Docker for Java Developers

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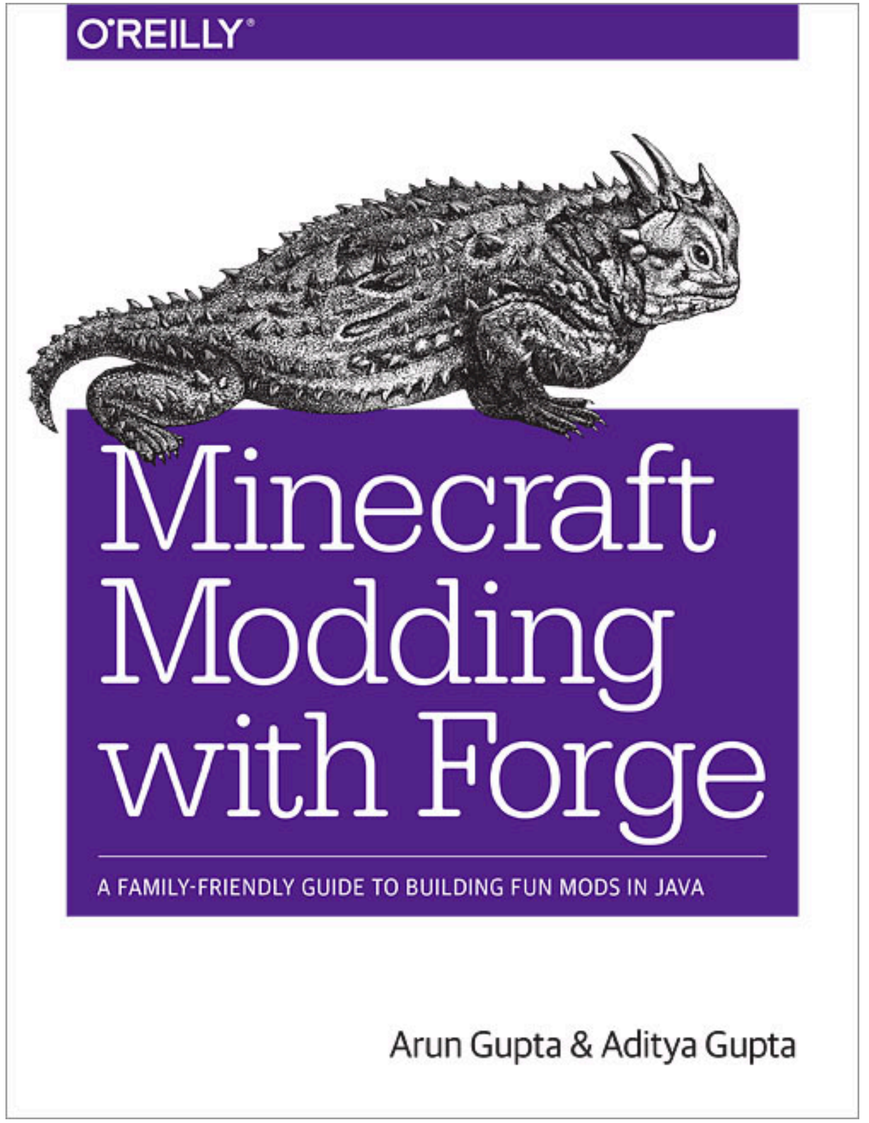
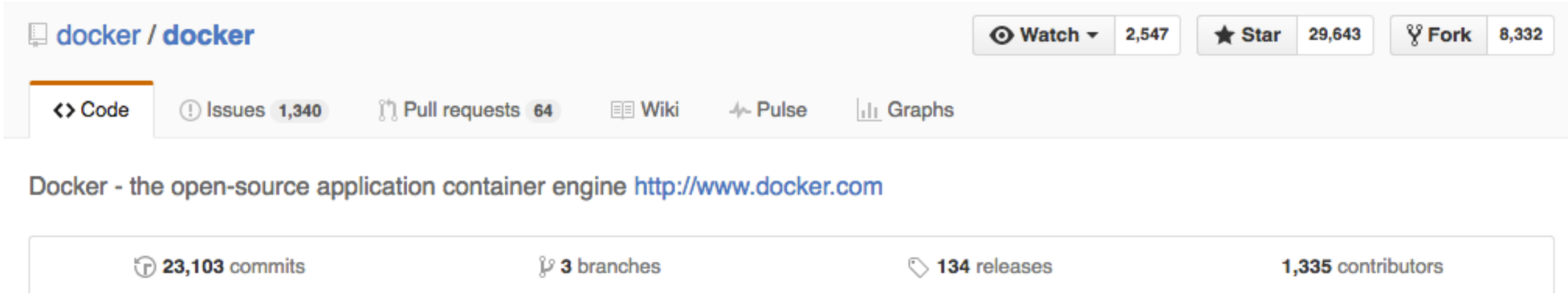
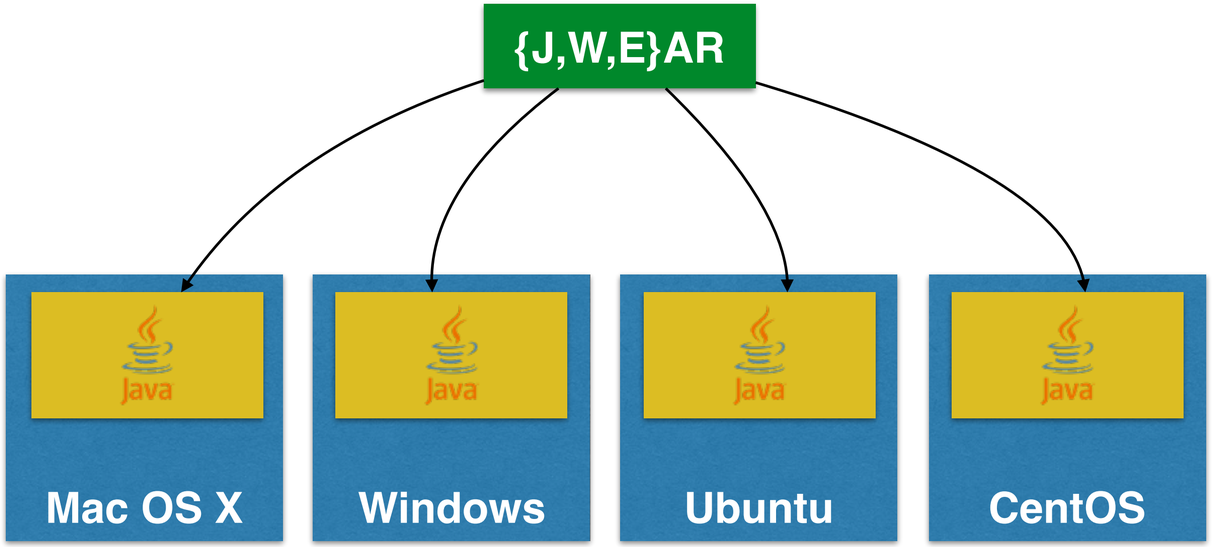


What is Docker?

