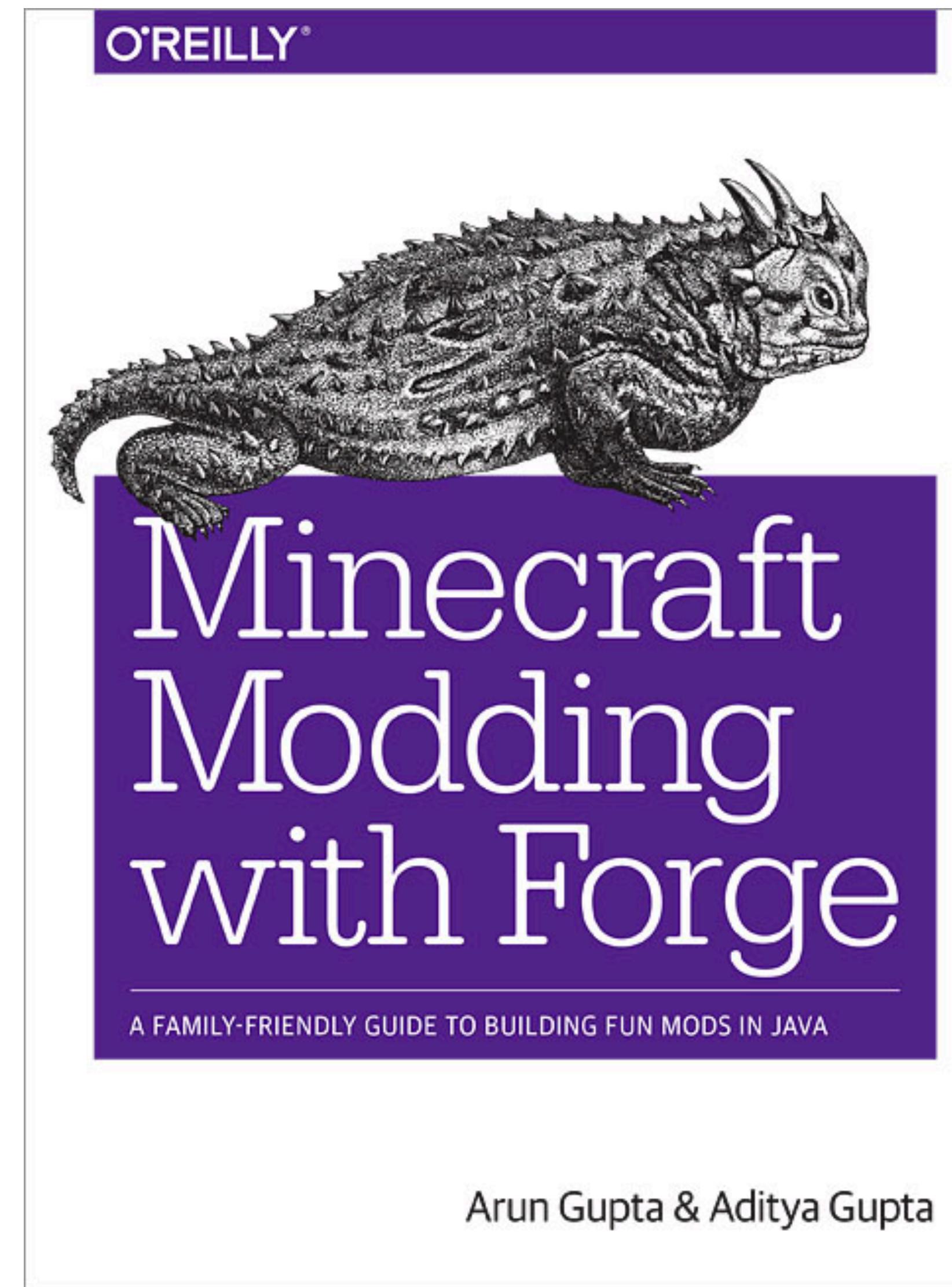


docker

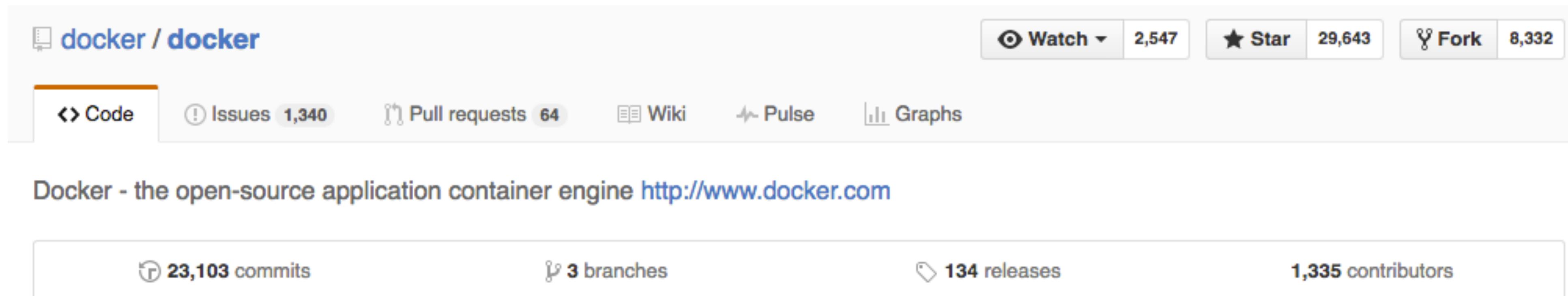
Docker for Java Developers

Arun Gupta, @arungupta
VP Developer Advocacy, Couchbase

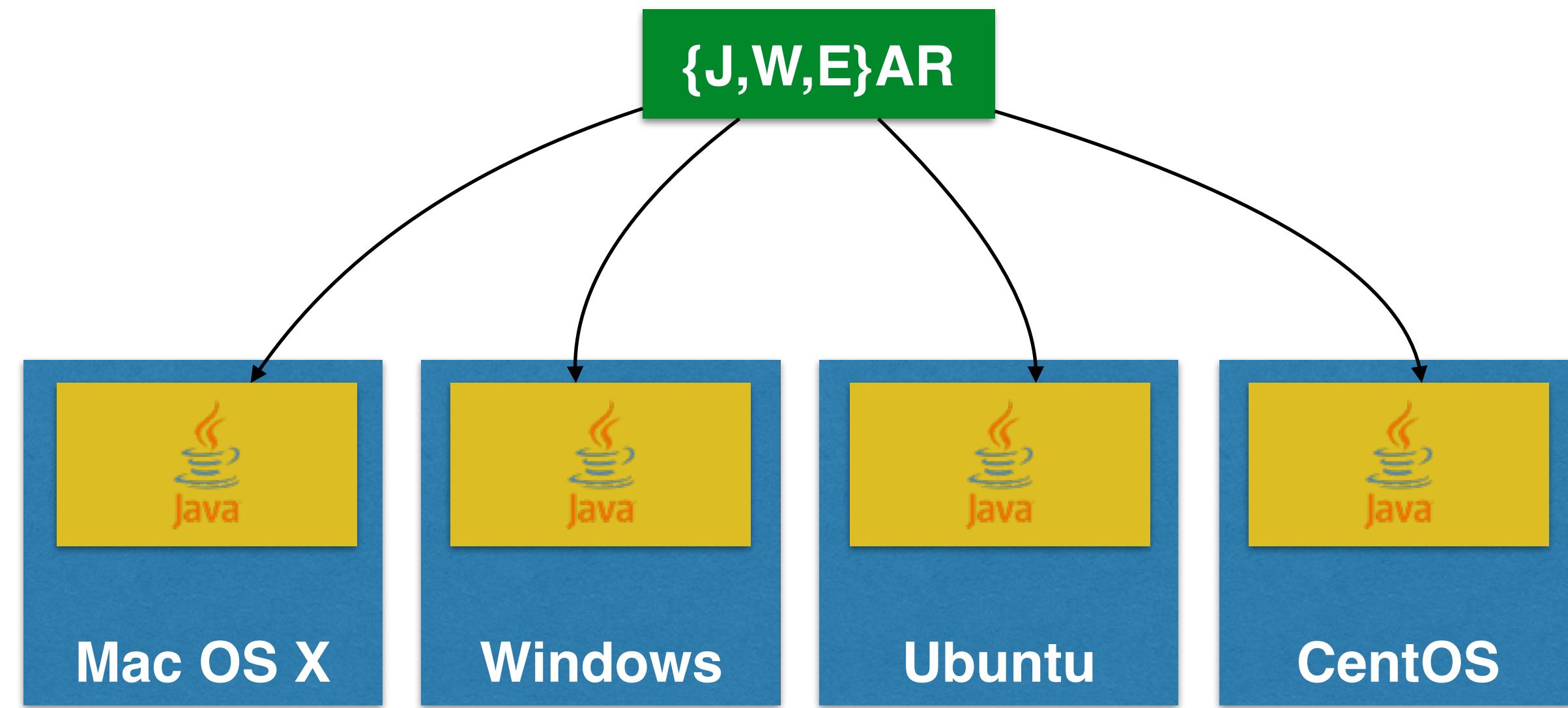


What is Docker?

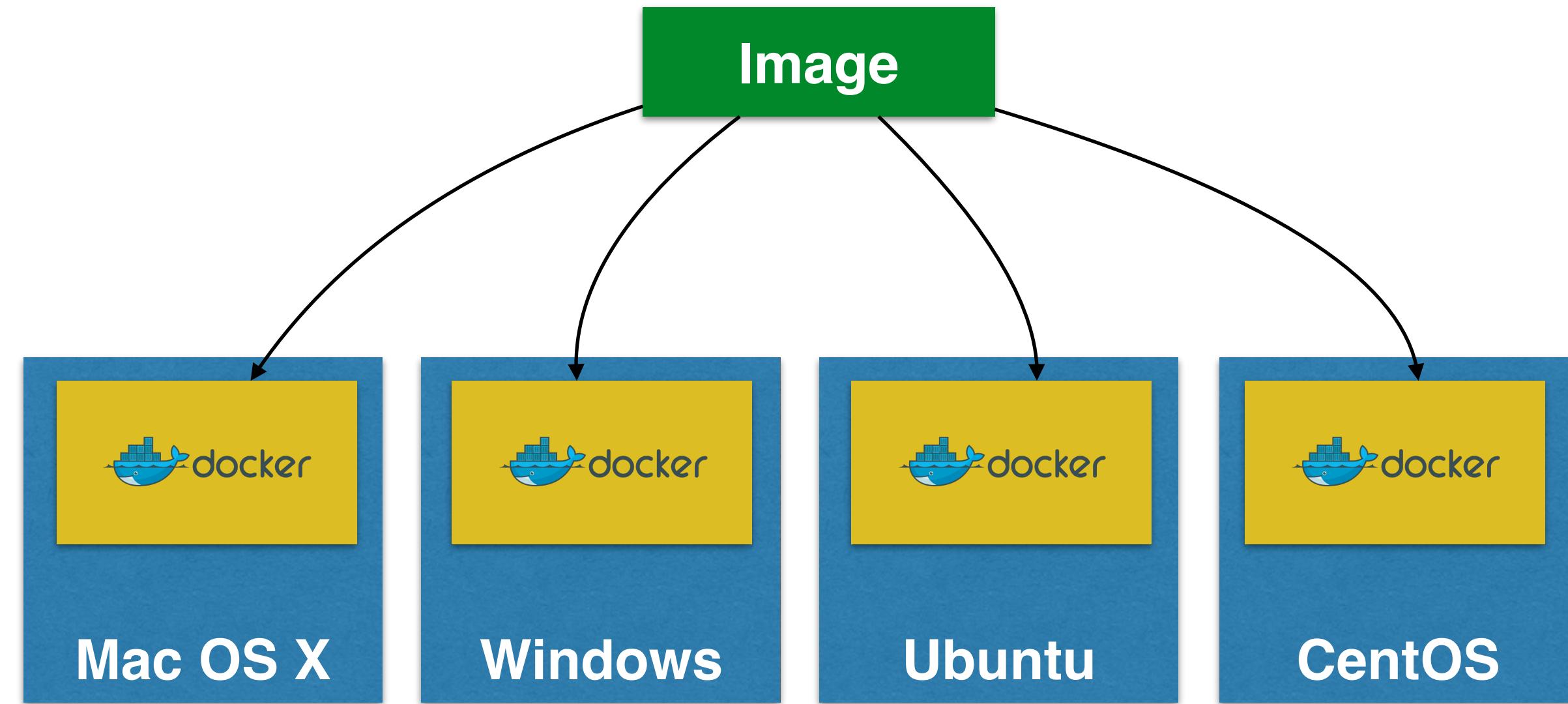
- Open source project and company



- Used to create containers for software applications
- Package Once Deploy Anywhere (PODA)

