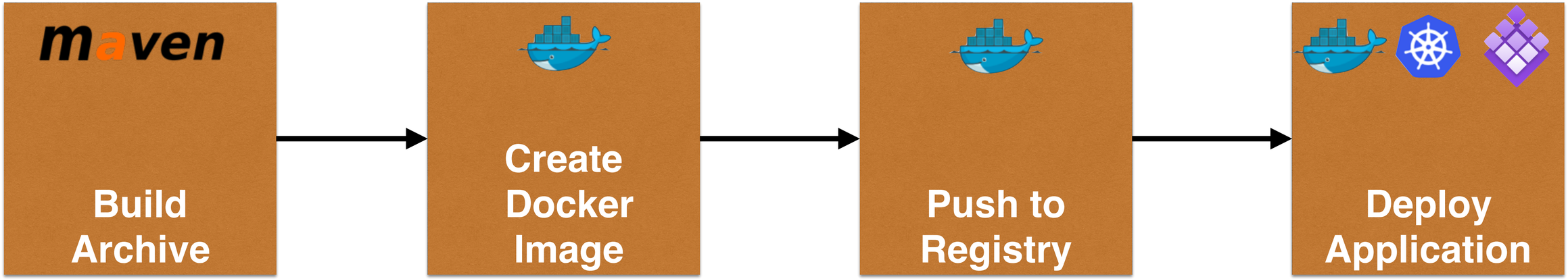
- Ops
  - Managers
  - Workers
- Developer
  - Replicated and Global Service
  - Tasks
  - Scaling
  - Run-once
  - Compose

- Ops
  - Master
  - Worker
- Developer
  - Pods (Horizontal Pod Autoscaling)
  - Services
  - Deployment
  - Replica Set
  - Daemon Set
  - Job

- Ops
  - Master & Slaves (Mesos, public/private)
  - Frameworks (Marathon)
- Developer
  - Application
    - Task
    - Pod (multiple tasks that share)
  - Job

- Ops
  - Container Instance
  - Cluster
- Developer
  - Service
    - AutoScaling - integrated with CloudWatch
  - Task

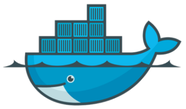
Containers and Java Developers



Docker Image with Maven

```
<plugin>
  <groupId>io.fabric8</groupId>
  <artifactId>docker-maven-plugin</artifactId>
  <version>0.19.0</version>
  <configuration>
   <images>
     <image>
       <name>hellojava</name>
       <build>
         <from>openjdk:latest</from>
         <assembly>
           <descriptorRef>artifact</
descriptorRef>
         </assembly>
         <cmd>java -jar maven/${project.name}-$
{project.version}.jar</cmd>
       </build>
       <run>
         <wait>
           <log>Hello World!</log>
         </wait>
        </run>
      </image>
    </images>
  </configuration>
  <executions>
    <execution>
      <id>docker:build</id>
      <phase>package</phase>
      <goals>
        <goal>build</goal>
      </goals>
    </execution>
    <execution>
      <id>docker:start</id>
      <phase>install</phase>
      <goals>
        <goal>run</goal>
        <goal>logs</goal>
      </goals>
    </execution>
  </executions>
</plugin>
```

Application Definition



```
version: “3”
services:
  db:
    image: arungupta/couchbase:travel
    ports:
      - 8091:8091
      - 8092:8092
      - 8093:8093
      - 11210:11210
  web:
    image: arungupta/wildfly-couchbase-javaee:travel
    environment:
      - COUCHBASE_URI=db
    ports:
      - 8080:8080
      - 9990:9990
```

Application Definition

```
apiVersion: v1
kind: Service
metadata:
  name: couchbase-service
spec:
  selector:
    app: couchbase-rc-pod
  ports:
    - name: admin
      port: 8091
    - name: views
      port: 8092
    - name: query
      port: 8093
    - name: memcached
      port: 11210
---
apiVersion: v1
kind: ReplicationController
metadata:
  name: couchbase-rc
spec:
  replicas: 1
  template:
    metadata:
      labels:
        app: couchbase-rc-pod
    spec:
      containers:
      - name: couchbase
        image: arungupta/wildfly-couchbase-javaee:travel
        ports:
        - containerPort: 8091
        - containerPort: 8092
        - containerPort: 8093
        - containerPort: 11210
---
apiVersion: batch/v1
kind: Job
metadata:
  name: web
  labels:
    name: web-pod
spec:
  template:
    metadata:
      name: web-pod
    spec:
      containers:
      - name: web-pod
        image: arungupta/couchbase:travel
        env:
        - name: COUCHBASE_URI
          value: couchbase-service
      restartPolicy: Never
```