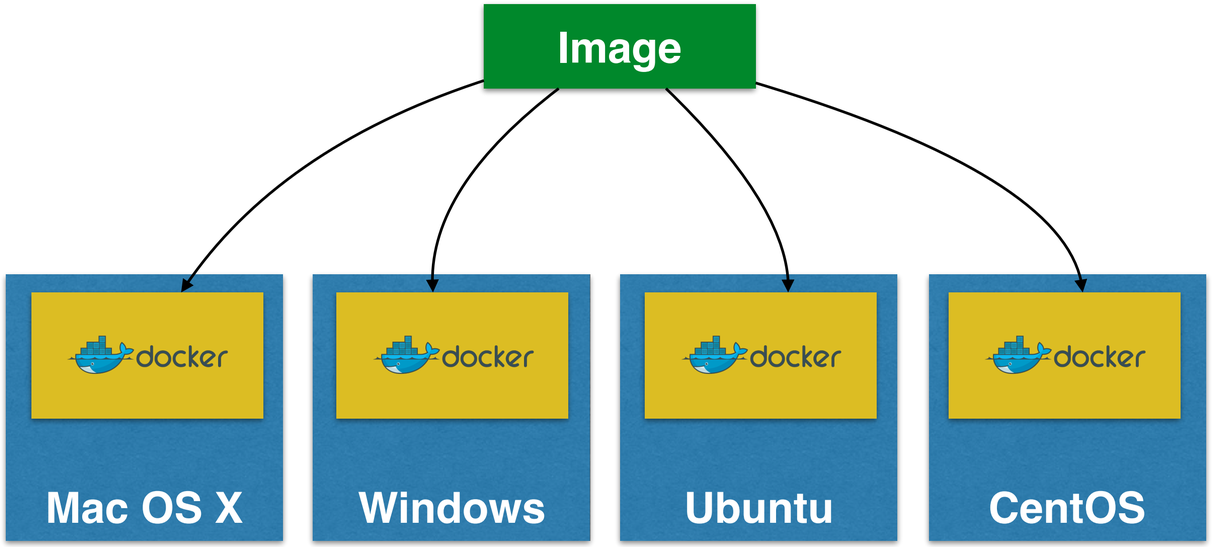
- Open source project and company



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

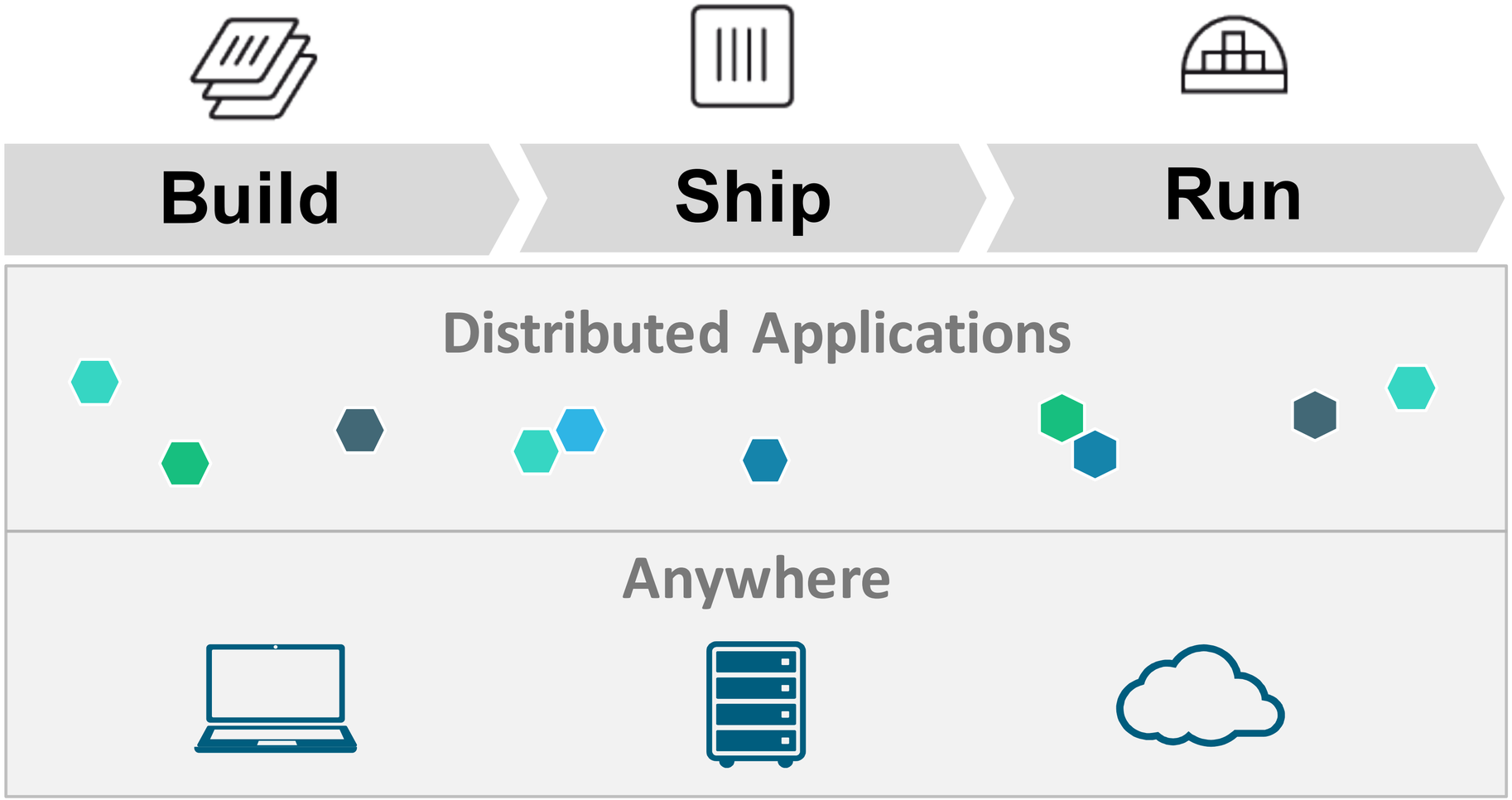


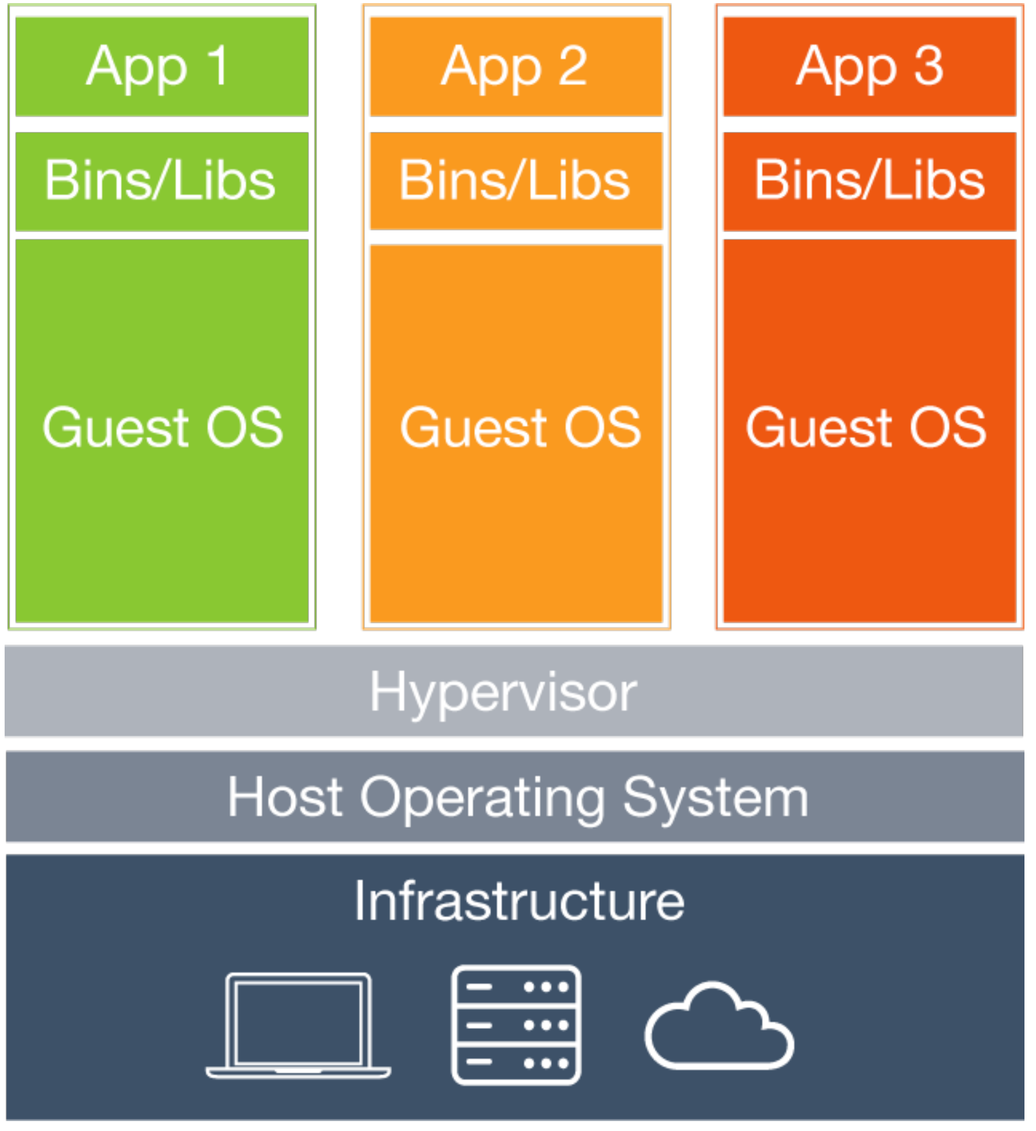
WORA = Write Once Run Anywhere

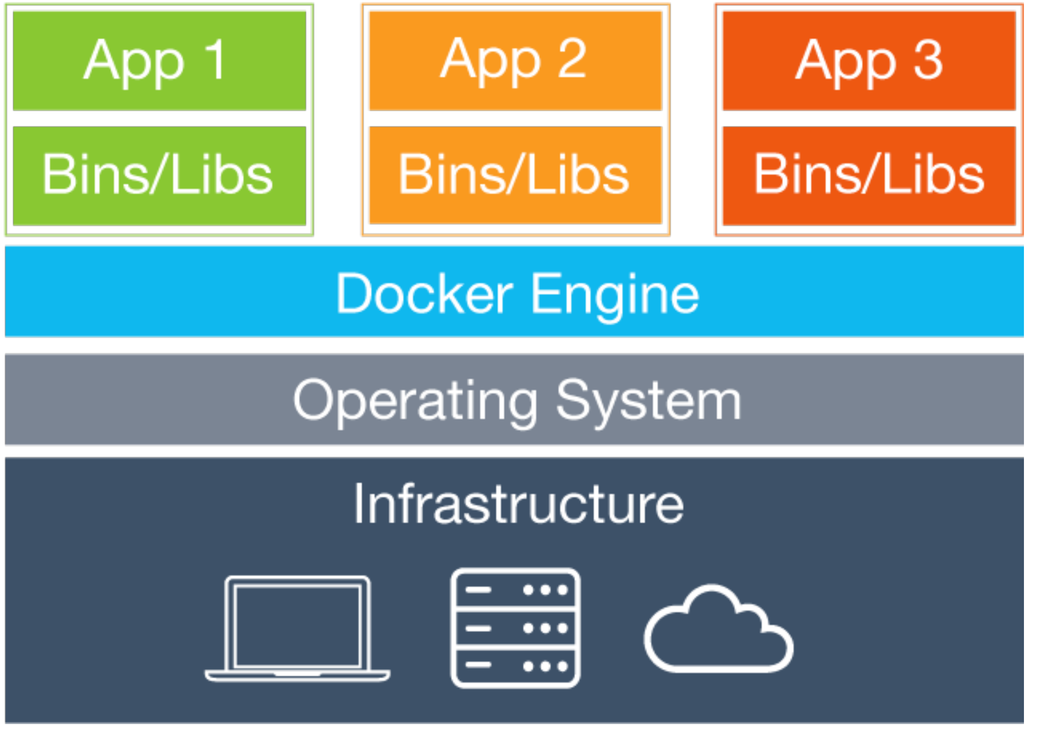


PODA = Package Once Deploy Anywhere

Docker Mission







Build