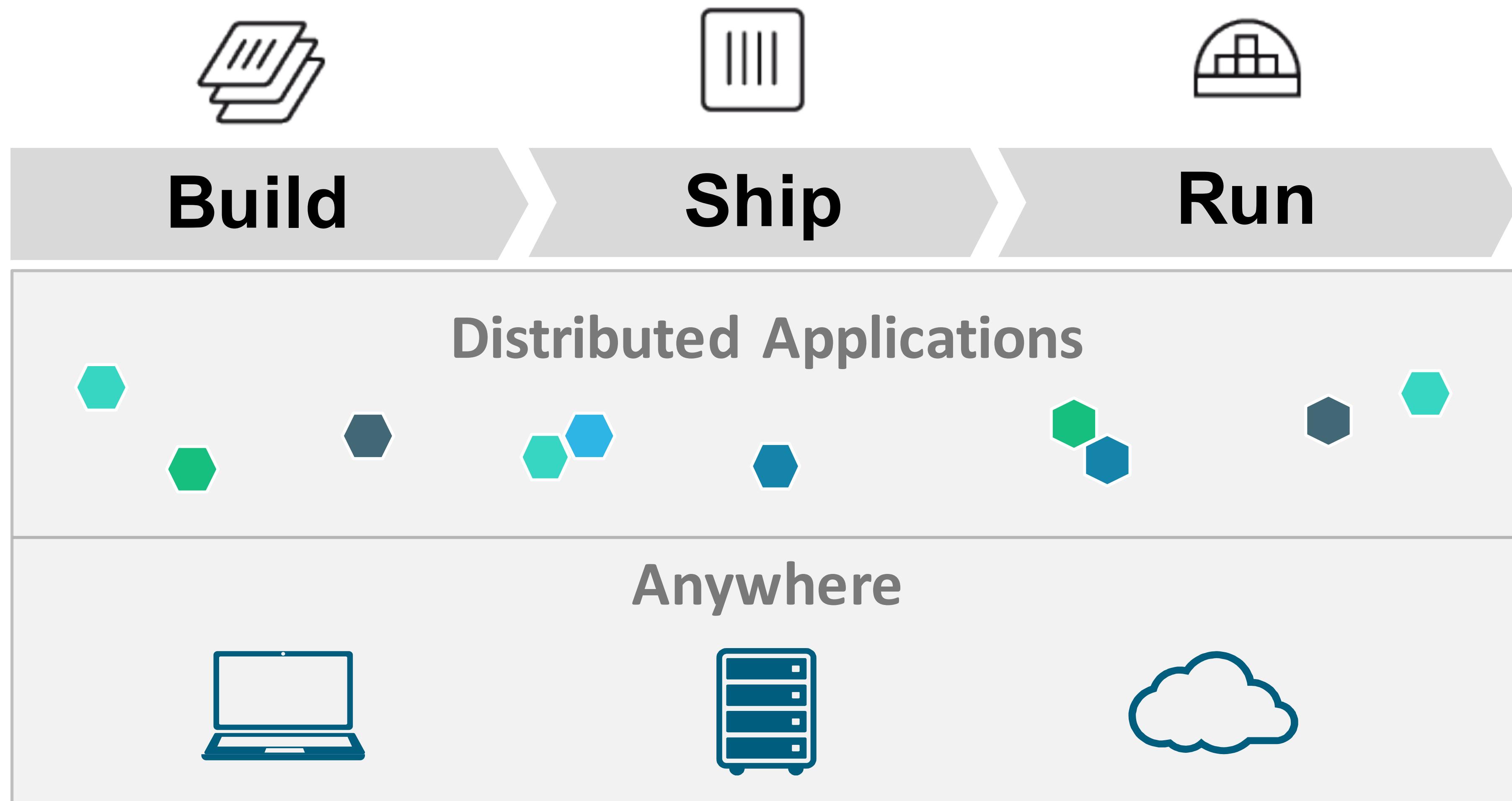


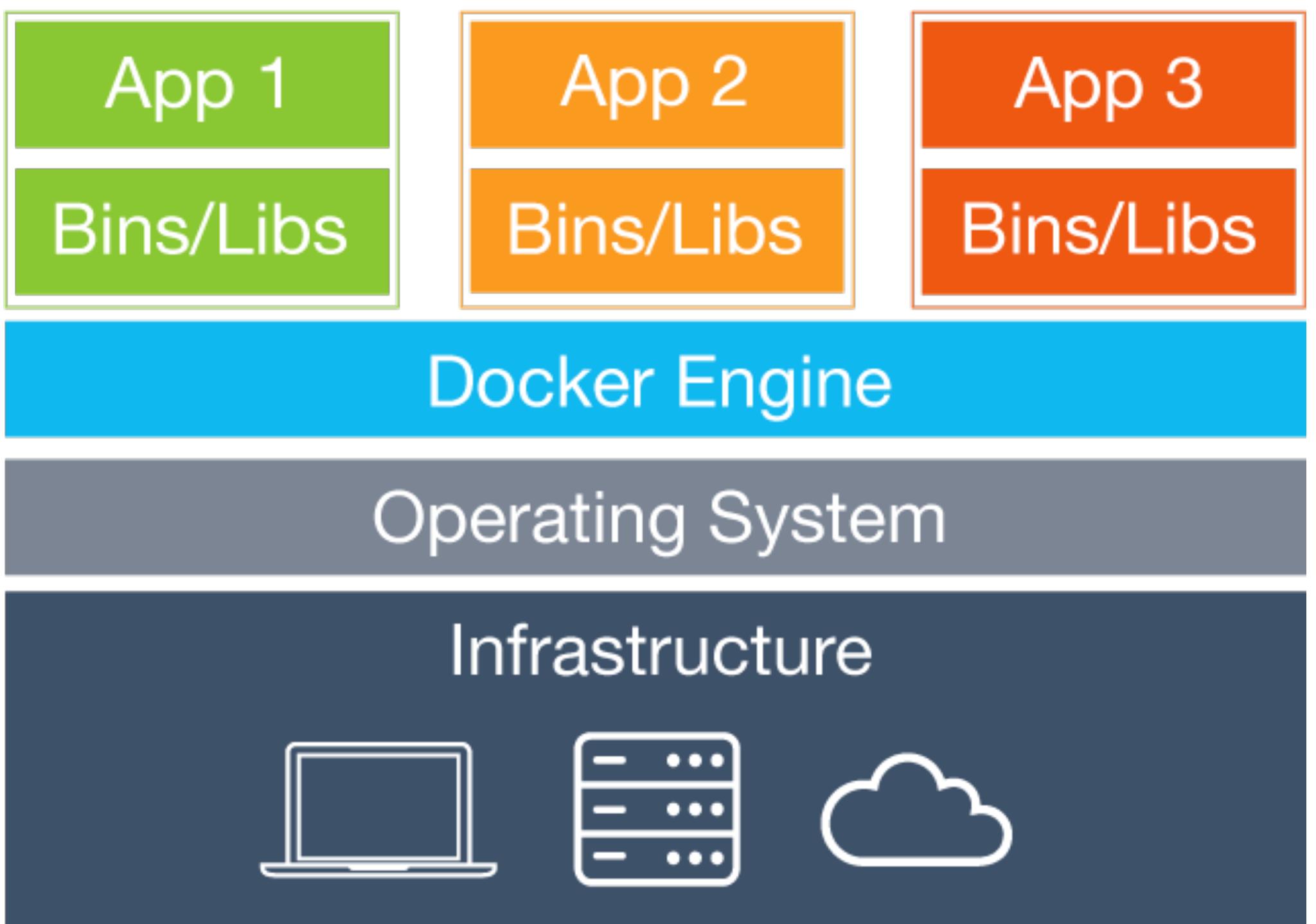
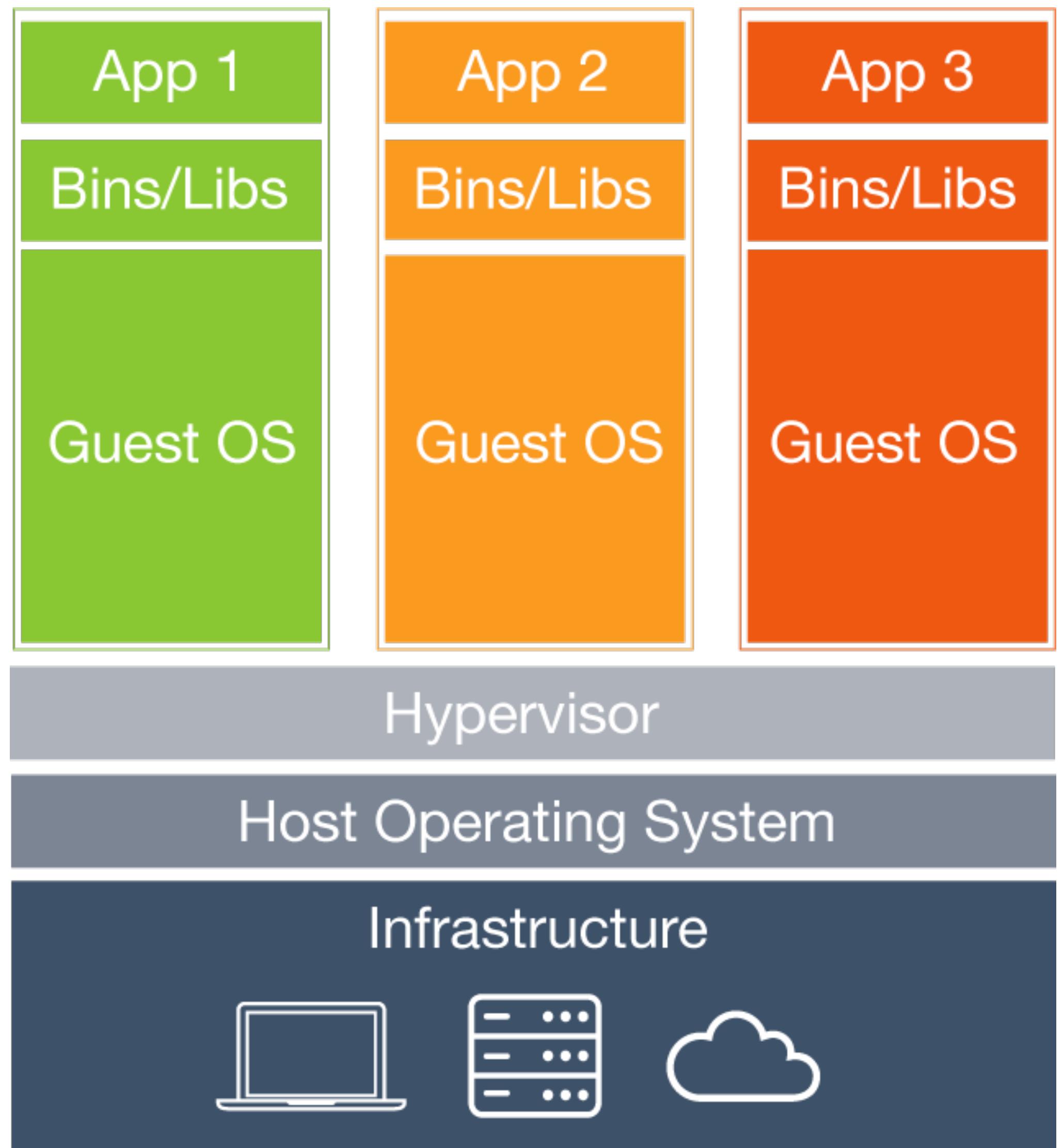
WORA = Write Once Run Anywhere



PODA = Package Once Deploy Anywhere

Docker Mission







Build

Develop an app using Docker containers with
any language and any toolchain.

```
FROM ubuntu
```

```
CMD echo "Hello world"
```

```
FROM java
```

```
COPY target/hello.jar /usr/src/hello.jar
```

```
CMD java -cp /usr/src/hello.jar org.example.App
```

Dockerfile reference

Usage

Format

 Environment replacement

 .dockerignore file

FROM

MAINTAINER

RUN

 Known issues (RUN)

CMD

LABEL

EXPOSE

ENV

ADD

COPY

ENTRYPOINT

 Exec form ENTRYPOINT example

 Shell form ENTRYPOINT example

VOLUME

USER

WORKDIR

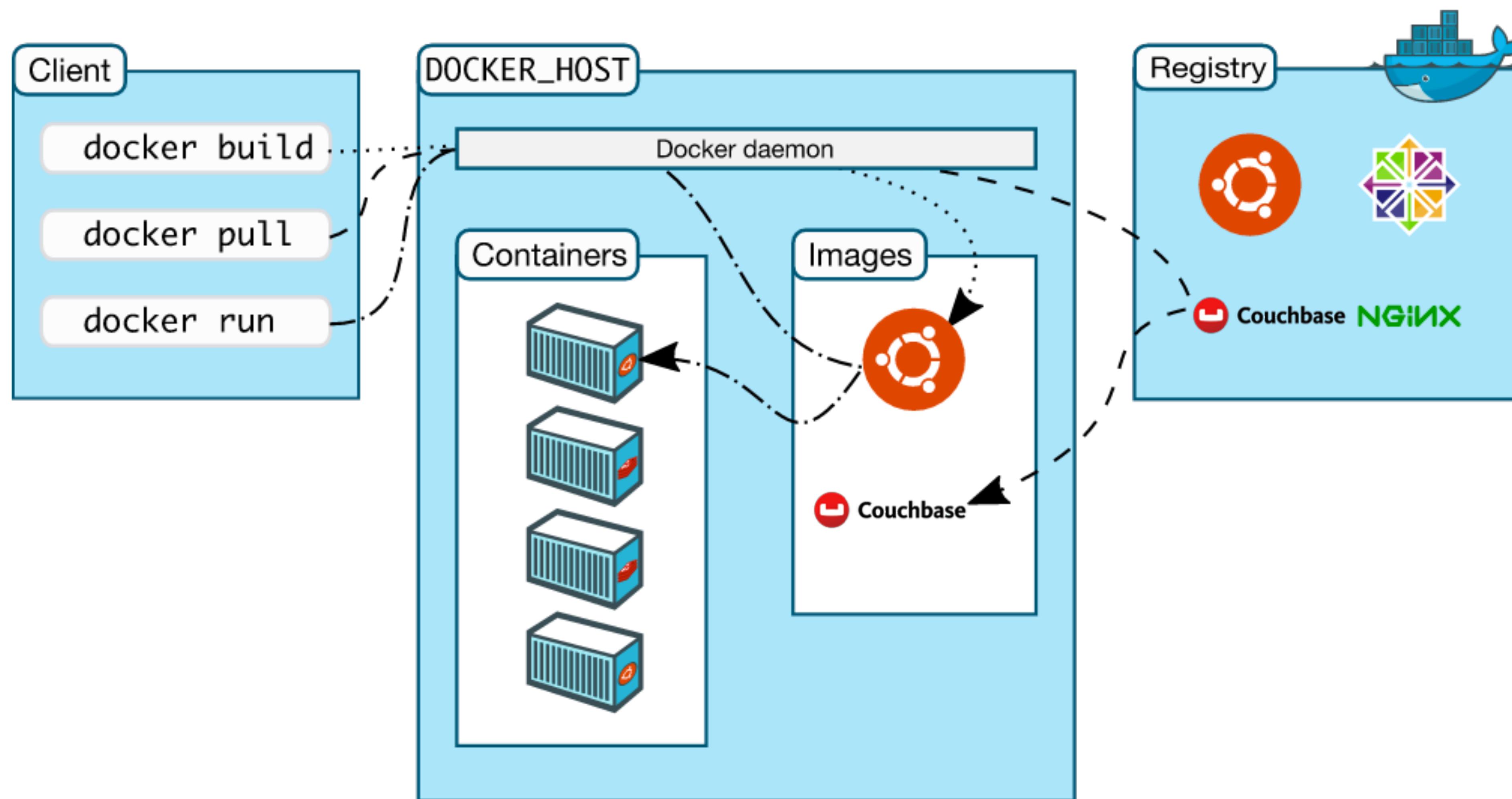
ARG

ONBUILD

STOPSIG

Dockerfile examples

Docker Workflow



Union File System

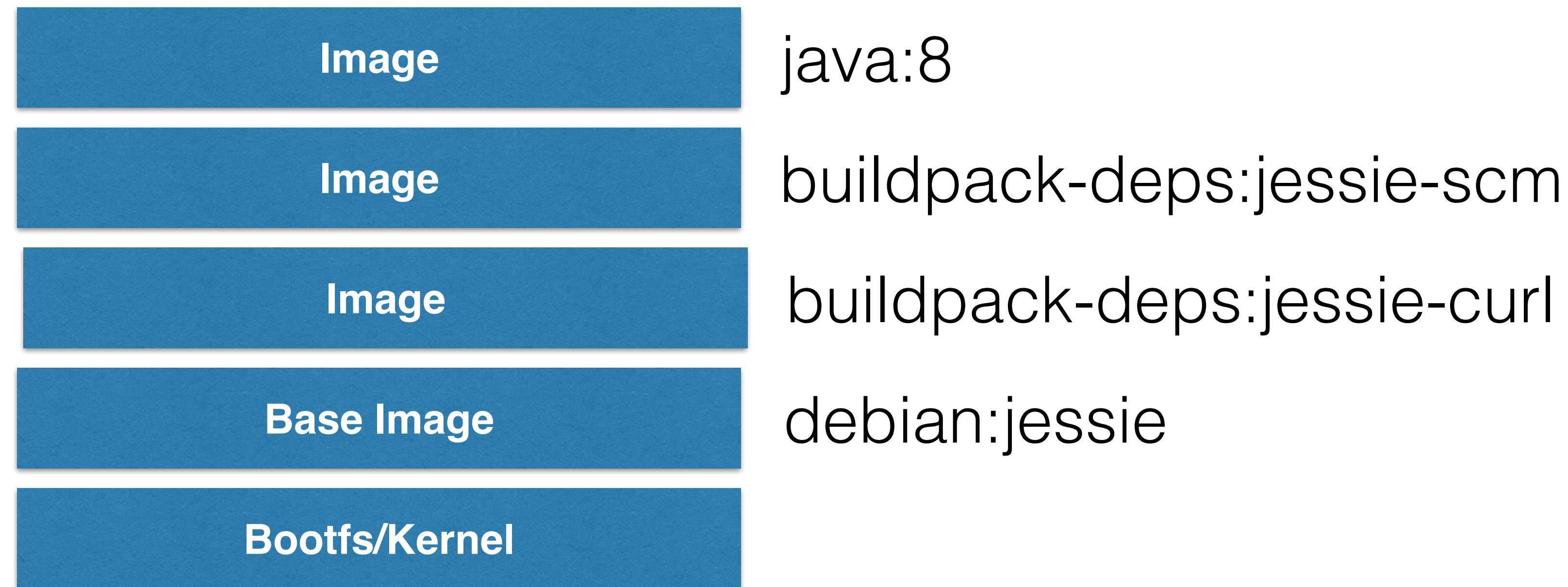


Image Layers - Couchbase

```
~ > docker images couchbase
```

REPOSITORY	TAG	IMAGE ID	CREATED	VIRTUAL SIZE
couchbase	latest	45abdd57689a	3 weeks ago	372 MB

```
~ > docker history couchbase
```

IMAGE	CREATED	CREATED BY	SIZE
45abdd57689a	3 weeks ago	/bin/sh -c #(nop) VOLUME [/opt/couchbase/var]	0 B
dd8c5611343d	3 weeks ago	/bin/sh -c #(nop) EXPOSE 11207/tcp 11210/tcp	0 B
30852bbad62b	3 weeks ago	/bin/sh -c #(nop) CMD ["couchbase-server"]	0 B
5537747ea12f	3 weeks ago	/bin/sh -c #(nop) ENTRYPOINT &{ ["/entrypoint.	0 B
e8a83a5448df	3 weeks ago	/bin/sh -c #(nop) COPY file:cbb44c9c65b64a9dc	182 B
18165b90fef9	3 weeks ago	/bin/sh -c #(nop) COPY file:34e32c52f0895191f	389 B
5f37b8bdc5a6	3 weeks ago	/bin/sh -c wget -N \$CB_RELEASE_URL/\$CB_VERSI0	212.1 MB
1a8da511d01b	3 weeks ago	/bin/sh -c groupadd -g 1000 couchbase && user	328.7 kB
d9b2222c39b4	3 weeks ago	/bin/sh -c #(nop) ENV CB_VERSION=4.0.0 CB_REL	0 B
815f08b3c781	3 weeks ago	/bin/sh -c apt-get update && apt-get inst	23.57 MB
fc38f156c0ea	3 weeks ago	/bin/sh -c #(nop) MAINTAINER Couchbase Docker	0 B
2a7a952931ec	3 weeks ago	/bin/sh -c #(nop) CMD ["/bin/bash"]	0 B
10f1b5844a9c	3 weeks ago	/bin/sh -c sed -i 's/^#\s*/(deb.*universe\)\$/'	1.911 kB
23c388b926b6	3 weeks ago	/bin/sh -c echo '#!/bin/sh' > /usr/sbin/polic	156.2 kB
b45376f323f5	3 weeks ago	/bin/sh -c #(nop) ADD file:4a9e089e81d6581a54	135.9 MB

Image Layers - Java

```
~ > docker images java
```

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
java	openjdk-8-jdk-alpine	78afabc37d4f	6 days ago	145.5 MB
java	8	f298aed75633	6 days ago	642.9 MB
java	latest	f298aed75633	6 days ago	642.9 MB

```
~ > docker history java
```

IMAGE	CREATED	CREATED BY	SIZE
COMMENT			
f298aed75633	6 days ago	/bin/sh -c /var/lib/dpkg/info/ca-certificates	418.2 kB
<missing>	6 days ago	/bin/sh -c set -x && apt-get update && apt-	349.2 MB
<missing>	6 days ago	/bin/sh -c #(nop) ENV CA_CERTIFICATES_JAVA_VE	0 B
<missing>	6 days ago	/bin/sh -c #(nop) ENV JAVA_DEBIAN_VERSION=8u7	0 B
<missing>	6 days ago	/bin/sh -c #(nop) ENV JAVA_VERSION=8u72	0 B
<missing>	6 days ago	/bin/sh -c #(nop) ENV JAVA_HOME=/usr/lib/jvm/	0 B
<missing>	6 days ago	/bin/sh -c { echo '#!/bin/sh'; echo 'set	87 B
<missing>	6 days ago	/bin/sh -c #(nop) ENV LANG=C.UTF-8	0 B
<missing>	6 days ago	/bin/sh -c echo 'deb http://httpredir.debian.	61 B
<missing>	6 days ago	/bin/sh -c apt-get update && apt-get install	1.289 MB
<missing>	2 weeks ago	/bin/sh -c apt-get update && apt-get install	122.6 MB
<missing>	2 weeks ago	/bin/sh -c apt-get update && apt-get install	44.32 MB
<missing>	2 weeks ago	/bin/sh -c #(nop) CMD ["/bin/bash"]	0 B
<missing>	2 weeks ago	/bin/sh -c #(nop) ADD file:b5391cb13172fb513d	125.1 MB



Docker for Mac/Windows

- Native application and UI
- Auto update capability
- No additional software required, e.g. VirtualBox
 - OSX: xhyve VM using Hypervisor.framework
 - Windows: Hyper-V VM
- Better networking and filesystem mounting/notification
- Public Beta: docker.com/getdocker
- Requires Yosemite 10.10+ or Windows 10 64-bit

Docker for AWS

- Amazon CloudFormation template to start a Swarm of Docker Engines
- Integrated with Autoscaling, ELB, and EBS
- Only a browser and AWS account
- Sign up at beta.docker.com (restricted availability)
- Show demo



AWS ▾

Services ▾

Edit ▾

arun.gupta@couchbase.com @ ... ▾

N. California ▾

Support ▾

Create stack

[Select Template](#)[Review](#)[Specify Details](#)[Options](#)[Template](#)[Review](#)**Template URL**[REDACTED]
https://s3.amazonaws.com/d1.12.0-rc3-beta1/docker_for_aws.json**Description** Docker for AWS Beta 1 (docker 1.12.0-rc3)**Estimate cost**[Cost](#)[Details](#)**Stack name** Docker4AWS**Swarm Size****ManagerSize** 1**ClusterSize** 3**Swarm Properties****ManagerInstanceType** t2.micro**InstanceType** m3.medium**KeyName** arun@couchbase**Create IAM resources** Yes

Docker for Azure

- Same as Docker for AWS, but for Azure
- Integrated with VM Scale Sets for autoscaling, Azure Load Balancer, Azure Storage