Application Definition

```
{
   "id":"/webapp",
   "apps":[
      {
         "id":"database",
         "cpus":4,
         "mem":4096,
         "instances":1,
         "container":{
            "type":"DOCKER",
            "docker":{
               "image":"arungupta/couchbase:travel",
               "network":"USER"
            }
         },
         "ipAddress":{
            "networkName":"dcos"
         }
      },
      {
         "id":"web",
         "dependencies":[
            "/webapp/database"
         ],
         "cpus":2,
         "mem":4096,
         "instances":1,
         "container":{
            "type":"DOCKER",
            "docker":{
               "image":"arungupta/wildfly-couchbase-
javaee:travel",
               "network":"USER",
               "portMappings":[
                  {
                     "hostPort":0,
                     "containerPort":8080,
                     "protocol":"tcp"
                  }
               ]
            }
         },
         "ipAddress":{
            "networkName":"dcos"
         },
         "env":{
            "COUCHBASE_URI":"database-
webapp.marathon.containerip.dcos.thisdcos.directory"
         },
         "labels":{
            "HAPROXY_0_VHOST":"DCOS-PublicSlaveLo-
LZ6PIP10I08O-1004309391.us-west-1.elb.amazonaws.com",
            "HAPROXY_GROUP":"external"
         }
      }
   ]
}
```

Production

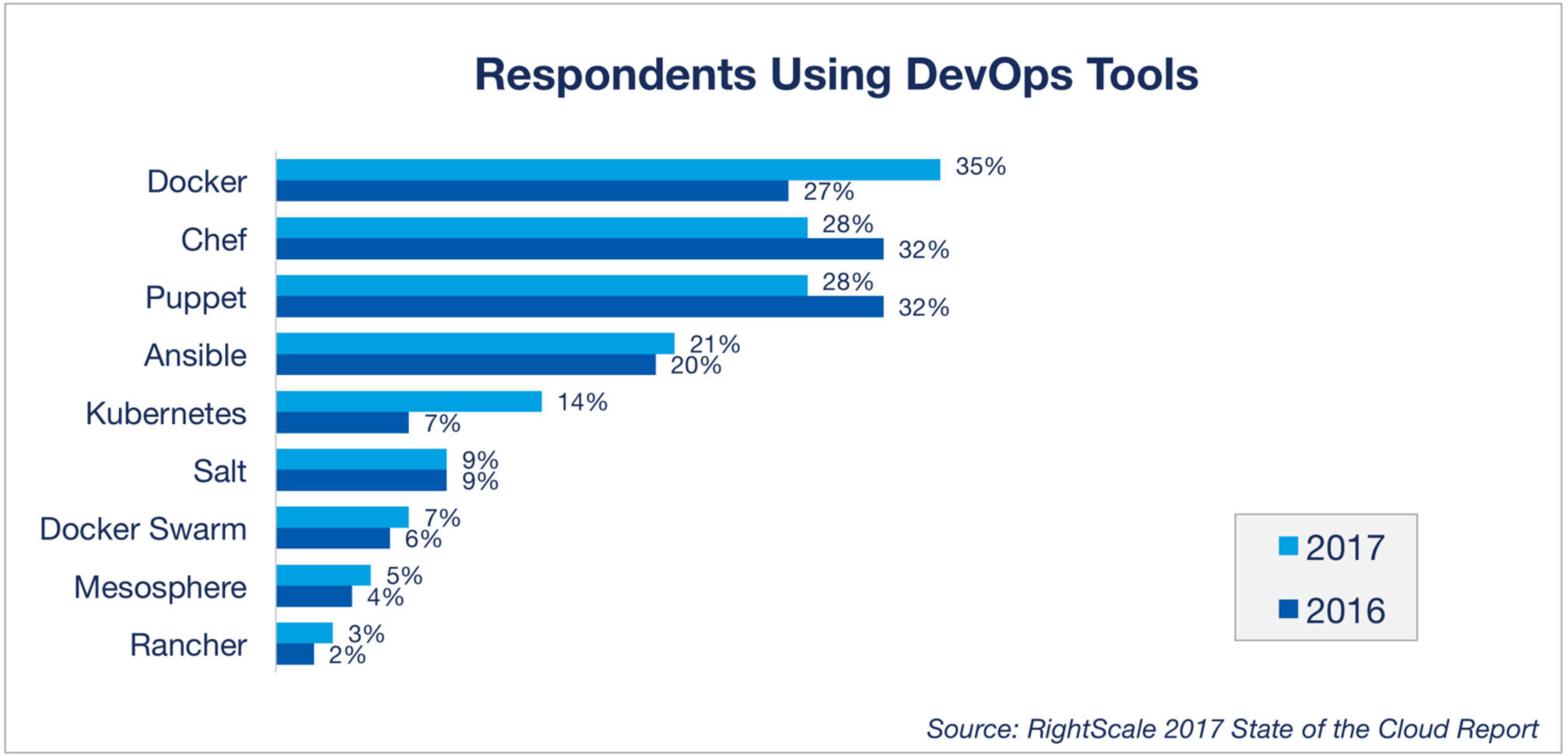
- Docker Enterprise Edition
  - Certified infrastructure
  - Certified containers from 3rd-party ISVs
  - Certified plugins from networking and storage vendors
  - End-to-end security
- AWS, Azure, GCP
- Bare metal
- Linux*, Windows Server 2016