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

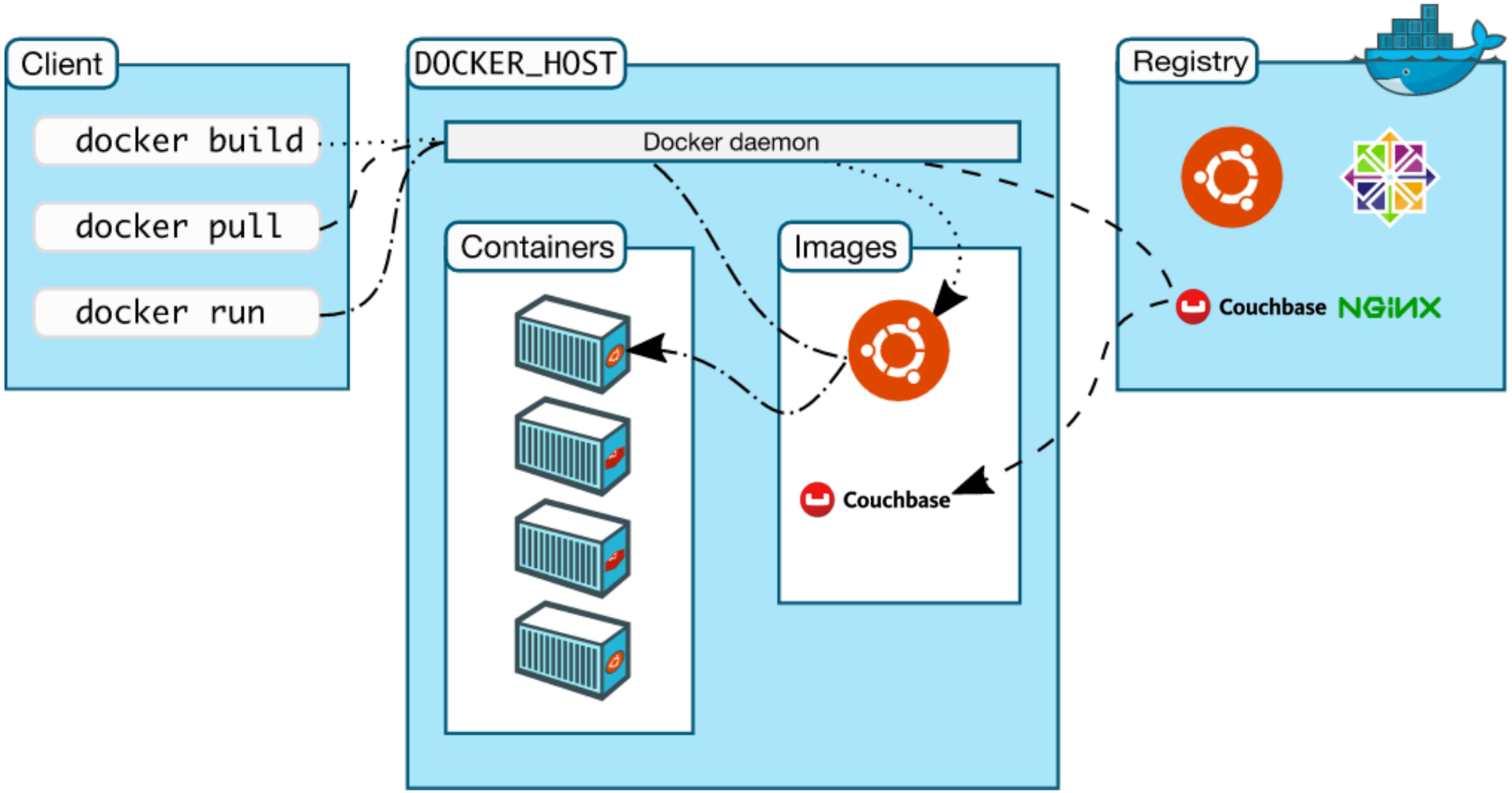
```
FROM ubuntu

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
  - STOPSIGNAL
  - Dockerfile examples

http://docs.docker.com/engine/reference/builder/

Docker Workflow



Union File System

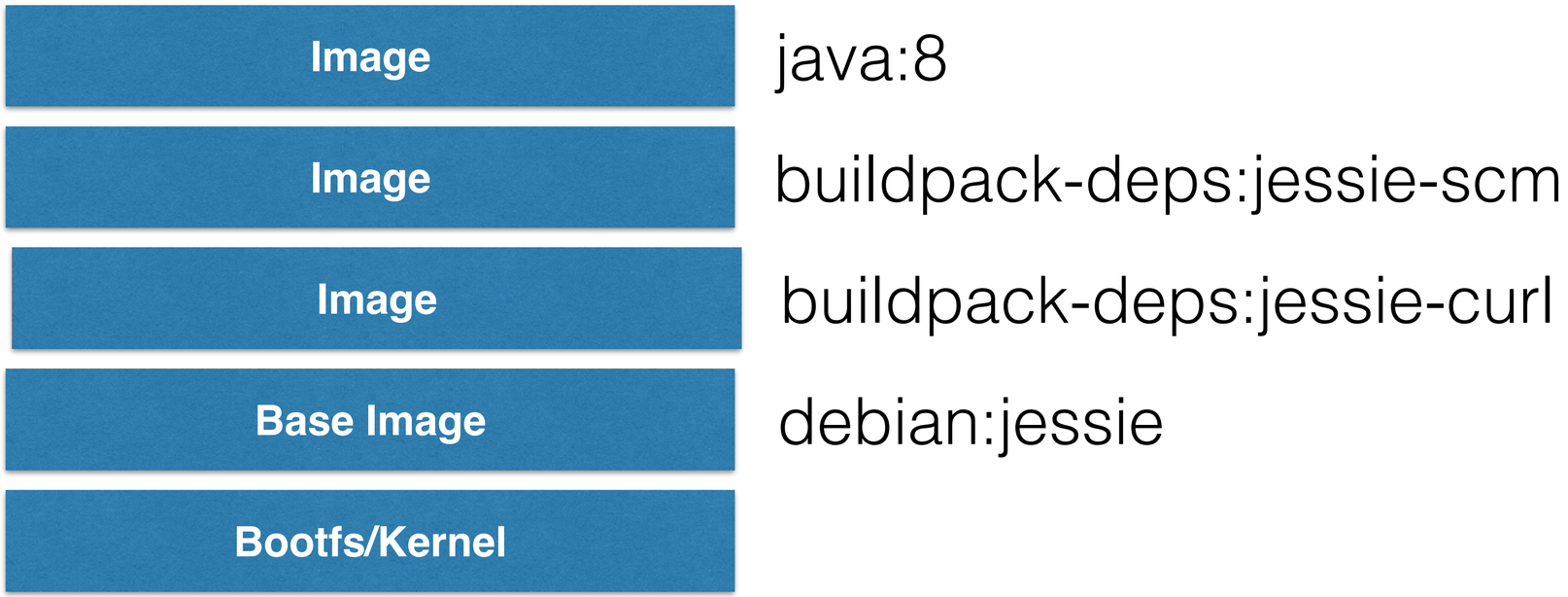


Image Layers - Couchbase