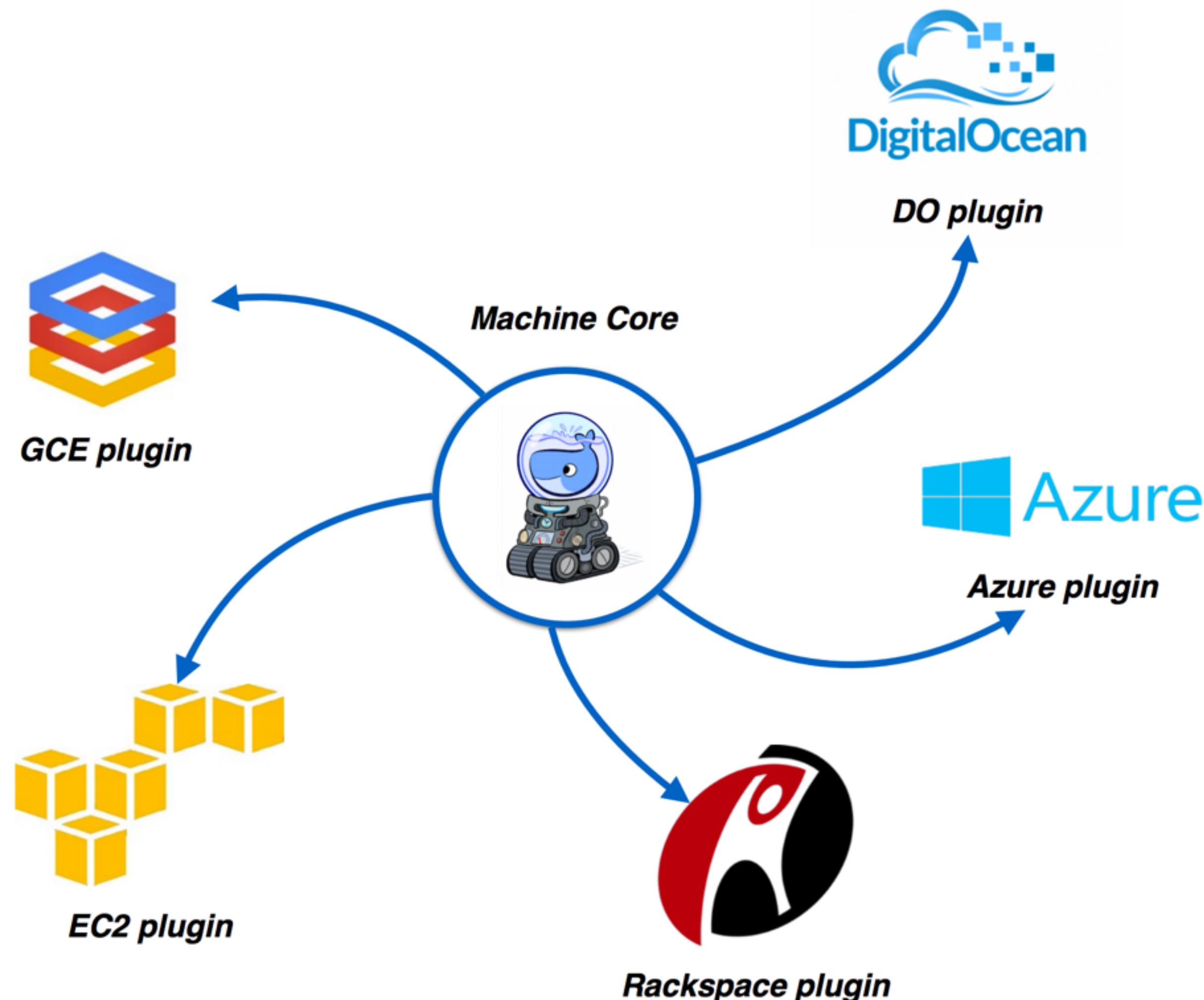
Docker Machine

- Pre-Docker 1.12
- Create Docker Host on computer or cloud provider

```
docker-machine create --driver=virtualbox myhost
```

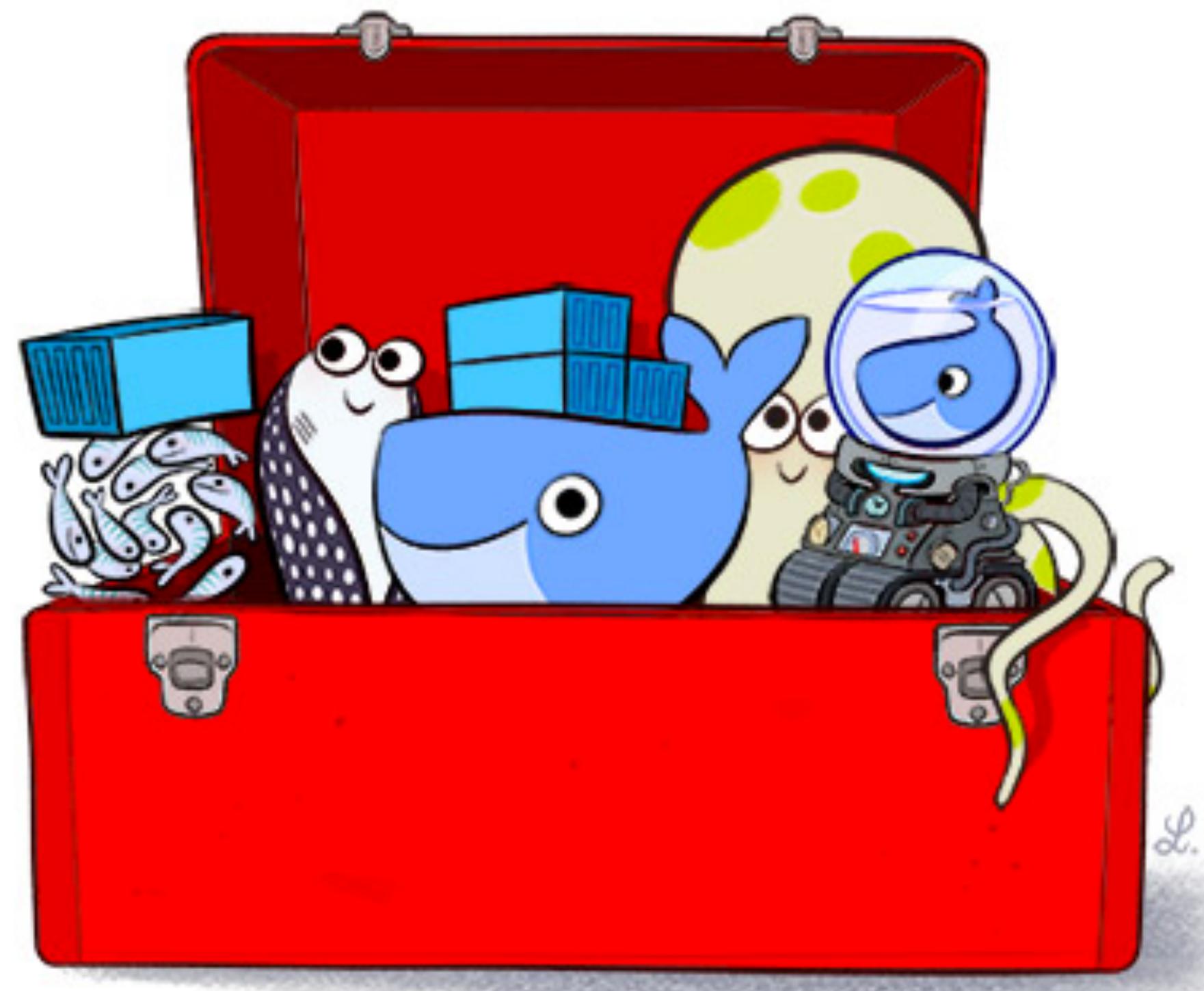
- Configure Docker client to talk to host
- Create and pull images
- Start, stop, restart containers
- Upgrade Docker

Docker Machine Providers



Docker Toolbox

- Docker Client
- Docker Machine
- Docker Compose
- Docker Kitematic
- Boot2Docker ISO
- Virtualbox





Docker Compose

- Defining and running multi-container applications
- Configuration defined in one or more files
 - `docker-compose.yml` (default)
 - `docker-compose.override.yml` (default)
 - Multiple files specified using `-f`
 - All paths relative to base configuration file
- Great for dev, staging, and CI

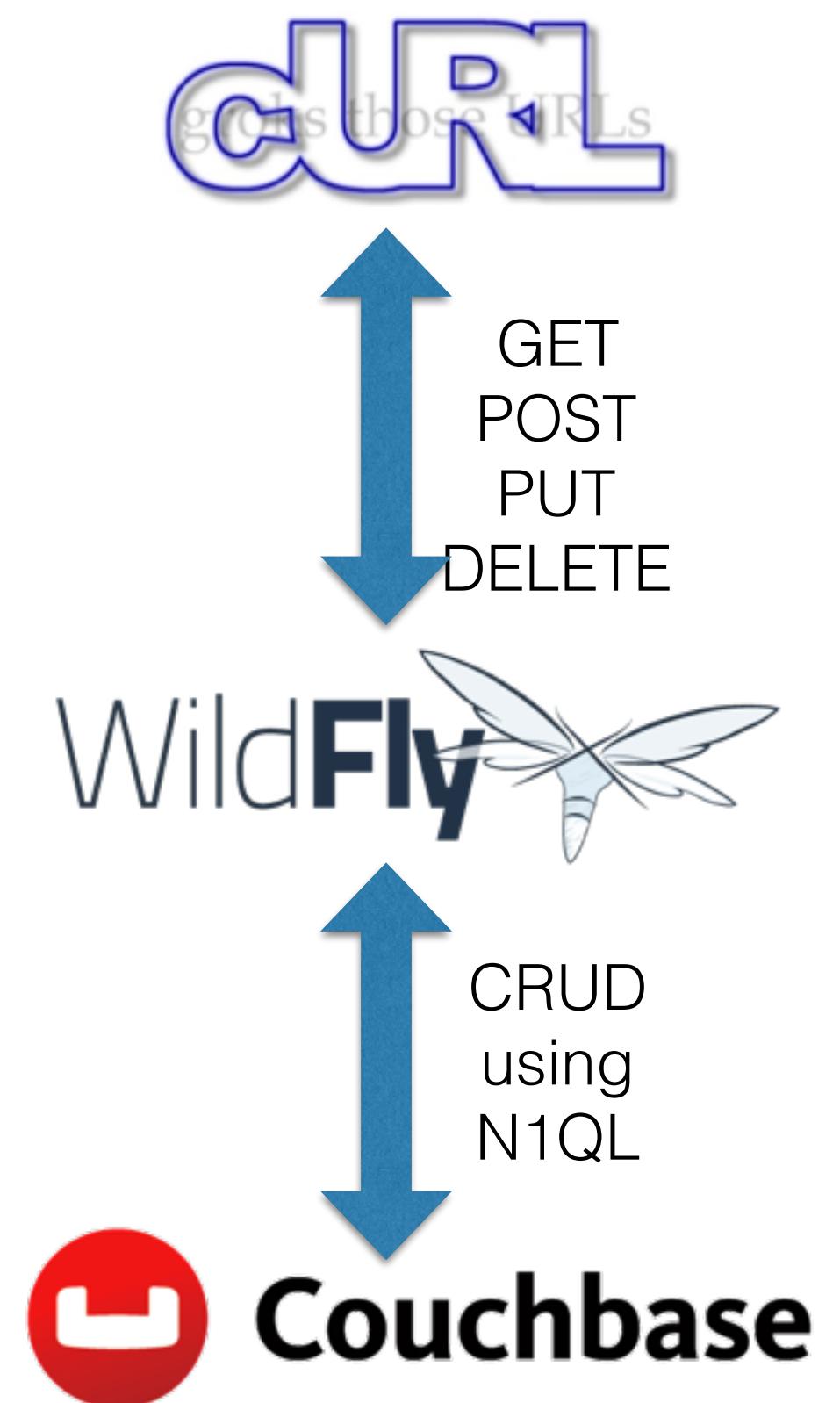


Docker Compose - One Service

```
version: "2"
services:
  db:
    image: couchbase
    volumes:
      - ~/couchbase:/opt/couchbase/var
    ports:
      - 8091:8091
      - 8092:8092
      - 8093:8093
      - 11210:11210
```



Docker Compose - Two Services



Docker Compose - Two Services

```
version: "2"
services:
  db:
    image: couchbase
    ports:
      - 8091:8091
      - 8092:8092
      - 8093:8093
      - 11210:11210
  web:
    image: arungupta/wildfly
    environment:
      - COUCHBASE_URI=db
    ports:
      - 8080:8080
      - 9990:9990
```



Overriding Services in Docker Compose

```
web:  
  image: jboss/wildfly  
  ports:  
    - 8080:8080
```

docker-compose.yml

```
web:  
  ports:  
    - 9080:8080
```

docker-compose.override.yml

docker-compose up -d

Dev/Prod with Compose

```
db-dev:  
  image: arungupta/couchbase  
  ports:  
    - . . .  
  
web:  
  image: arungupta/wildfly  
  environment:  
    - COUCHBASE_URI=db-dev:8093  
  ports:  
    - 8080:8080
```

docker-compose.yml

docker-compose up -d

```
web:  
  environment:  
    - COUCHBASE_URI=db-prod:8093  
  ports:  
    - 8080:80  
  
db-prod:  
  image: . . .
```

production.yml

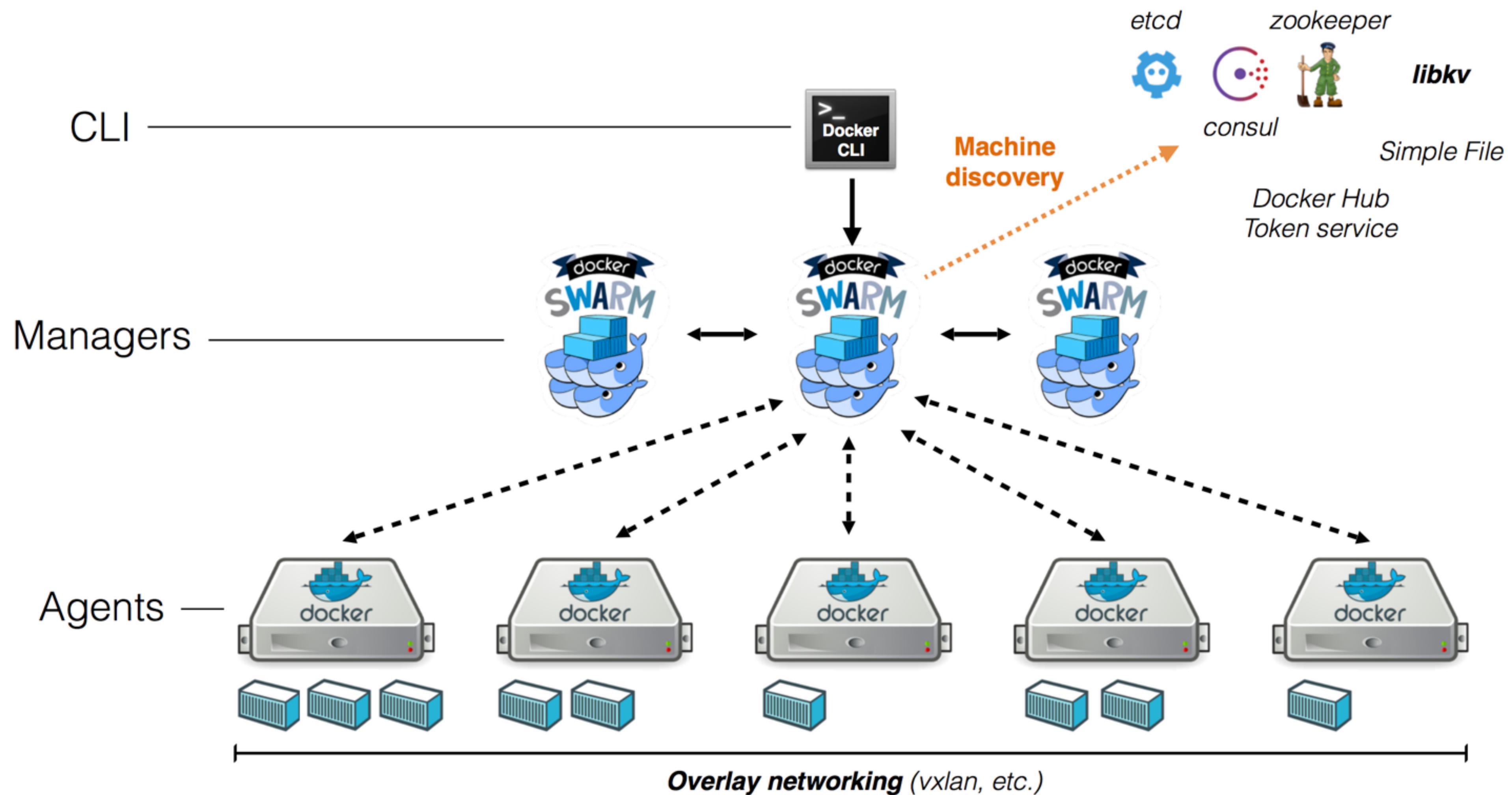
docker-compose up
-f docker-compose.yml
-f production.yml
-d



Docker Swarm

- Native clustering for Docker
- Provides a unified interface to a pool of Docker hosts
- Fully integrated with Machine and Compose
- Serves the standard Docker API
- 1.2.4 - Ready for production
 - Reschedule containers when a node fails
 - Better node management

Stress tested on 1000 EC2 nodes, ~30k containers





Master High Availability

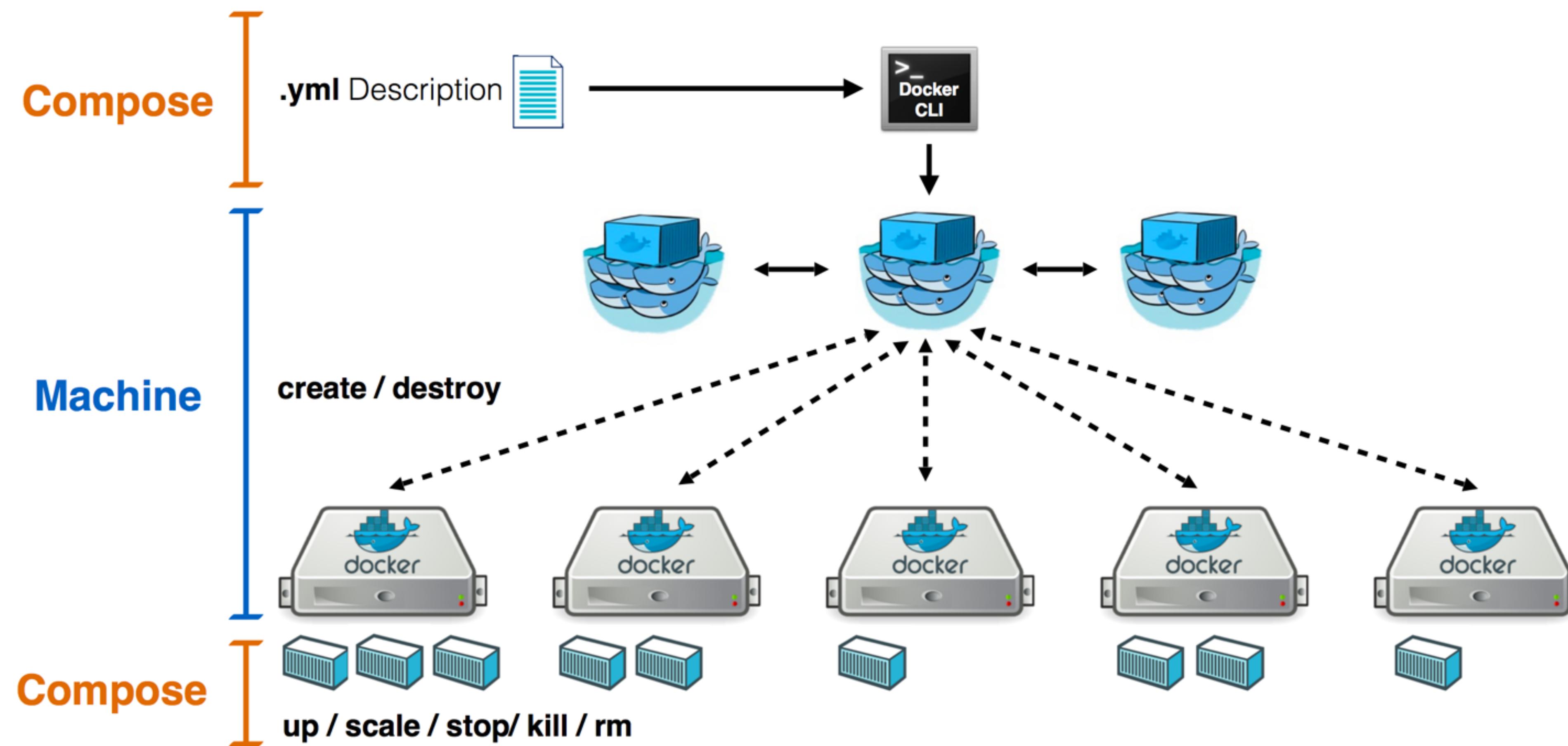
- Handle the failover of a manager instance
- **Primary** manager, multiple **replica** instances
- Requests to replica are proxied to primary
- `docker run swarm manage`
 - `--replication`: Enable Swarm manager replication
 - `--replication-ttl "30s"`: Leader lock release time on failure
 - `--advertise`, `--addr`: Address of the swarm manager joining the cluster