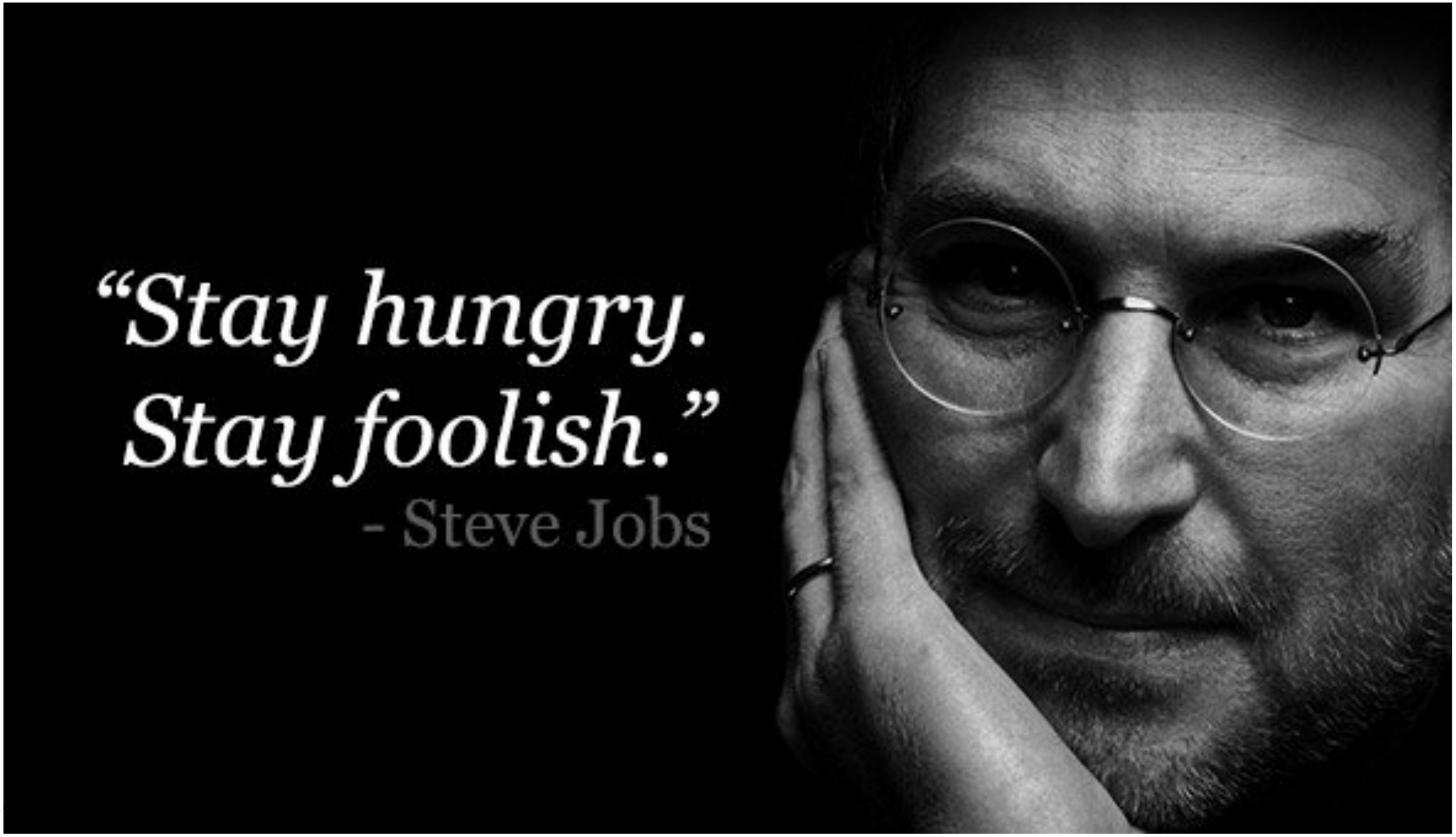
- AWS, Azure, GCP
- Bare metal
- Red Hat OpenShift

- Mesosphere Enterprise DC/OS
  - Advanced operational & troubleshooting
  - Multi-tenancy
  - Networking, storage, security
  - DC/OS Universe
- AWS, Azure, GCP, etc
- Bare metal

- Amazon Web Services

DevOps





References

- Docker: docs.docker.com
- Kubernetes: kubernetes.io
- DC/OS: dcos.io
- AWS ECS: aws.amazon.com/ecs
- Slides: github.com/arun-gupta/docker-java