```
~ > 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
COMMENT
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
18165b90fefa        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_VERSIO   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
```

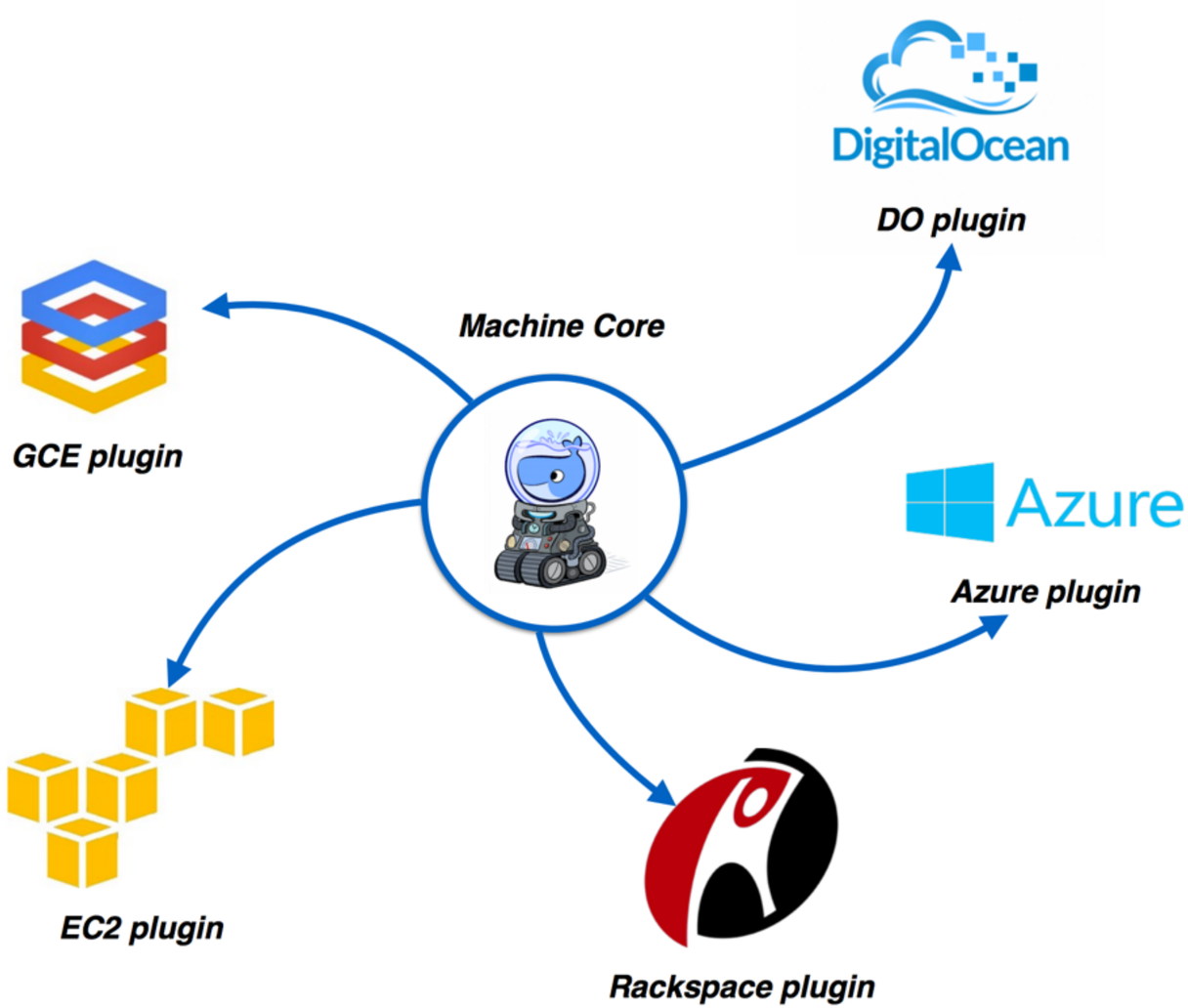
Docker Machine

- 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 for Mac/Windows

- Native user interface and auto-update capability
- No VirtualBox!
  - OSX: xhyve VM using Hypervisor.framework
  - Windows: Hyper-V VM
- Better networking and filesystem mounting/notification

Docker Toolbox

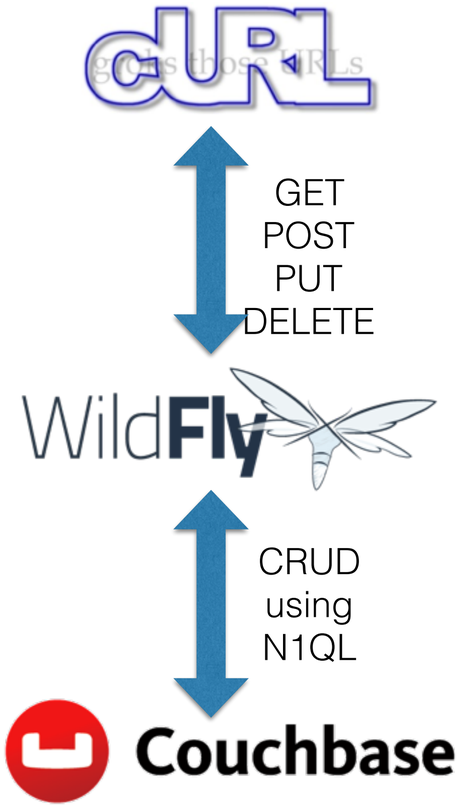
- Docker Client
- Docker Machine
- Docker Compose
- Docker Kitematic
- Boot2Docker ISO
- Virtualbox

https://www.docker.com/toolbox

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

- 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 - Two Services

```
version: “2”
services:
  db:
    container_name: "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