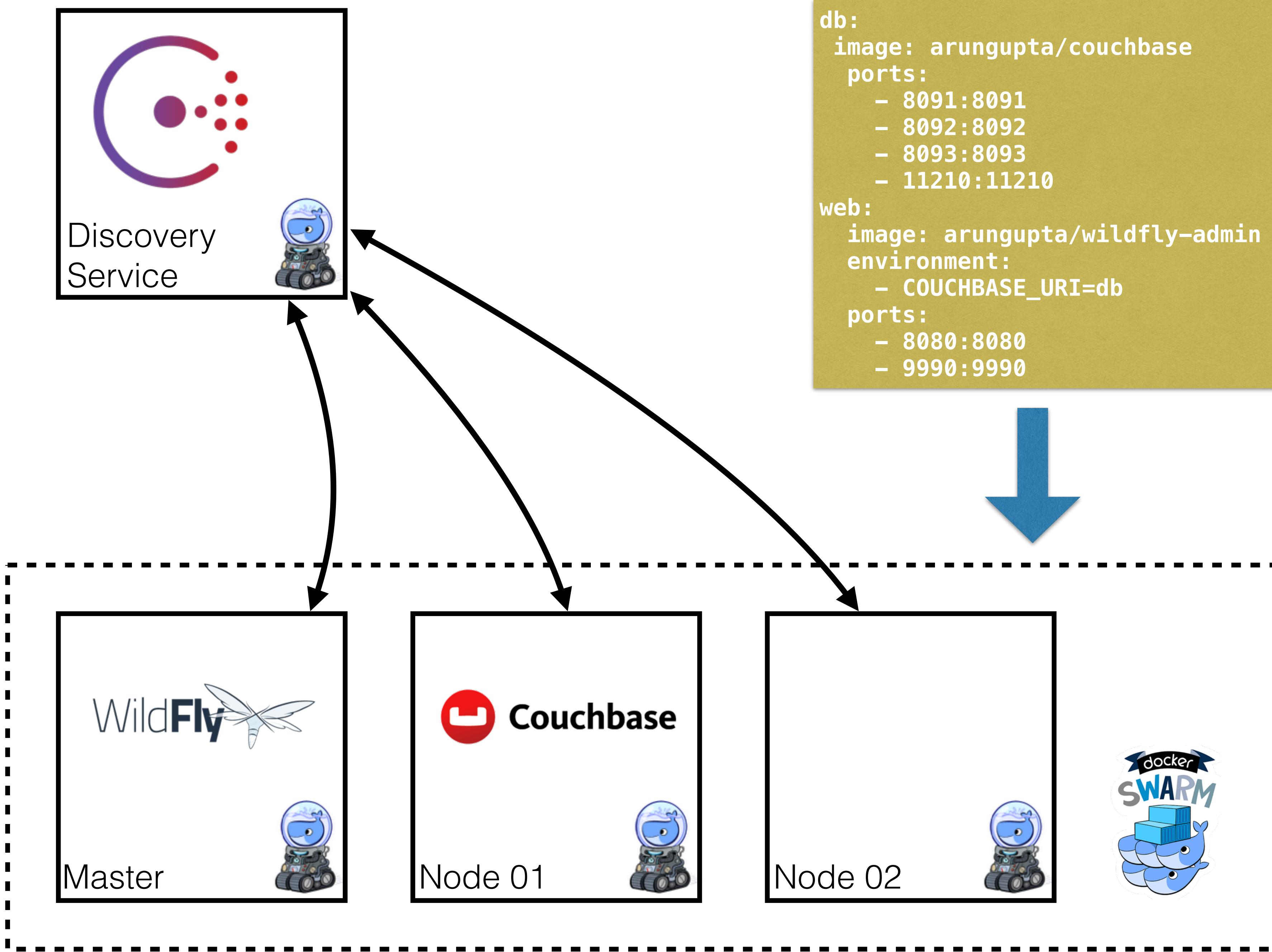


Scheduling Backends

- Based on CPU (-c), RAM (-m), number of containers
- `docker machine create --strategy <value>`
 - `spread` (default): node with least number of running containers
 - `binpack`: node with most number of running containers
 - `random`: mostly for debugging
- API for pluggable backends (e.g. Mesos) coming

Machine + Swarm + Compose





Swarm Mode Overview

- New in 1.12
- Natively managing a cluster of Docker Engines called a Swarm
- Use Docker CLI to create a swarm, deploy apps, and manage swarm
- Uses SwarmKit
- May be backwards incompatible

Swarm Kit

- Toolkit for orchestrating distributed systems
- Raft-based consensus
- Swarm node - Worker and/or Manager
 - Worker comes with Docker Container Executor
 - Tasks run on Worker
 - Tasks are organized in Services
 - Service has desired state (e.g. how many replicas)
- Resource/strategy aware - *spread* is default
- Reconcile the desired and actual state
- Secure OOTB using mutual TLS

Swarm Mode Cluster on Amazon

Type	Protocol	Port Range	Source
SSH	TCP	22	Anywhere 0.0.0.0/0
Custom TCP Rule	TCP	2377	Anywhere 0.0.0.0/0
Custom TCP Rule	TCP	7946	Anywhere 0.0.0.0/0
Custom UDP Rule	UDP	7946	Anywhere 0.0.0.0/0
Custom TCP Rule	TCP	4789	Anywhere 0.0.0.0/0
Custom UDP Rule	UDP	4789	Anywhere 0.0.0.0/0

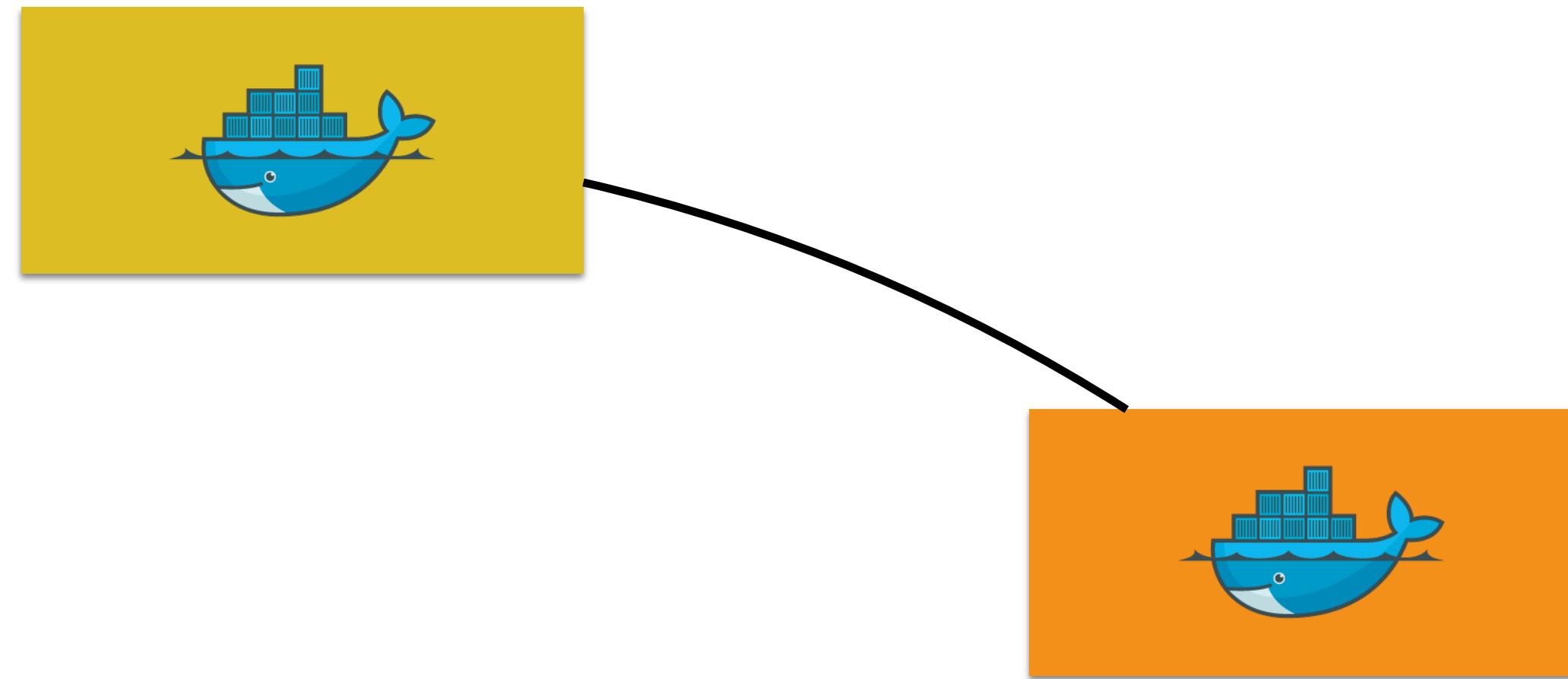
- 2377: Cluster management communications
- 7946: Communication among nodes
- 4789: Overlay network traffic

Swarm Mode: Initialize



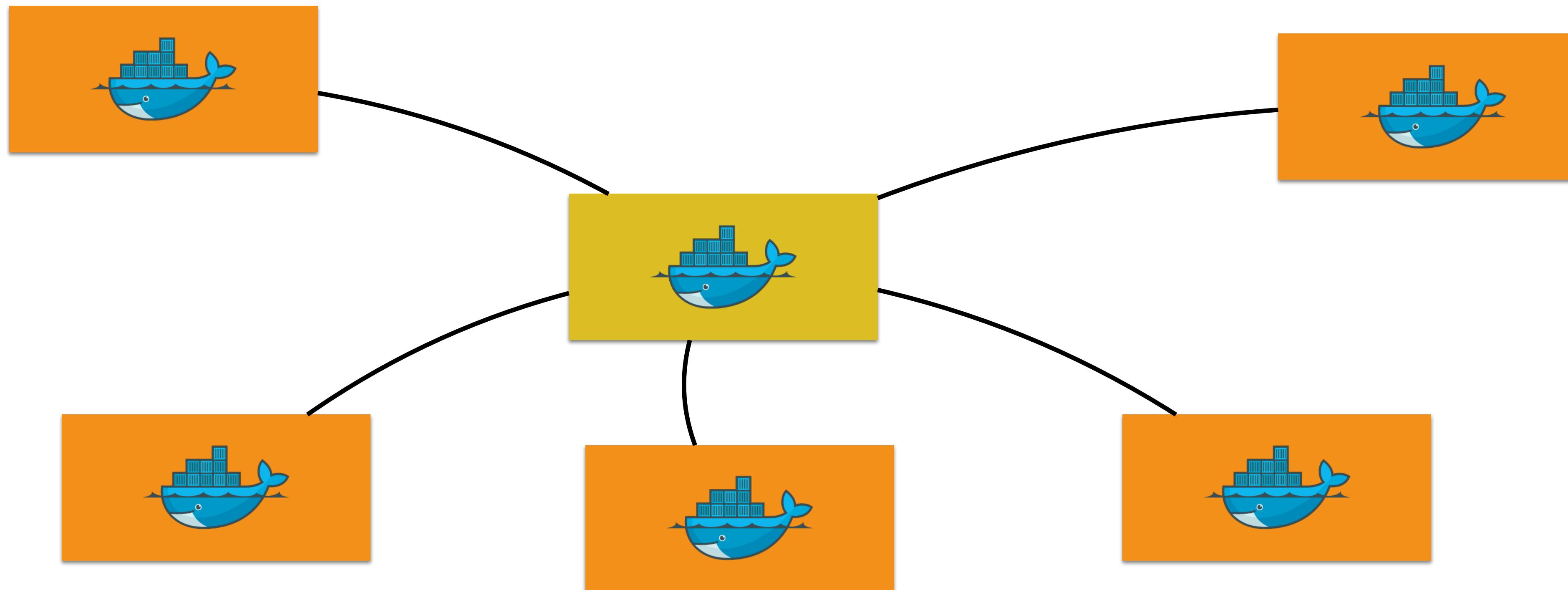
```
docker swarm init --listen-addr <ip>:2377 --secret <SECRET>
```

Swarm Mode: Add Worker



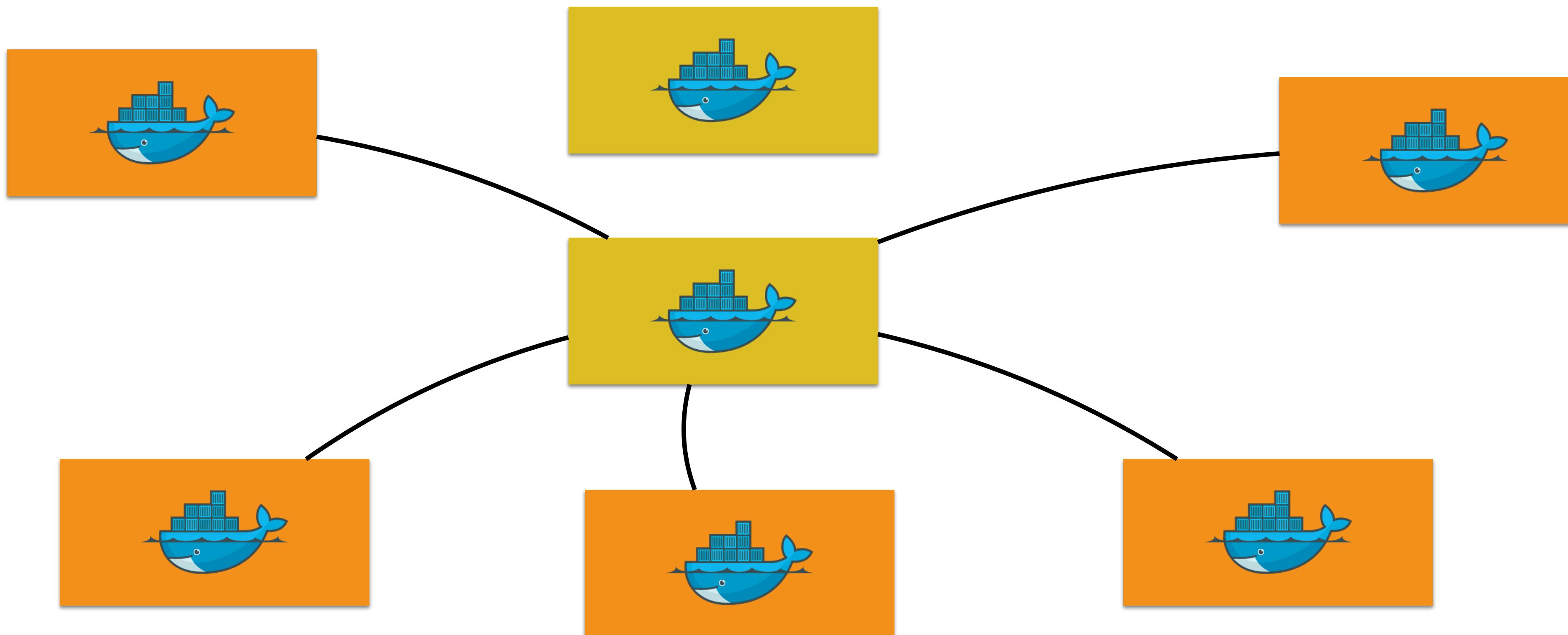
```
docker swarm join --secret <SECRET> <IP of manager>:2377
```

Swarm Mode: Add More Workers

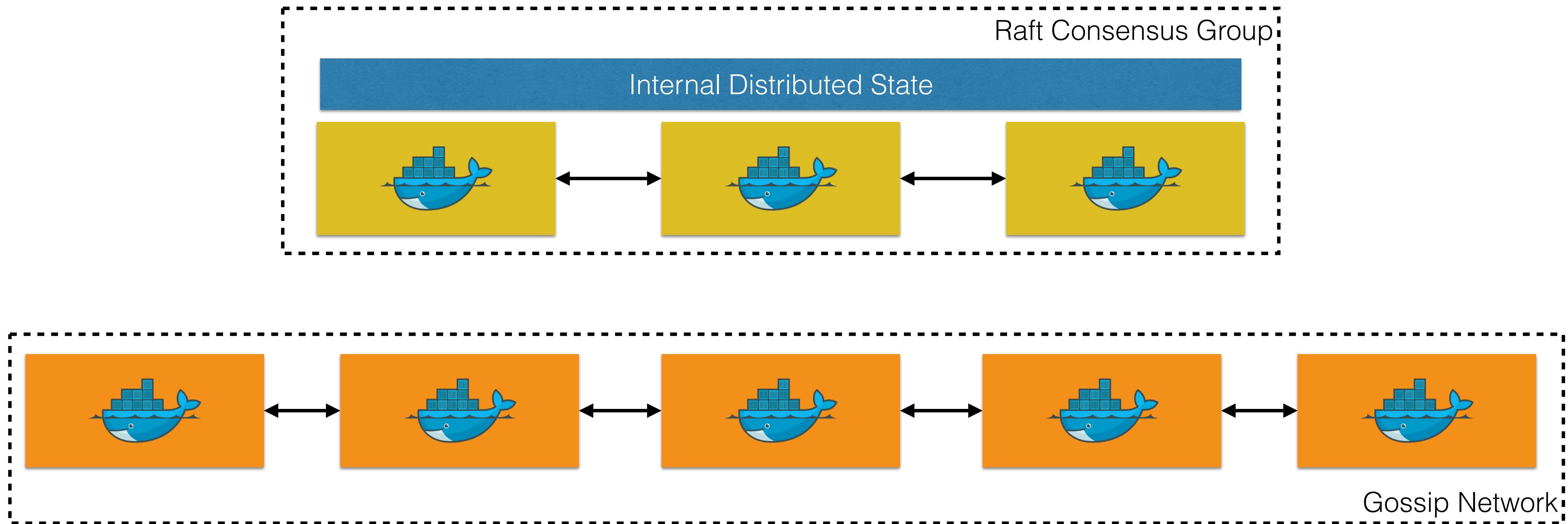


```
docker swarm join --secret <SECRET> <IP of manager>:2377
```

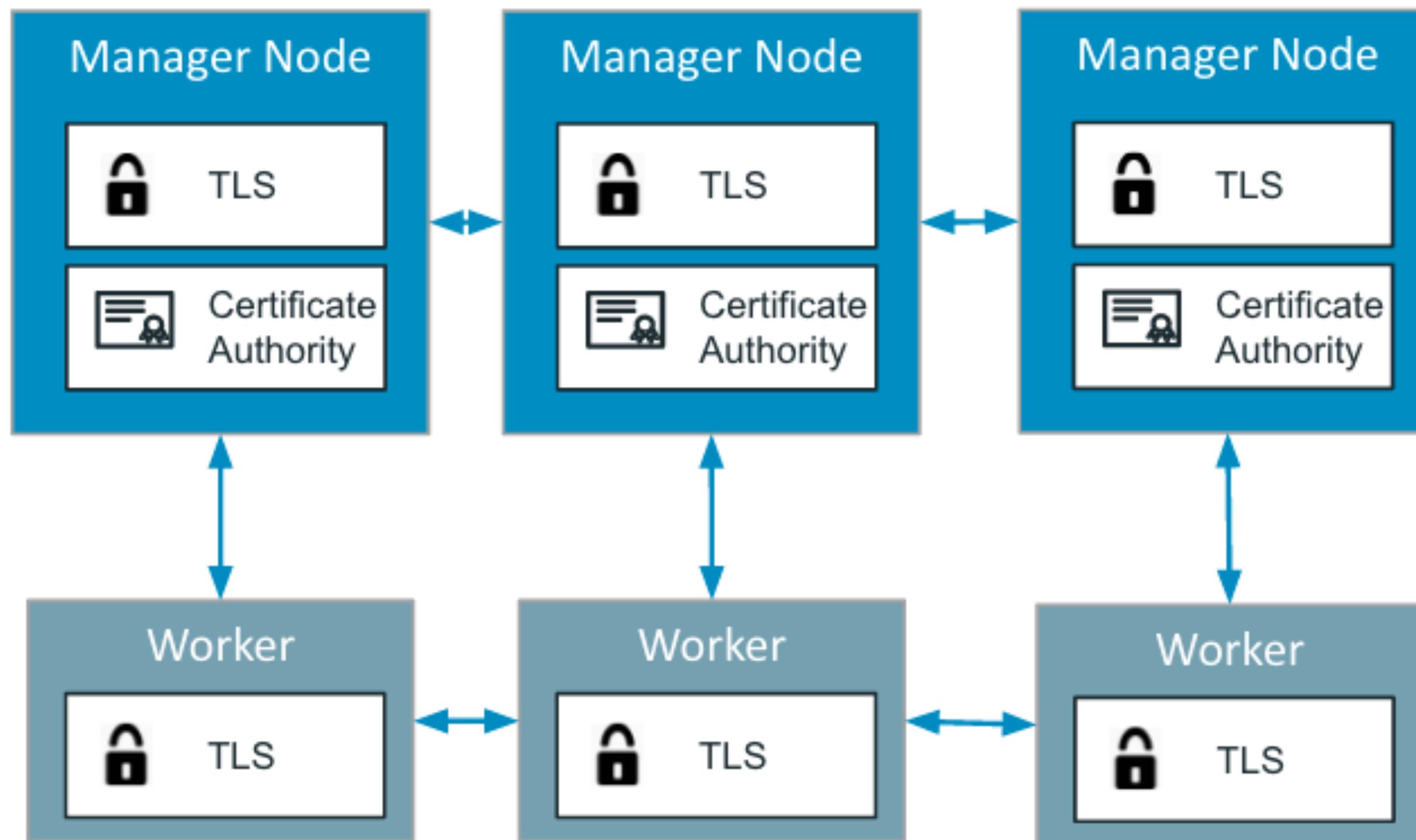
Swarm Mode: Multi Master??



Swarm Mode: Protocols

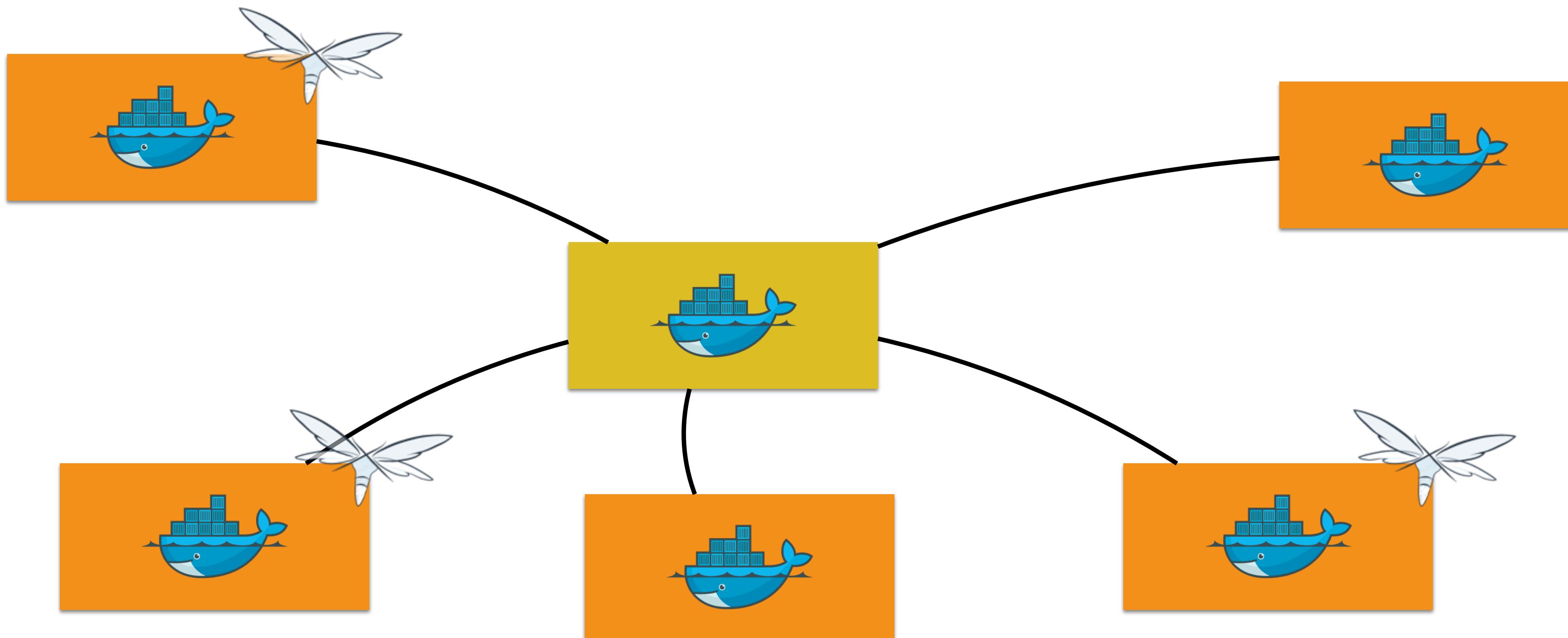


Secure by Default



- Cryptographic node identity
- Automatic encryption and mutual authentication (TLS)
- Automatic cert rotation (90 days, can be up to 30 mins)
- External CA integration

Swarm Mode: Replicated Service

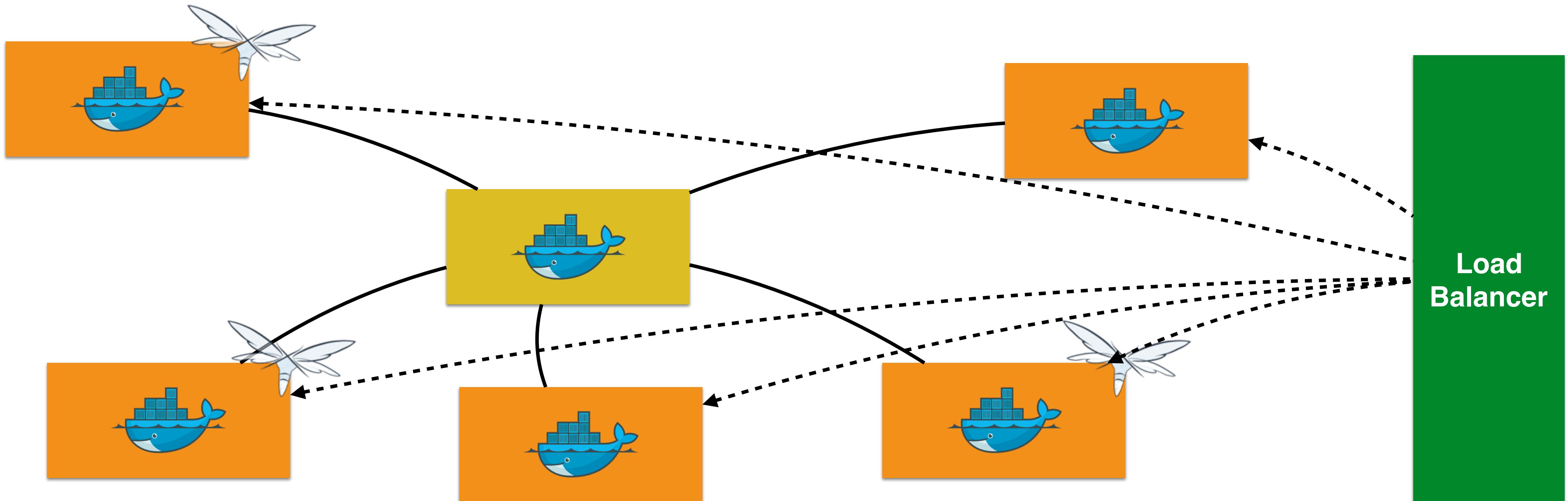


```
docker service create --replicas 3 --name web jboss/wildfly
```

Swarm Mode - Routing Mesh

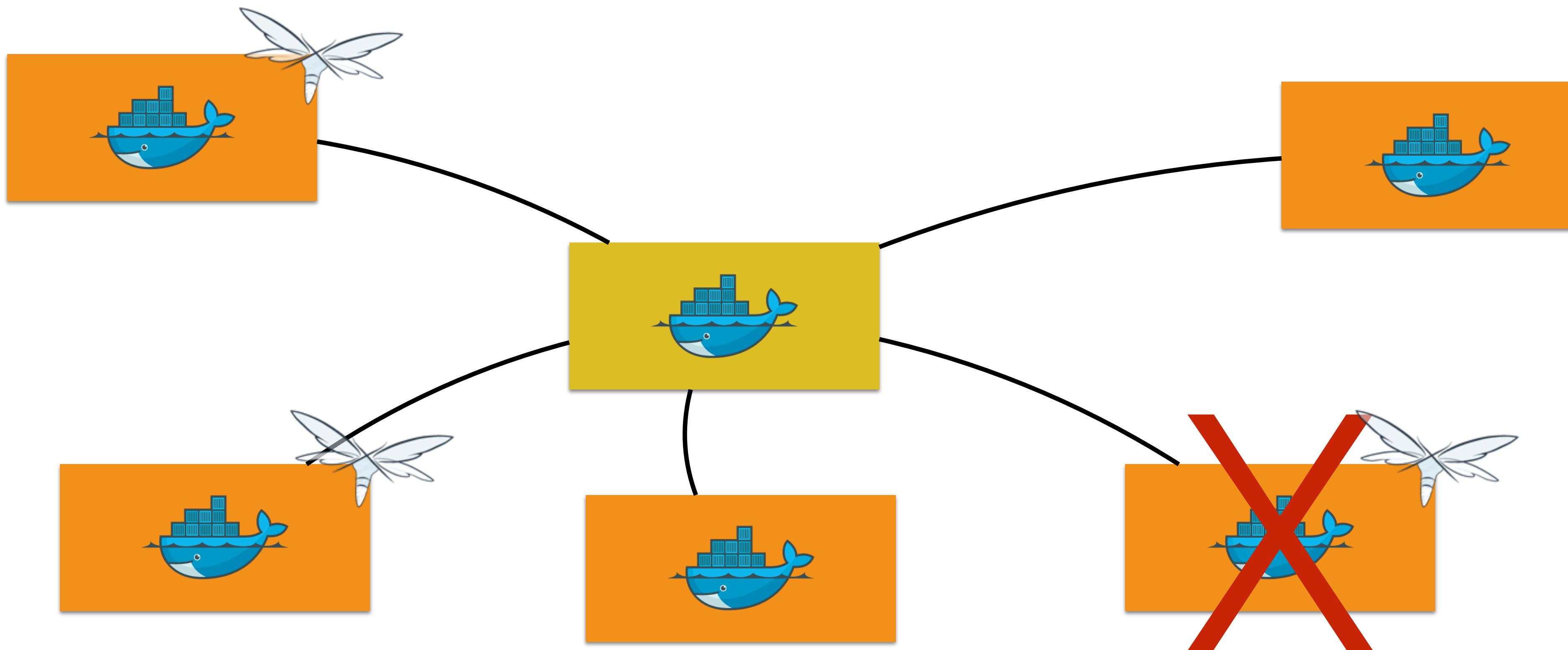
- Load balancers are host-aware, not container-aware
- Swarm mode introduces container-aware routing mesh
- Reroutes traffic from any host to a container
 - Reserves a Swarm-wide ingress port
 - Uses DNS-based service discovery

Swarm Mode: Routing Mesh

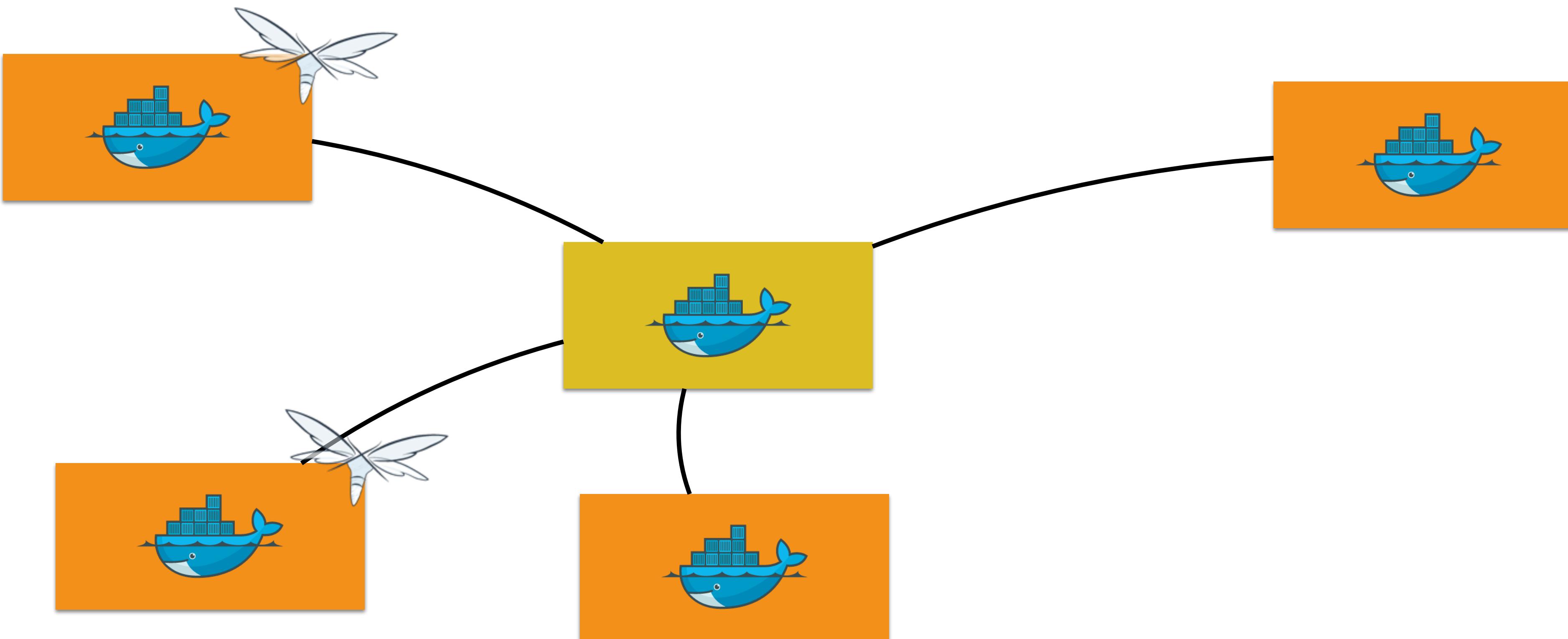


```
docker service create --replicas 3 --name web -p 8080:8080 jboss/wildfly
```