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

docker-compose.yml

```
mywildfly:
  ports:
    - 9080:8080
```

docker-compose.override.yml

```
docker-compose up -d
```

Dev/Prod with Compose

```
mycouchbase:
  container_name: "db-dev"
  image: arungupta/couchbase
  ports:
    - . . .
mywildfly:
  image: arungupta/wildfly
  environment:
    - COUCHBASE_URI=db-dev:8093
  ports:
    - 8080:8080
```

docker-compose.yml

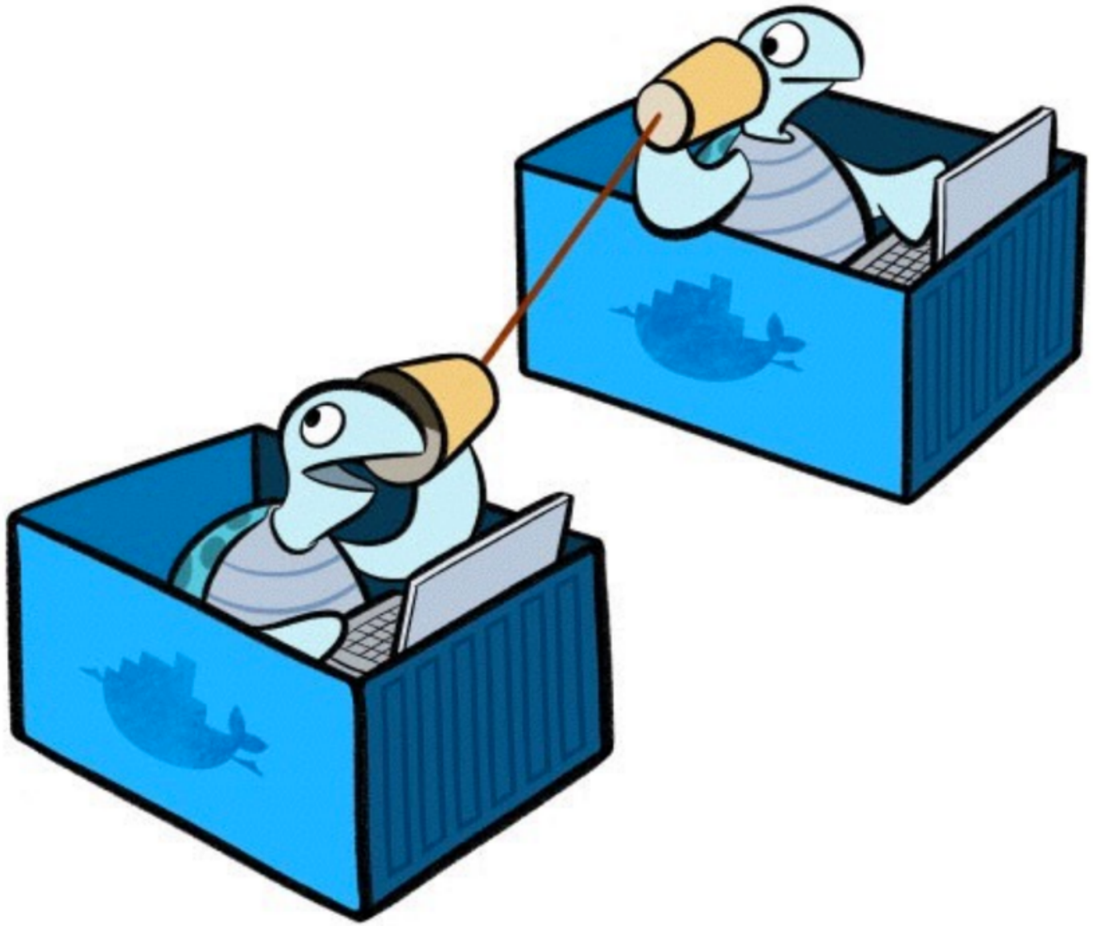
```
docker-compose up -d
```

```
mywildfly:
 environment:
    - COUCHBASE_URI=db-prod:8093
  ports:
    - 8080:80
mycouchbase:
  container_name: "db-prod"
```

production.yml

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

Multi-host Networking



Default Networks

```
docker network ls
NETWORK ID          NAME                DRIVER
8cf651cafbef        bridge              bridge
14e63204639e        none                null
96901337c96f        host                host
```

Network Name	Purpose
`bridge`	Default network that containers connect to
`none`	Container-specific networking stack
`host`	Adds container on hosts networking stack

Multi-host Networking

- Create virtual networks and attach containers
- **`Bridge`** network span single host
- **`Overlay`** network spans multiple hosts
  - Uses **`libnetwork`** (built-in VXLAN-based overlay network driver) and Docker's **`libkv`**
- Works with Swarm and Compose
- Pluggable: Calico, Cisco, Weave, . . .

docker network

```
docker network --help

Usage: docker network [OPTIONS] COMMAND [OPTIONS]

Commands:
  disconnect                Disconnect container from a network
  inspect                   Display detailed network information
  ls                        List all networks
  rm                        Remove a network
  create                    Create a network
  connect                   Connect container to a network
```

Application Code

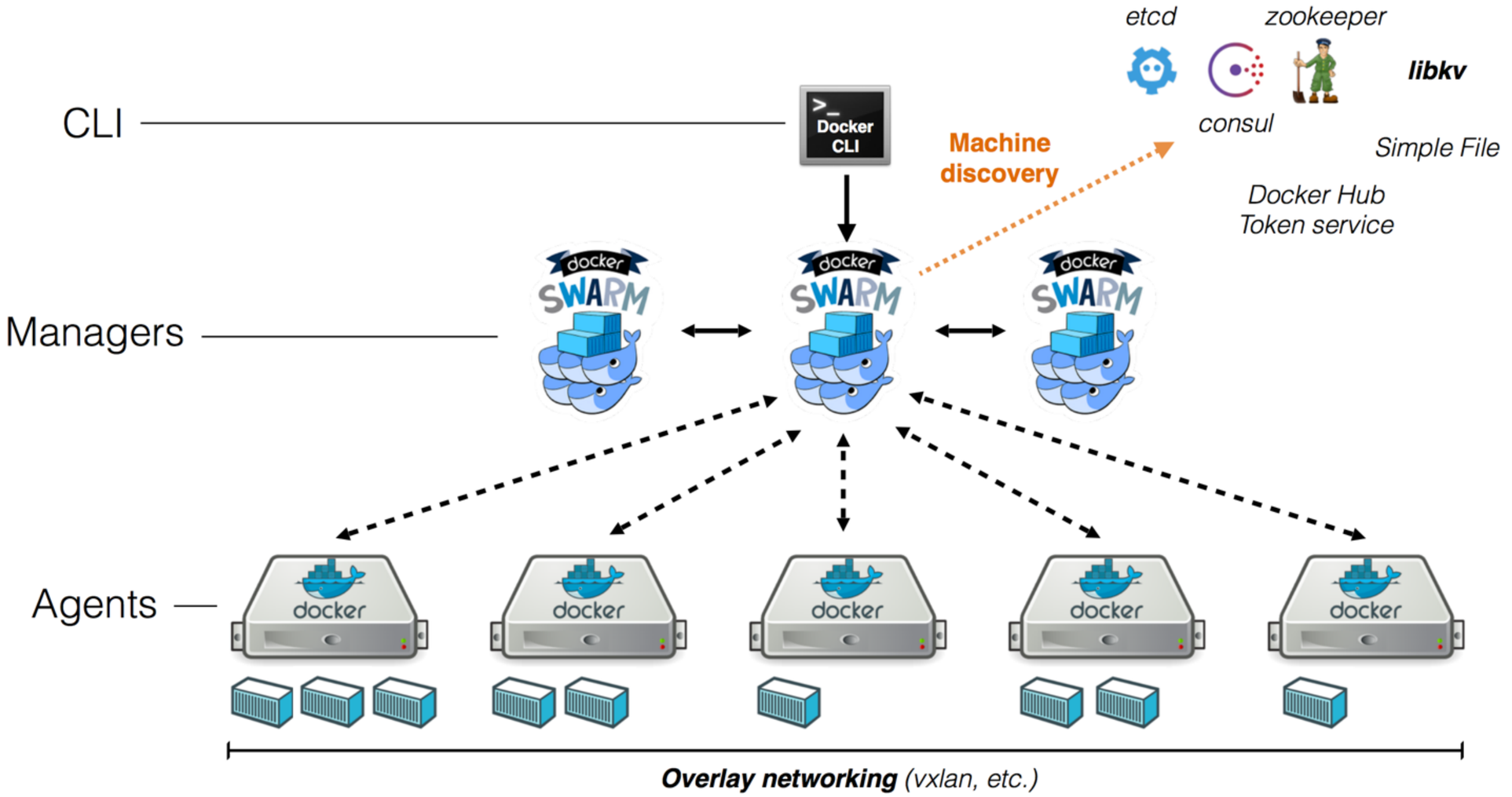
```
version: “2”
services:
  db:
    container_name: "db"
    image: couchbase
    ports:
      - 8091:8091
      - 8092:8092
      - 8093:8093
      - 11210:11210
  web:
    image: arungupta/wildfly-admin
    environment:
      - COUCHBASE_URI=db
    ports:
      - 8080:8080
      - 9990:9990
```

```
CouchbaseCluster.create(System.getenv(“COUCHBASE_URI”));
```