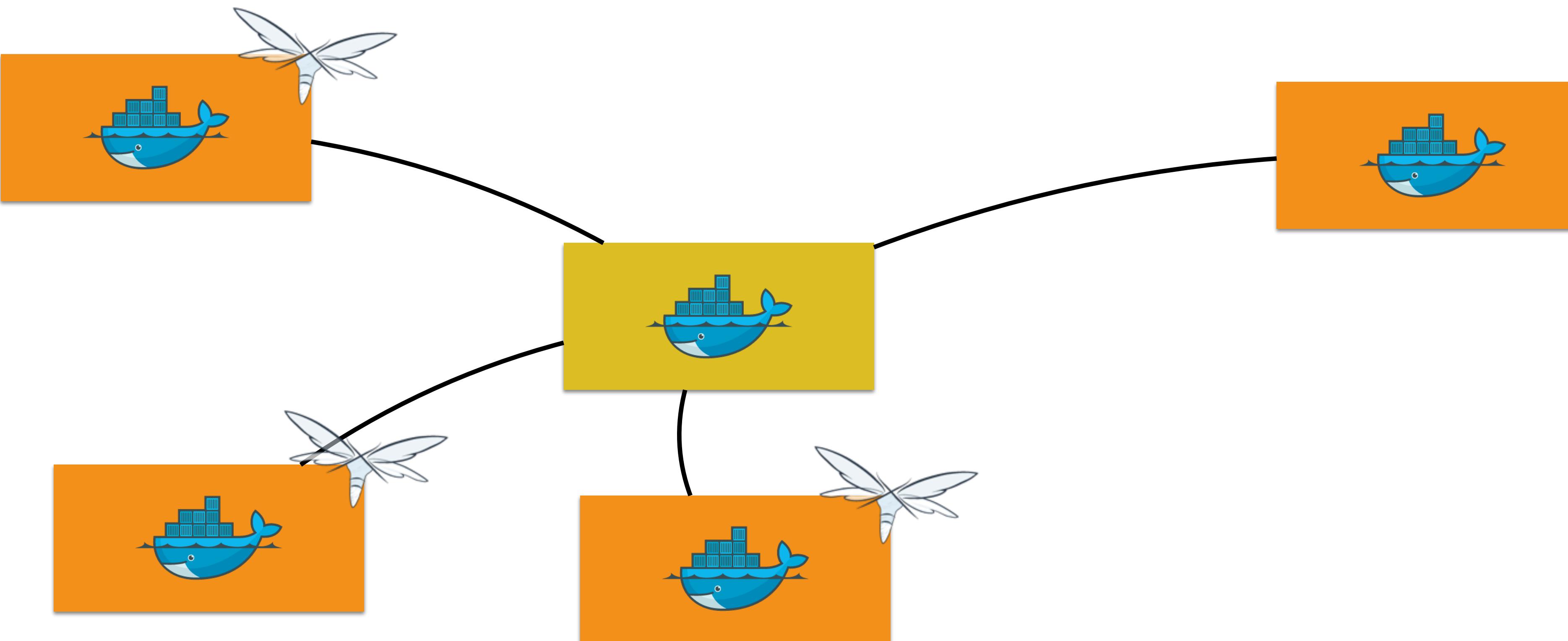
Swarm Mode: Node Failure



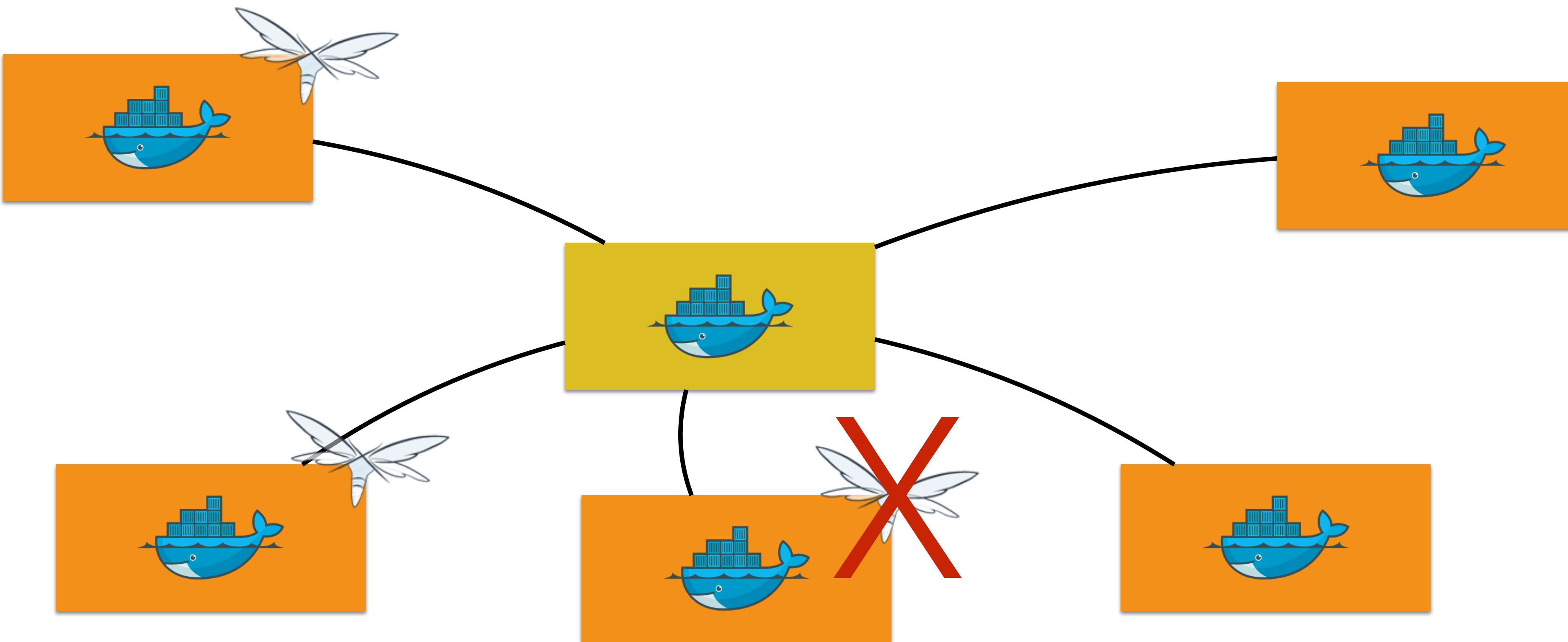
Swarm Mode: Desired != Actual



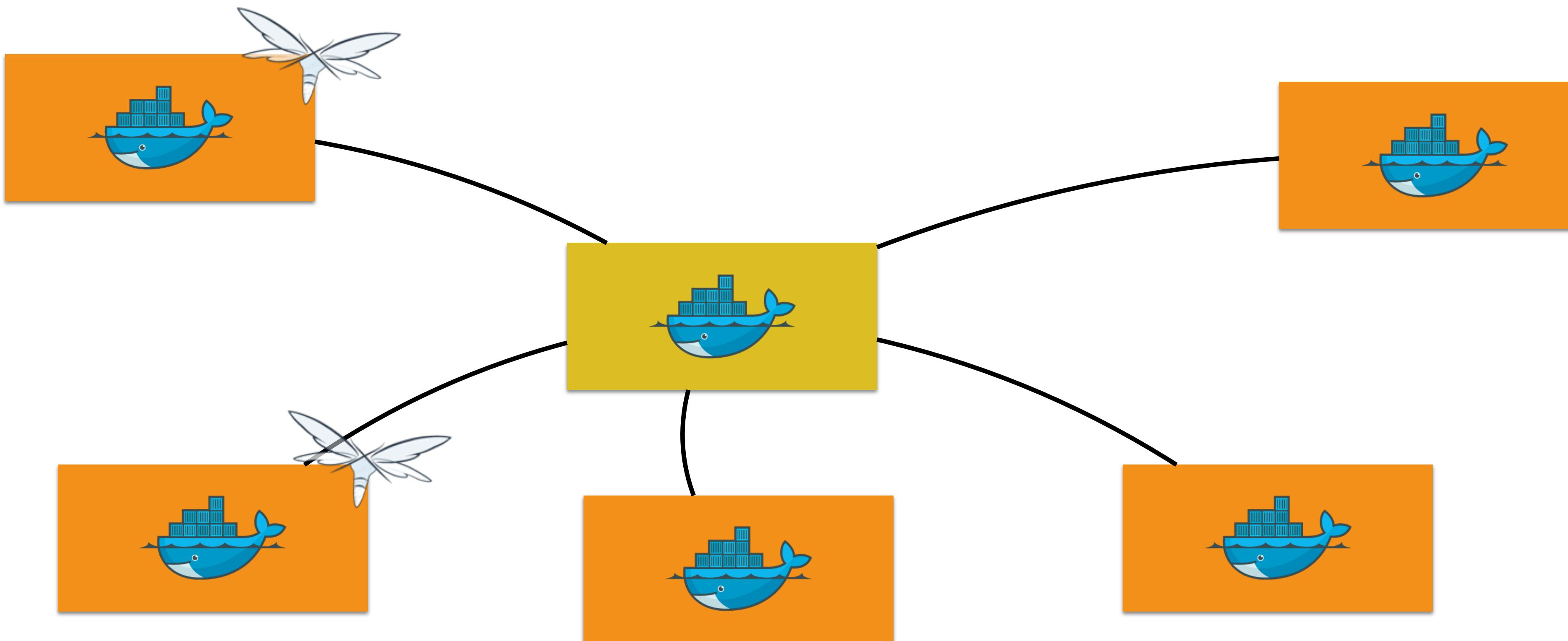
Swarm Mode: Reconcile



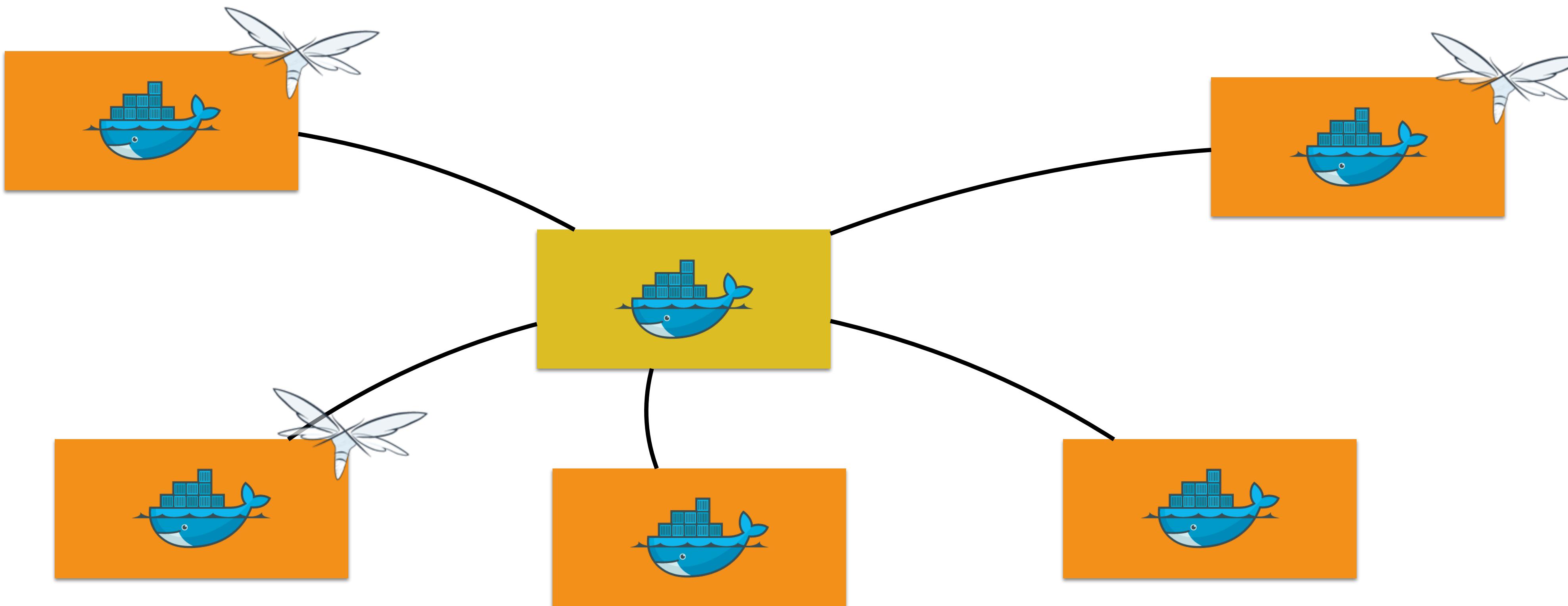
Swarm Mode: Container Failure



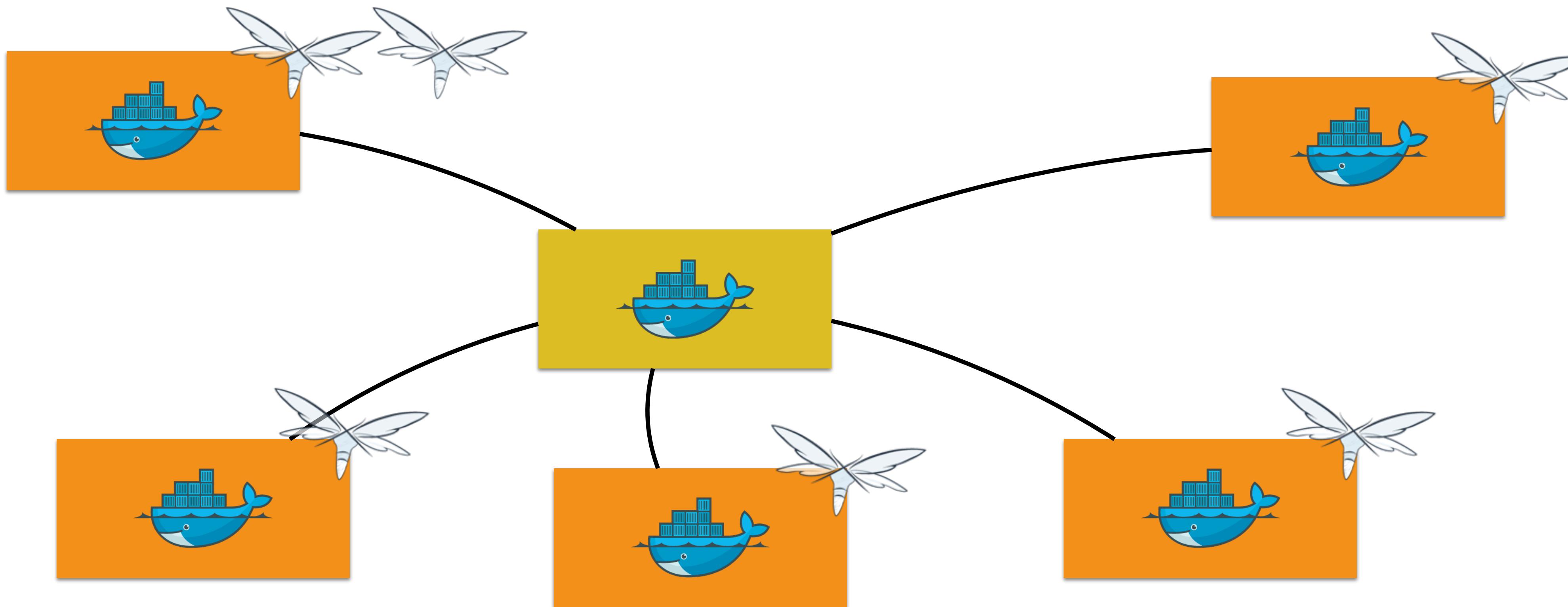
Swarm Mode: Desired != Actual



Swarm Mode: Reconcile

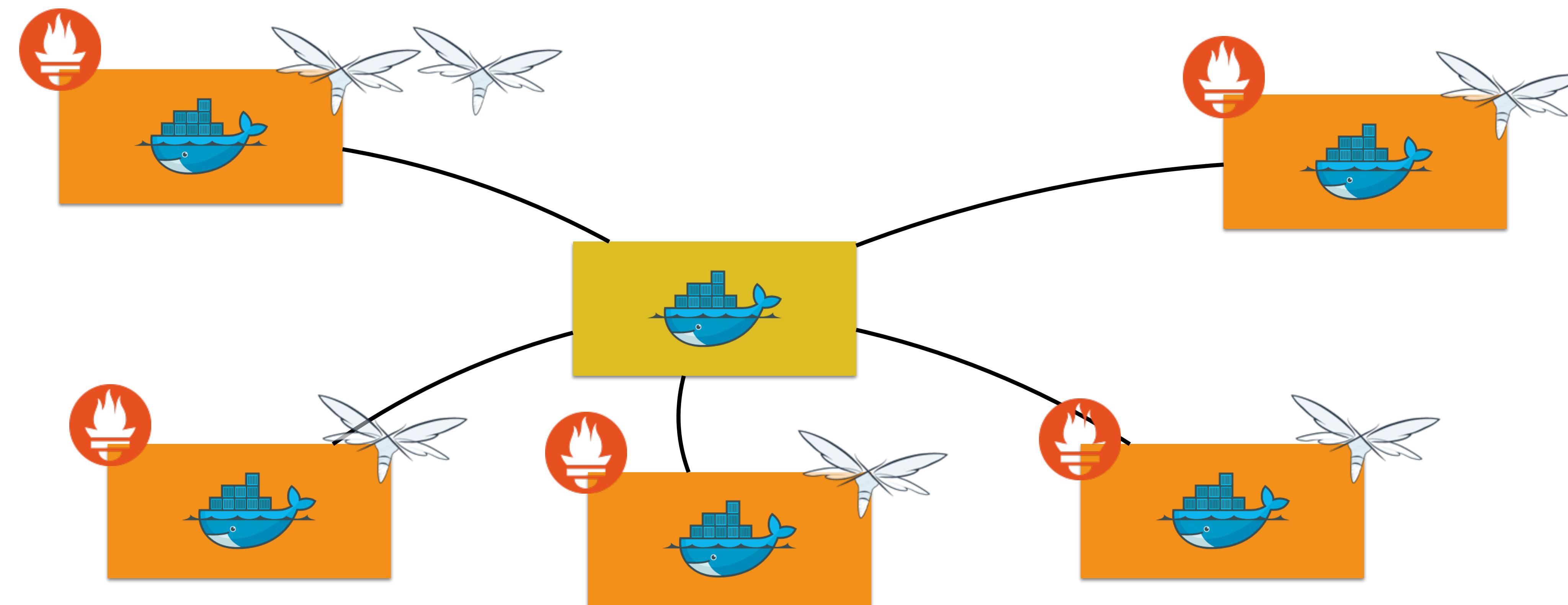


Swarm Mode: Scale



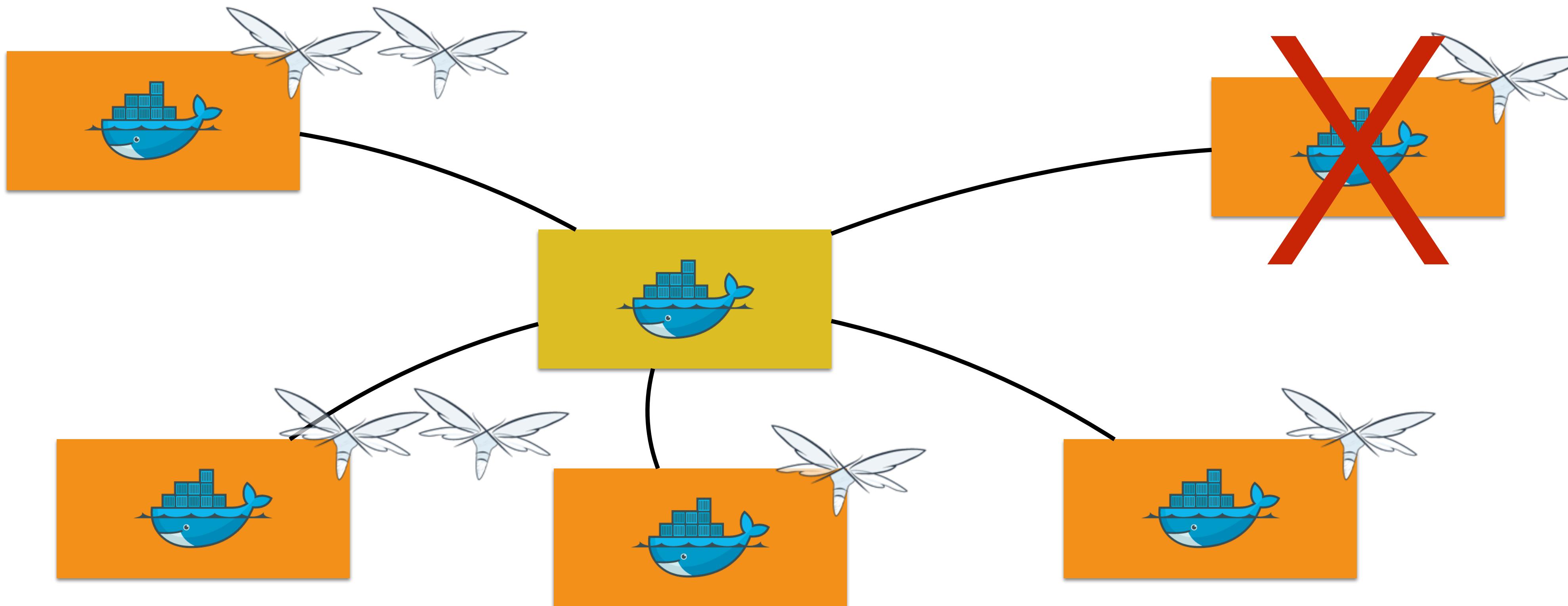
`docker service scale web=6`

Swarm Mode: Global Service



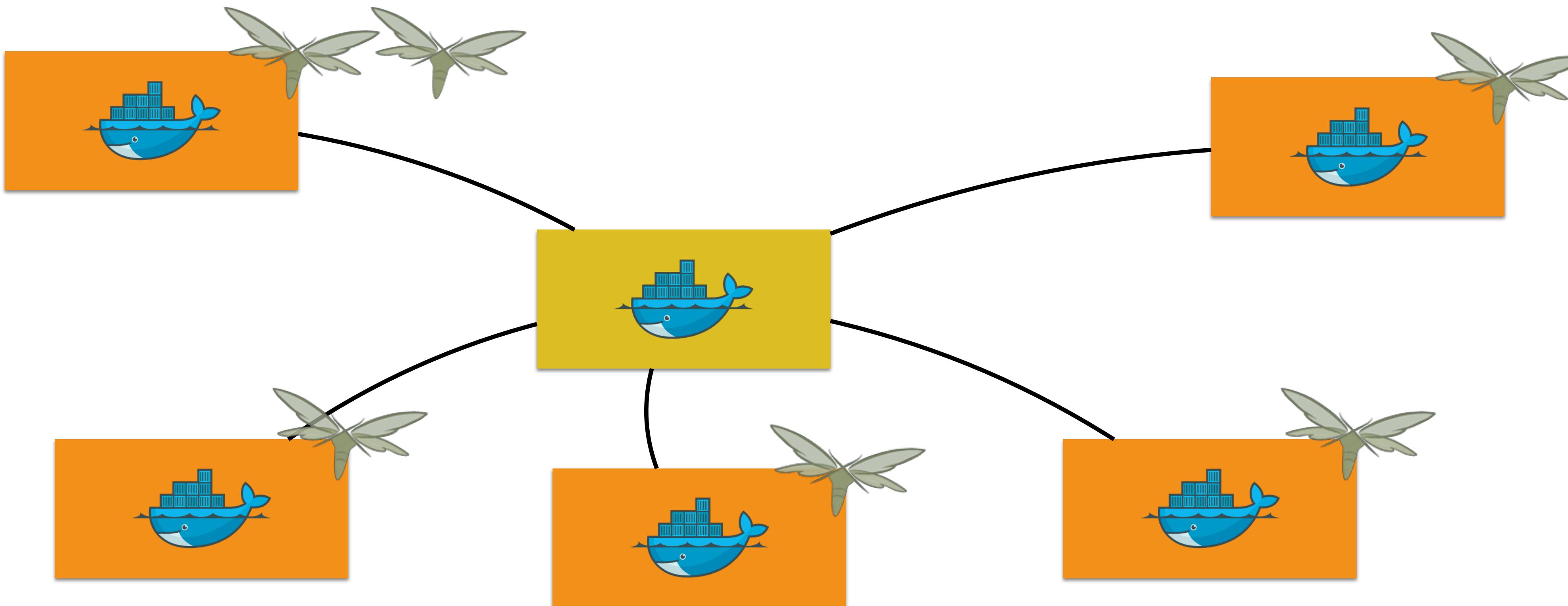
```
docker service create --mode=global --name=prom prom/prometheus
```

Swarm Mode: Drain Node



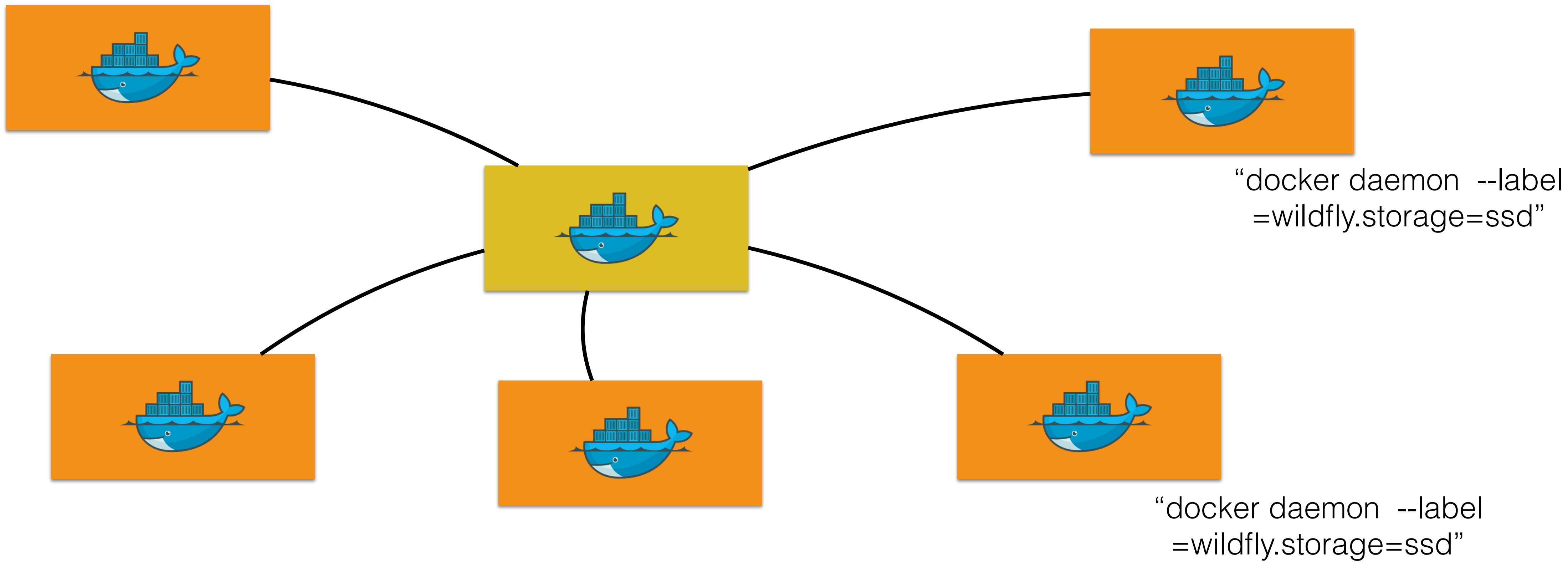
```
docker node update --availability drain <nodename>
```

Swarm Mode: Rolling Updates



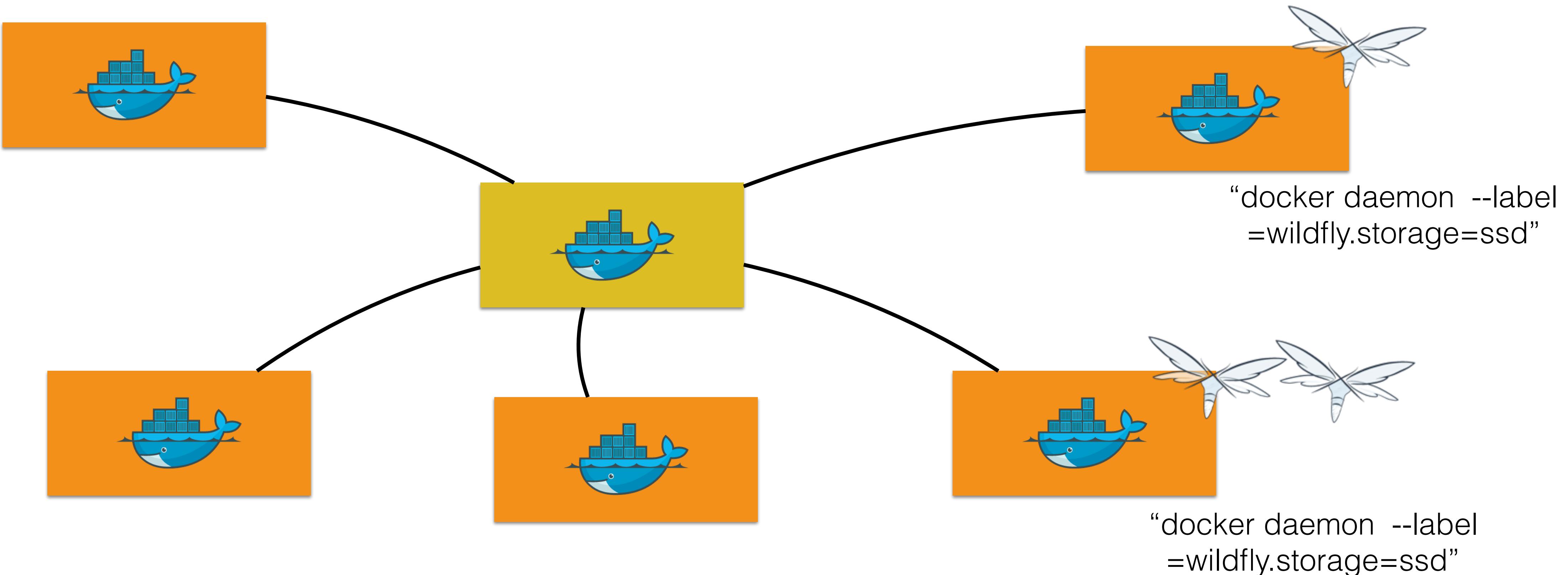
```
docker service update web --image wildfly:2 --update-parallelism  
2 --update-delay 10s
```

Swarm Mode: Label



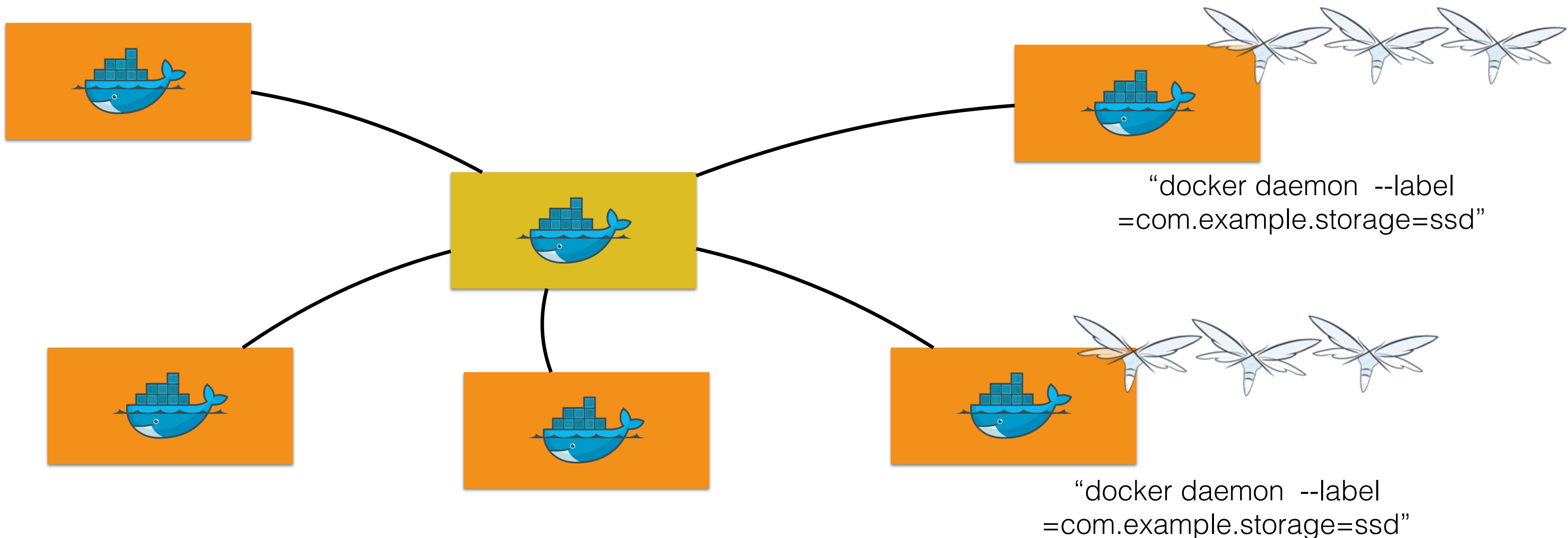
```
DOCKER_OPTS="--label=wildfly.storage=ssd"
```

Swarm Mode: Constraints



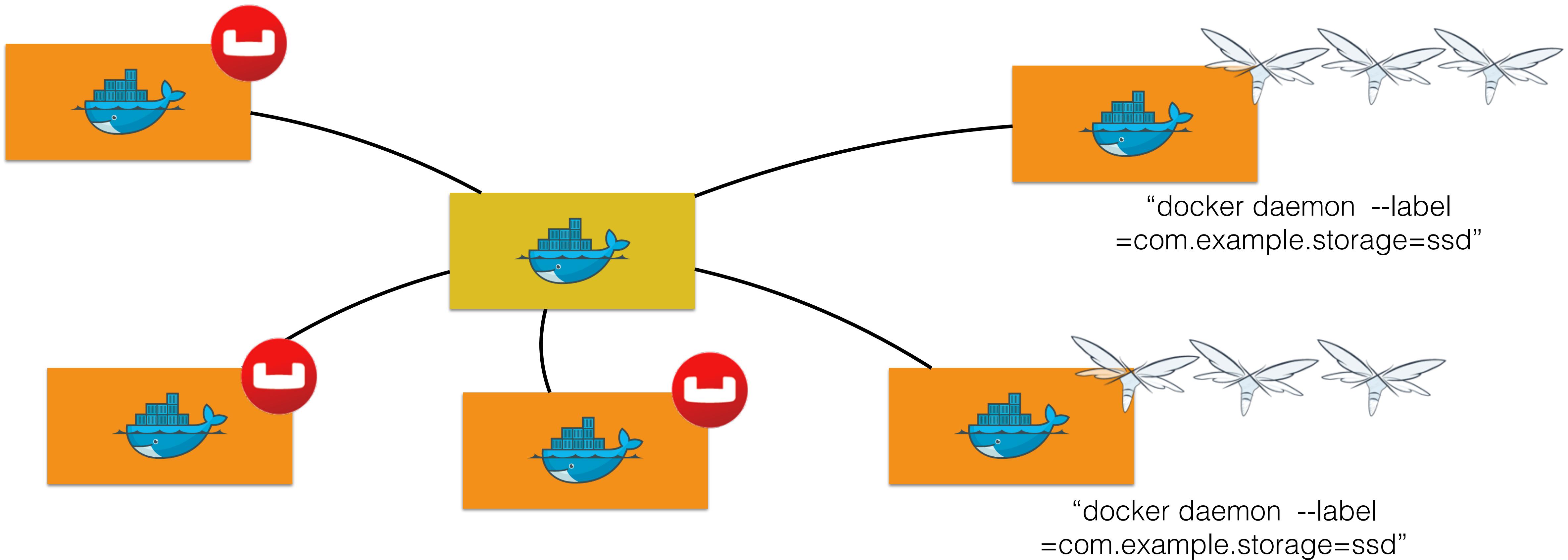
```
docker service create --replicas=3 --name=frontend --  
constraint engine.labels.wildfly.storage==ssd jboss/wildfly
```

Swarm Mode: Constraints



```
docker service scale web=6
```

Swarm Mode: Constraints



```
docker service create --replicas=3 --name=db couchbase
```

Persistent Storage

- Data volumes - used to persist data independent of container's lifecycle
- Multiple plugins: Flocker, Ceph, . . .

```
docker volume --help

Usage: docker volume [OPTIONS] [COMMAND]

Manage Docker volumes

Commands:
  create           Create a volume
  inspect          Return low-level information on a volume
  ls               List volumes
  rm              Remove a volume
```

Persistent Storage

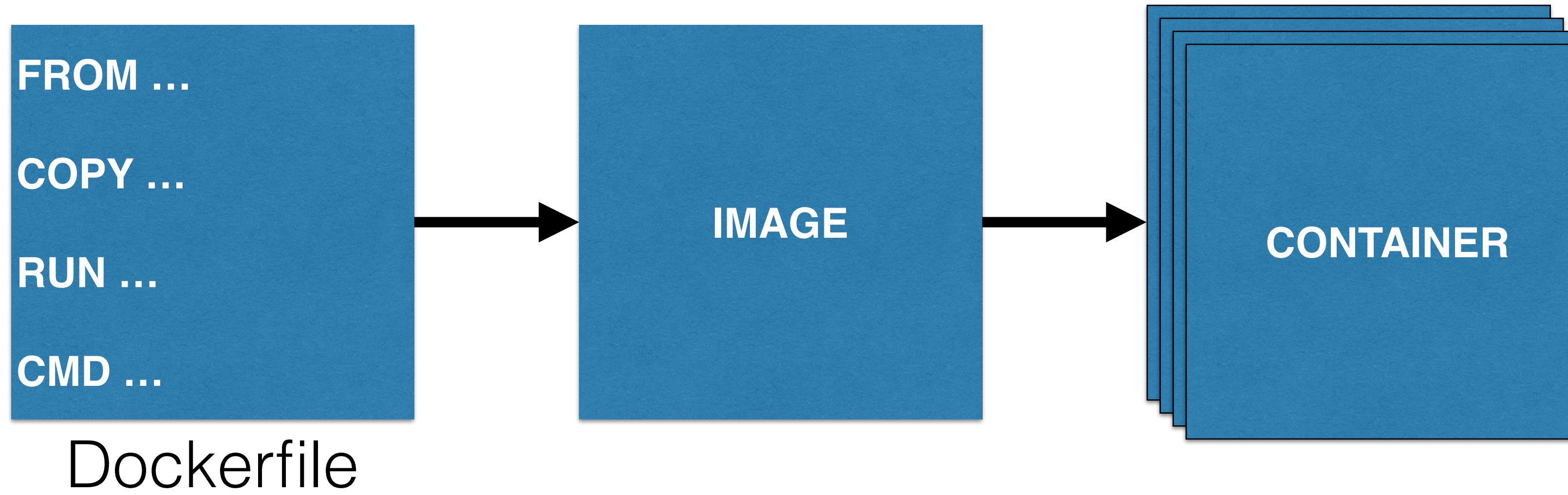
Create a volume

```
docker volume create --name=data data
```

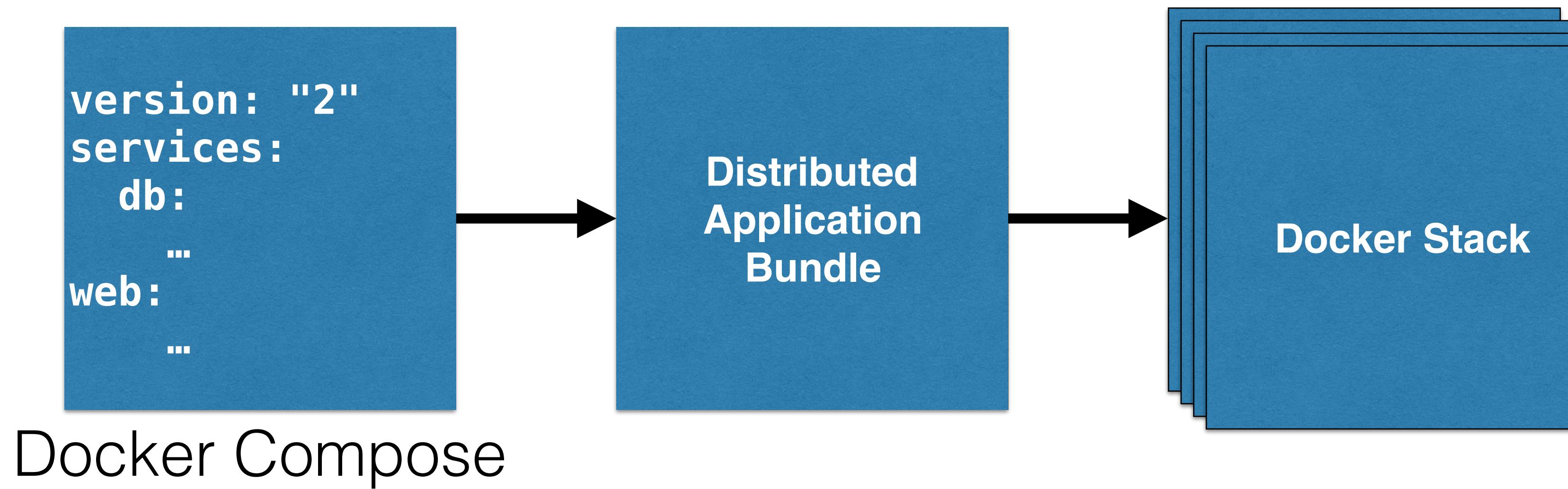
Run a container with the volume

```
docker run -it -v data:/opt/couchbase/var couchbase
```

Docker Lifecycle



Distributed Application Bundle





Docker Cloud

- SaaS
- Build your images
- Deploy and manage across different clouds
 - Amazon, Digital Ocean, Microsoft, Azure, IBM SoftLayer
 - BYON





Docker Cloud



Build

Containerize your applications and accelerate development.