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
- 1.1 - Ready for production
  - Reschedule containers when a node fails (experimental)
  - Better node management

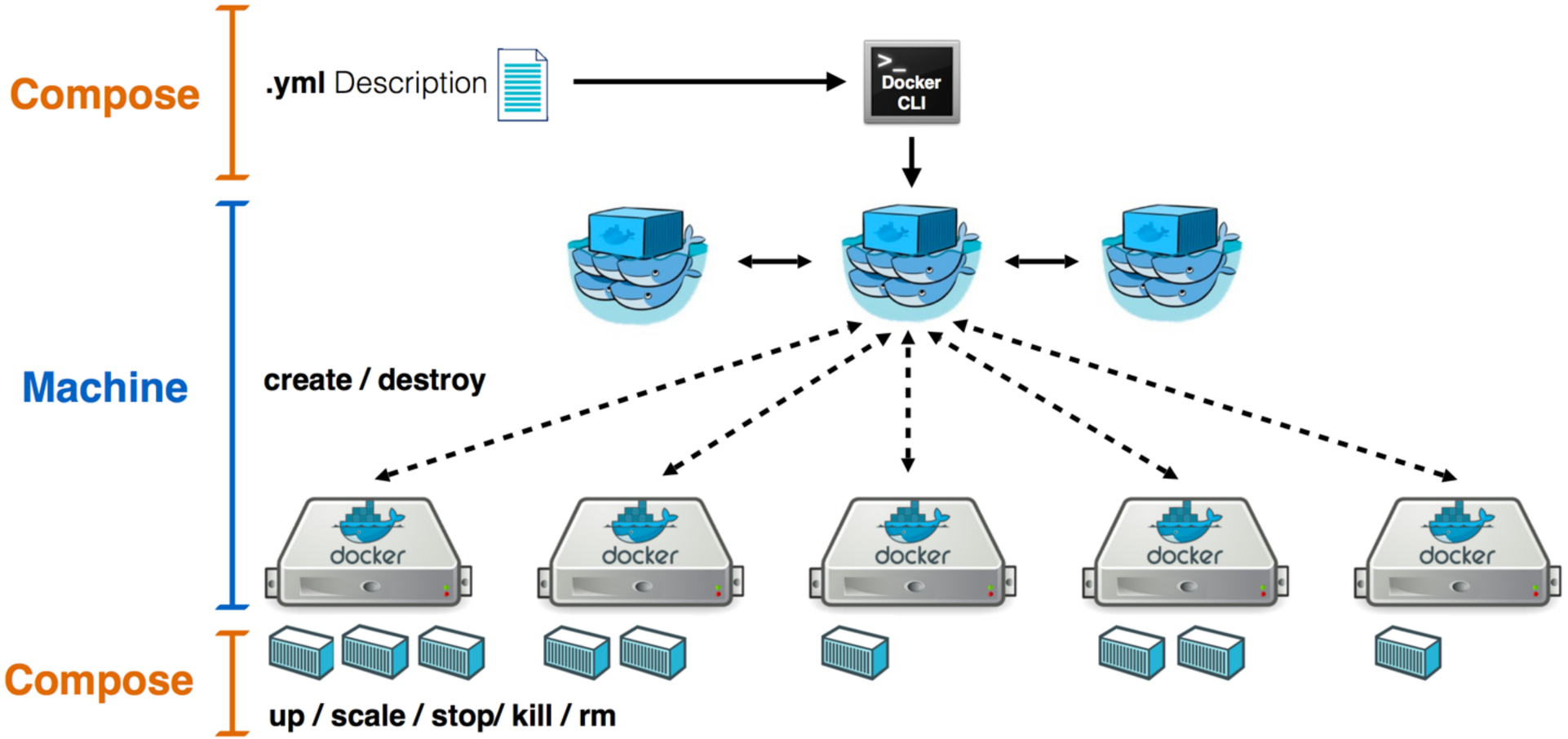
Stress tested on 1000 EC2 nodes, ~30k containers



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



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
```

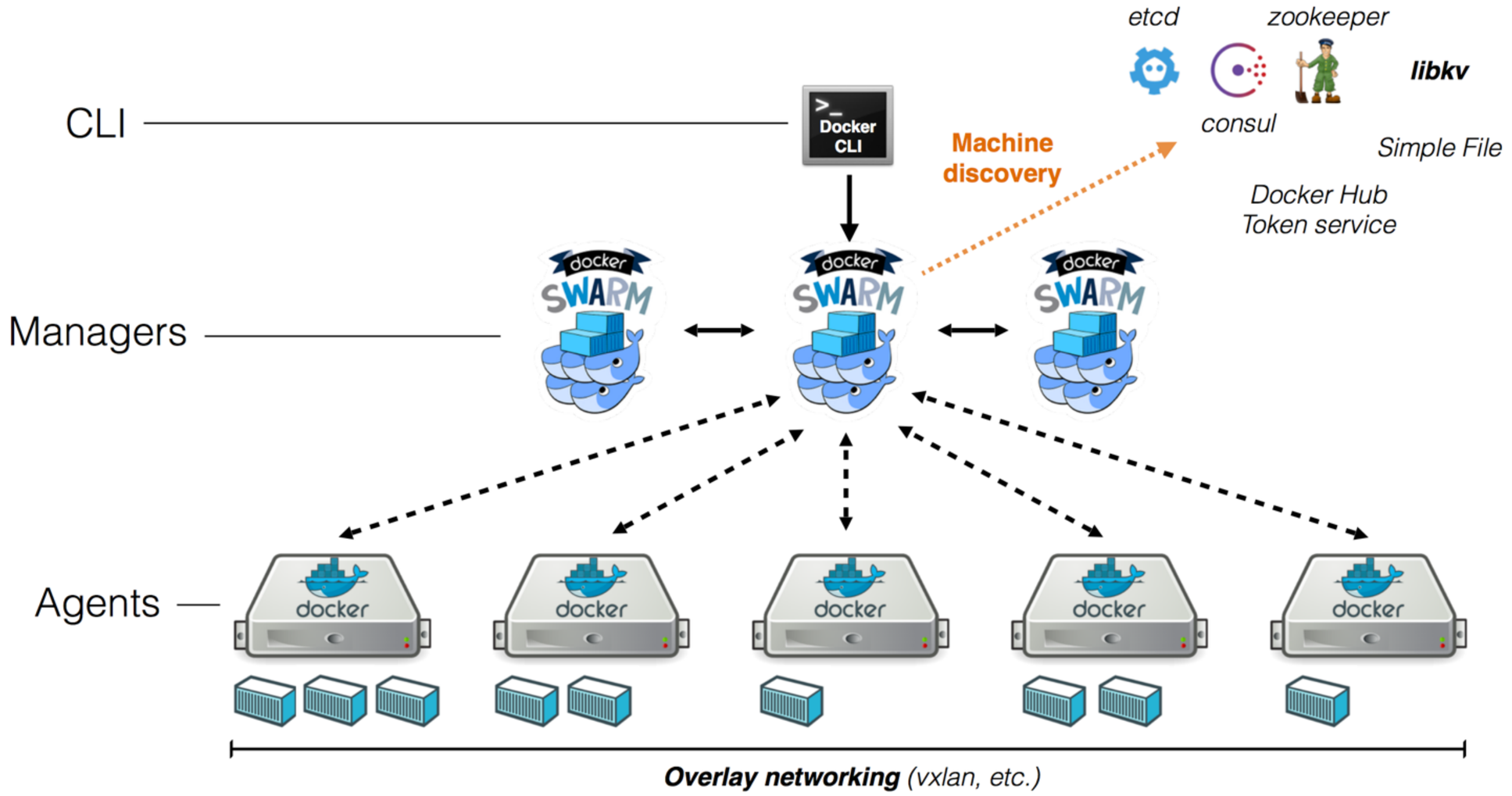
Persistent Storage

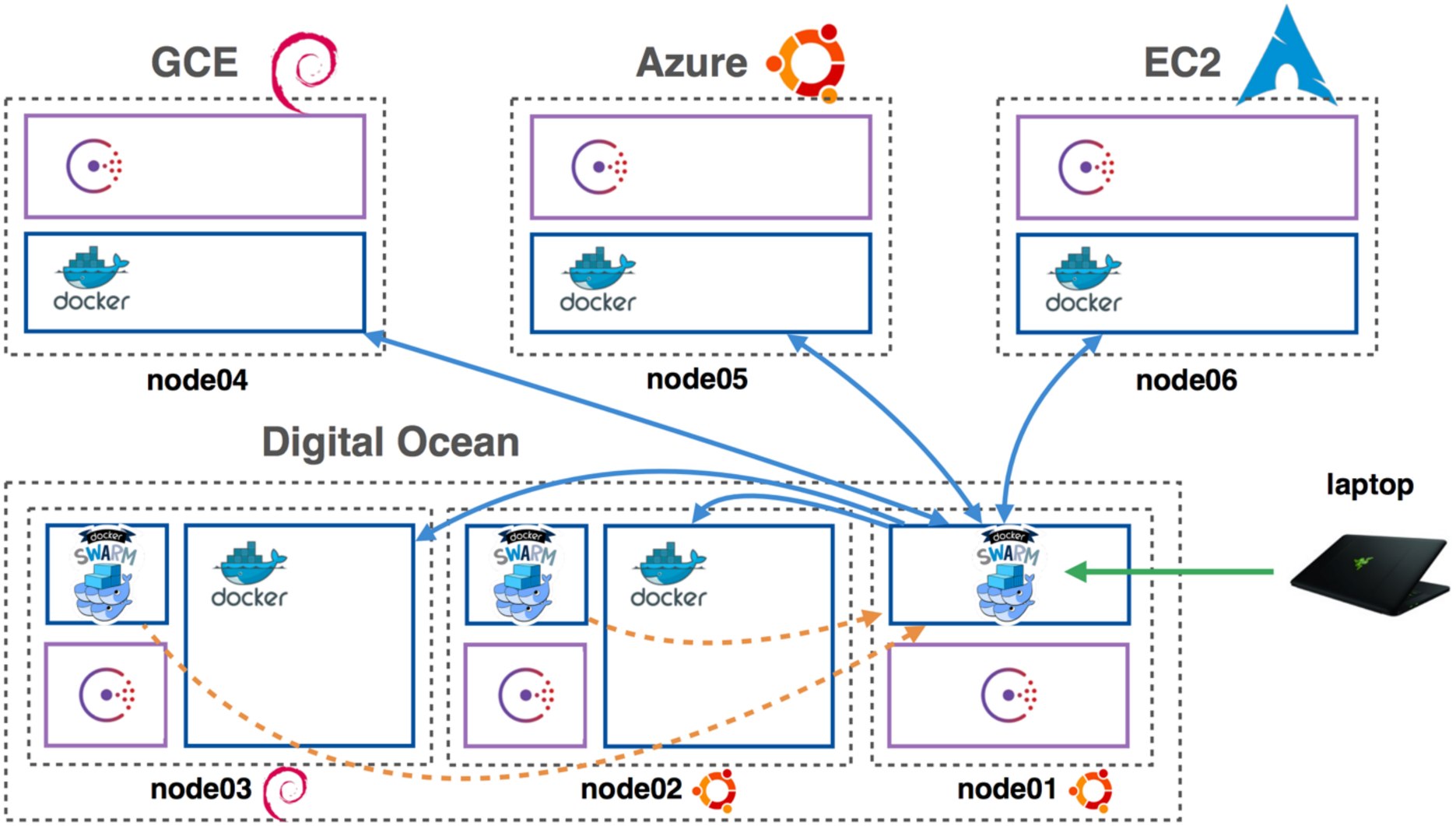
Create a volume