Deploy

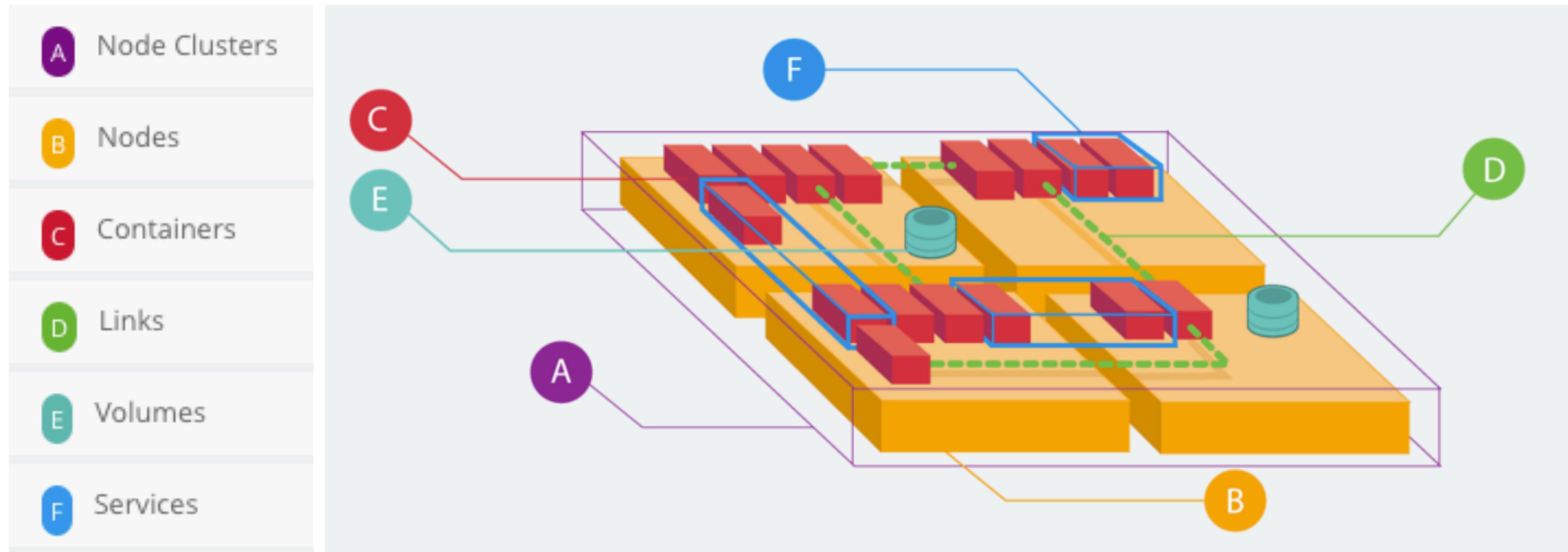
All frameworks and technologies welcomed.
Scale with ease on any Cloud.



Manage

Simplify operations, focus on your code, and forget about managing servers.

Docker Cloud Architecture



Create a node cluster



Image arungupta/couchbase

Service name couchbase-1924aaf6

Image tag latest

Stack (No stack)

Deployment strategy Emptiest node

Number of containers 1

Deploy tags

Provider Amazon Web Services

Region us-west-1

VPC Auto

Subnet Auto

Ports

Container port	Protocol	Published	Node port
11207	tcp	<input type="checkbox"/>	--
11210	tcp	<input checked="" type="checkbox"/>	dynamic
11211	tcp	<input type="checkbox"/>	--
tcp		<input type="checkbox"/>	--
tcp		<input type="checkbox"/>	--
tcp		<input checked="" type="checkbox"/>	dynamic
tcp		<input checked="" type="checkbox"/>	dynamic
tcp		<input checked="" type="checkbox"/>	dynamic
tcp		<input checked="" type="checkbox"/>	dynamic

couchbase-1924aaf6 / COUC...

Stop Terminate Redeploy

▶ Running

34 minutes ago

Endpoints Logs Environment variables Volumes Terminal Timeline

Automatically refreshing

arungupta/couchbase:latest

/entrypoint.sh /opt/couchbase/...

32775->8091/tcp 32774->8092/tcp
32773->8093/tcp 32772->11210/tcp

11207/tcp 11211/tcp 18091/tcp
18092/tcp

10.7.0.2

off

None

Bridge

```
2016-03-21T22:07:13.351371182Z * upload completely sent off: 26 out of 26 bytes
2016-03-21T22:07:13.353756594Z < HTTP/1.1 200 OK
2016-03-21T22:07:13.353780275Z < Server: Couchbase Server
2016-03-21T22:07:13.353789344Z < Pragma: no-cache
2016-03-21T22:07:13.353797575Z < Date: Mon, 21 Mar 2016 22:07:13 GMT
2016-03-21T22:07:13.353805473Z < Content-Length: 0
2016-03-21T22:07:13.353816319Z < Cache-Control: no-cache
2016-03-21T22:07:13.353824677Z <
2016-03-21T22:07:13.354209316Z 100 26 0 0 100 26 0 6772 --:--:-- --:--:-- 8666
2016-03-21T22:07:13.354226834Z * Connection #0 to host 127.0.0.1 left intact
2016-03-21T22:07:13.357390925Z * Trying 127.0.0.1...
2016-03-21T22:07:13.357713200Z * Total % Received % Xferd Average Speed Time Time Current
2016-03-21T22:07:13.357765231Z Dload Upload Total Spent Left Speed
2016-03-21T22:07:13.357940902Z 0 0 0 0 0 0 0 0 --:--:-- --:--:-- 0* Conn
2016-03-21T22:07:13.358003091Z > POST /settings/web HTTP/1.1
2016-03-21T22:07:13.358057746Z > User-Agent: curl/7.40.0-DEV
2016-03-21T22:07:13.358110137Z > Host: 127.0.0.1:8091
2016-03-21T22:07:13.358162421Z > Accept: */*
2016-03-21T22:07:13.358217086Z > Content-Length: 50
2016-03-21T22:07:13.358268561Z > Content-Type: application/x-www-form-urlencoded
2016-03-21T22:07:13.358317827Z >
2016-03-21T22:07:13.358677410Z } [50 bytes data]
2016-03-21T22:07:13.359053352Z * upload completely sent off: 50 out of 50 bytes
2016-03-21T22:07:13.939725813Z < HTTP/1.1 200 OK
2016-03-21T22:07:13.939801035Z < Server: Couchbase Server
2016-03-21T22:07:13.939854726Z < Pragma: no-cache
2016-03-21T22:07:13.939901212Z < Date: Mon, 21 Mar 2016 22:07:13 GMT
2016-03-21T22:07:13.939945663Z < Content-Type: application/json
2016-03-21T22:07:13.939991254Z < Content-Length: 39
2016-03-21T22:07:13.940043843Z < Cache-Control: no-cache
2016-03-21T22:07:13.940088813Z <
2016-03-21T22:07:13.940306545Z { [39 bytes data]
2016-03-21T22:07:13.941109018Z 100 89 100 39 100 50 66 85 --:--:-- --:--:-- 85
2016-03-21T22:07:13.941177878Z * Connection #0 to host 127.0.0.1 left intact
2016-03-21T22:07:13.942283607Z {"newBaseUri":"http://127.0.0.1:8091/"}/entrypoint.sh couchbase-server
```

Docker Cloud CLI

- brew install docker-cloud
- docker-cloud nodecluster create -t 1 --tag couchbase couchbase-node aws us-west-1 m3.large
- docker-cloud service create --tag couchbase -p 8091:8091 -p 8092:8092 -p 8093:8093 -p 11210:11210 arungupta/couchbase
- docker-cloud service start {SERVICE_ID}
- docker-cloud service inspect {SERVICE_ID} | jq ".container_ports[0].endpoint_uri" | sed 's/tcp/http/g'



Docker Registry

- Store and distribute Docker images
 - Control where images are stored
 - Own image distribution pipeline
 - Integrate image storage/distribution in dev workflow
- Docker Hub
 - Free-to-use and hosted
- Docker Trusted Registry
 - Commercially supported
 - RBAC, LDAP/AD integration, updates, etc

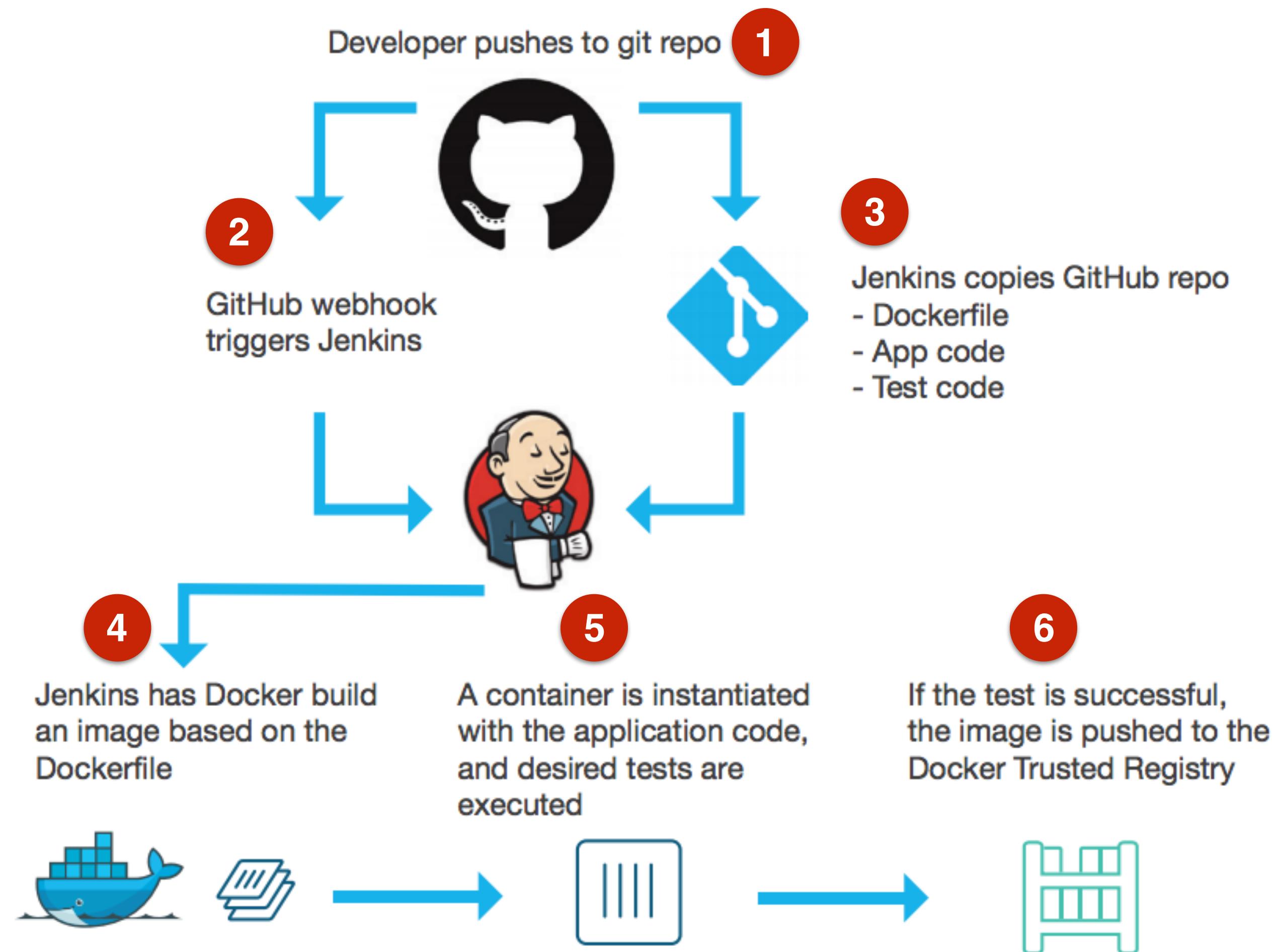


Registry Usage

- CI/CD with Docker
 - Centrally located base images
 - Store individual build images
 - Pull tested images to production

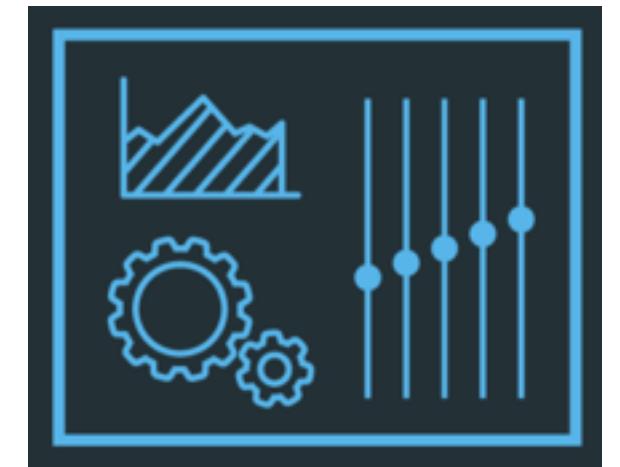
CI/CD with Docker + Jenkins

1. Push a commit to GitHub
2. GitHub webhook
3. Jenkins copies artifacts
4. Jenkins builds Docker image
5. Runs test on Docker container
6. Pushes to DTR



Monitoring Docker Containers

- `docker stats` command
 - LogEntries
- Docker Remote API: `/container/{container-name|cid}/stats`
- Docker Universal Control Plane
- cAdvisor
 - Prometheus
 - InfluxDB

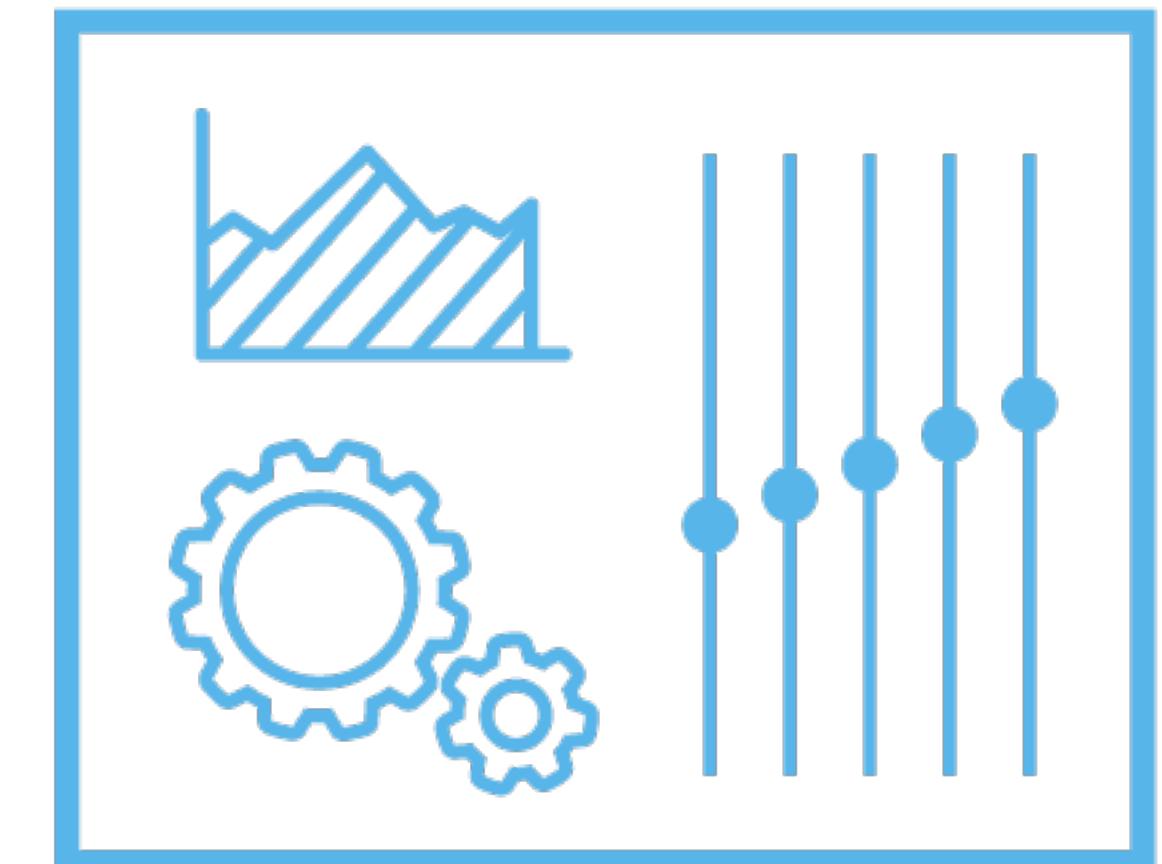


cAdvisor

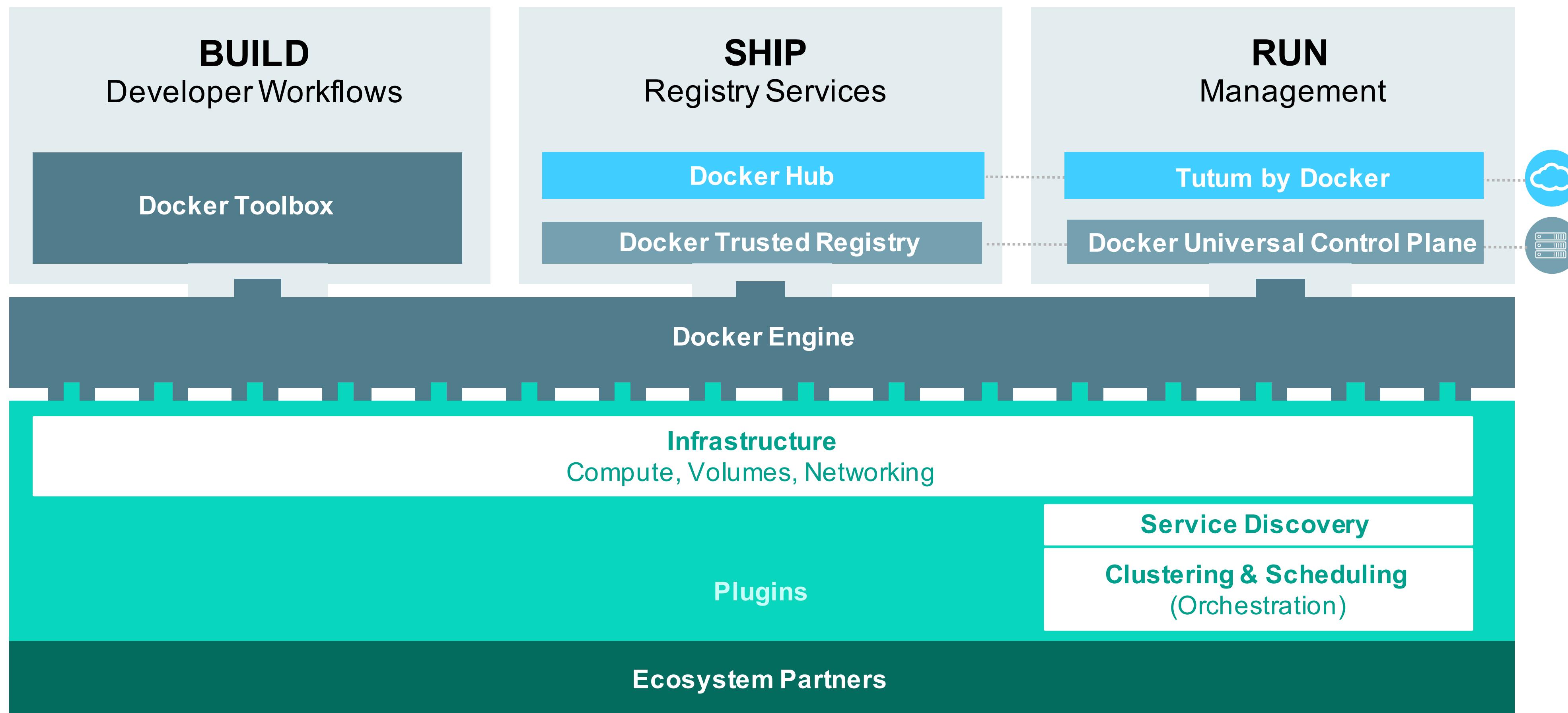


Docker Universal Control Plane

- On-premise management for Docker containers
- Build on Docker Remote API
 - Integrated support for CLI, Swarm, Compose and Trusted Registry
- Integration with LDAP/AD
- Audit Logs



Docker Mission



References

- Docker for Java Tutorial: github.com/docker/labs/tree/master/java
- Docker Scripts: github.com/arun-gupta/docker-scripts
- Docker Documentation: docs.docker.com