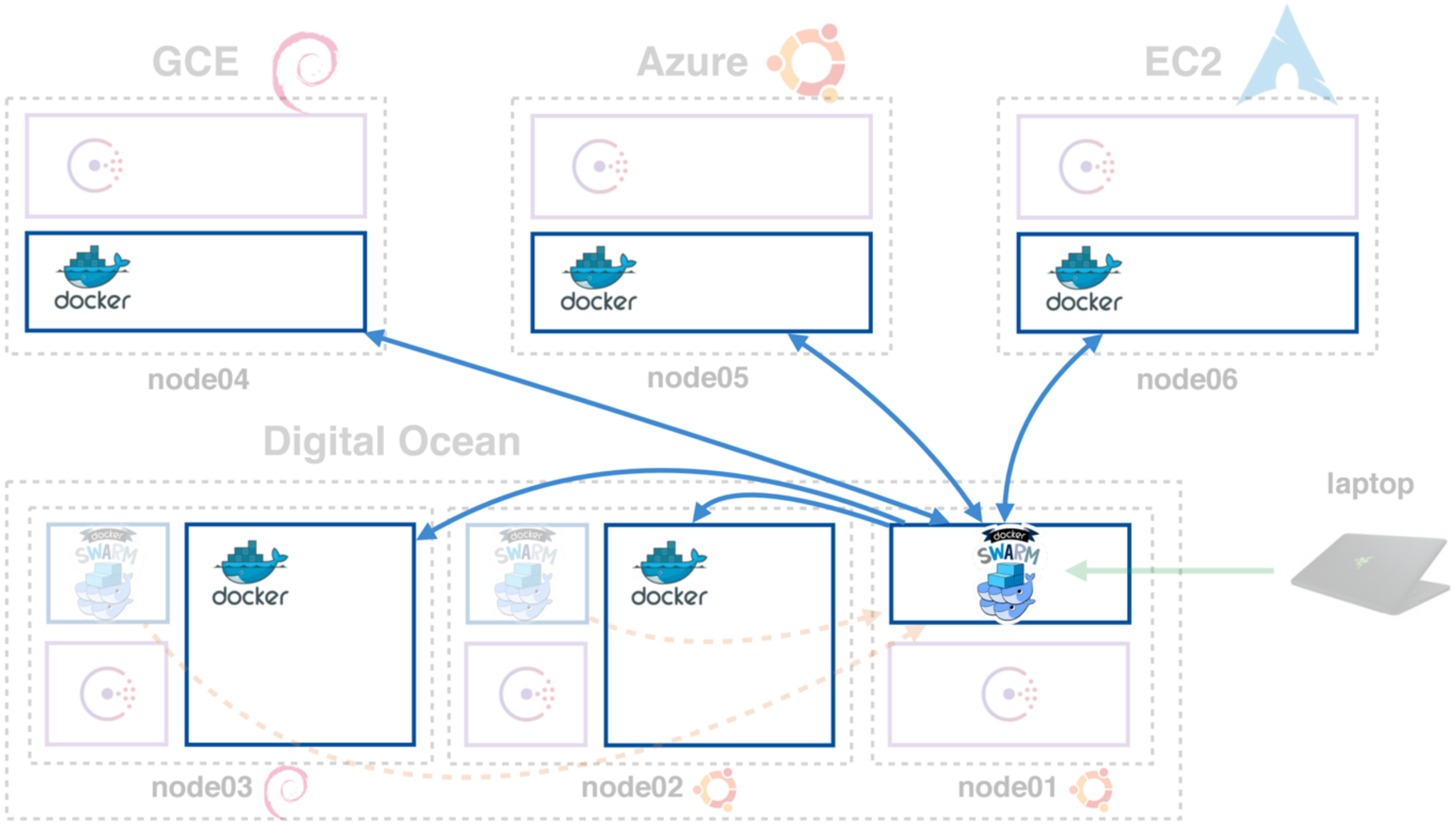
```
docker volume create –name=data data
```

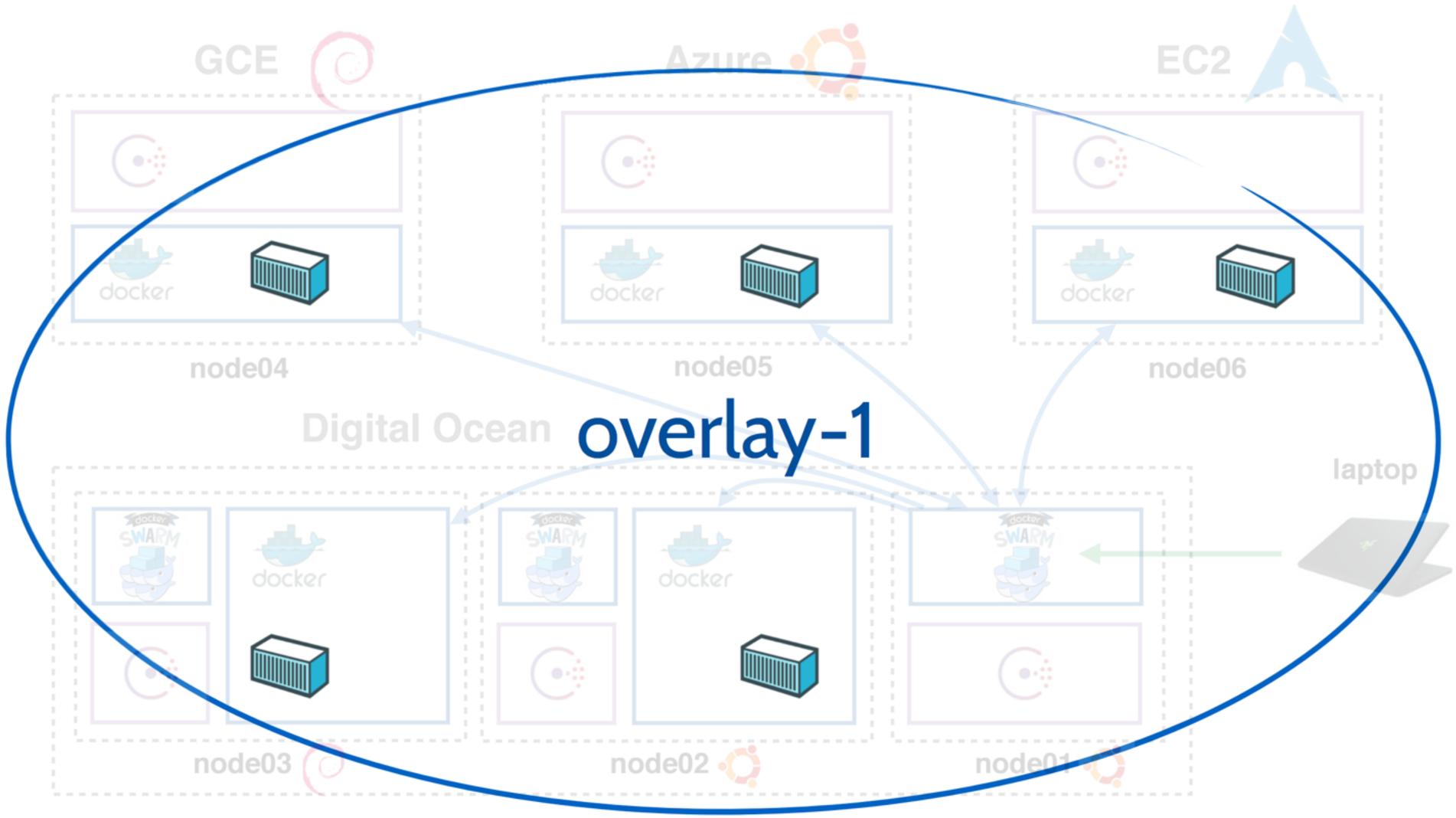
Run a container with the volume

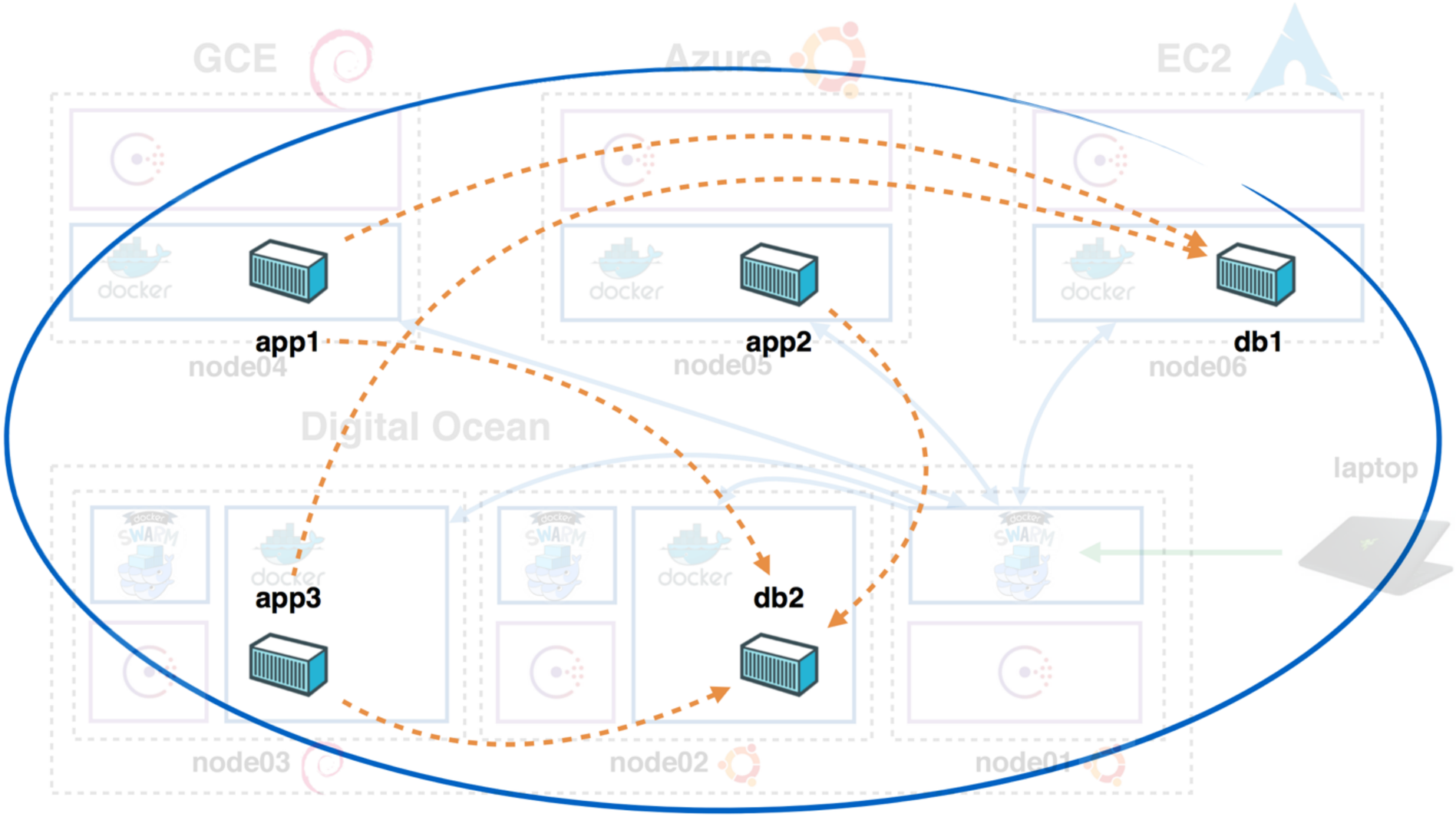
```
docker run -it -v data:/opt/couchbase/var couchbase
```

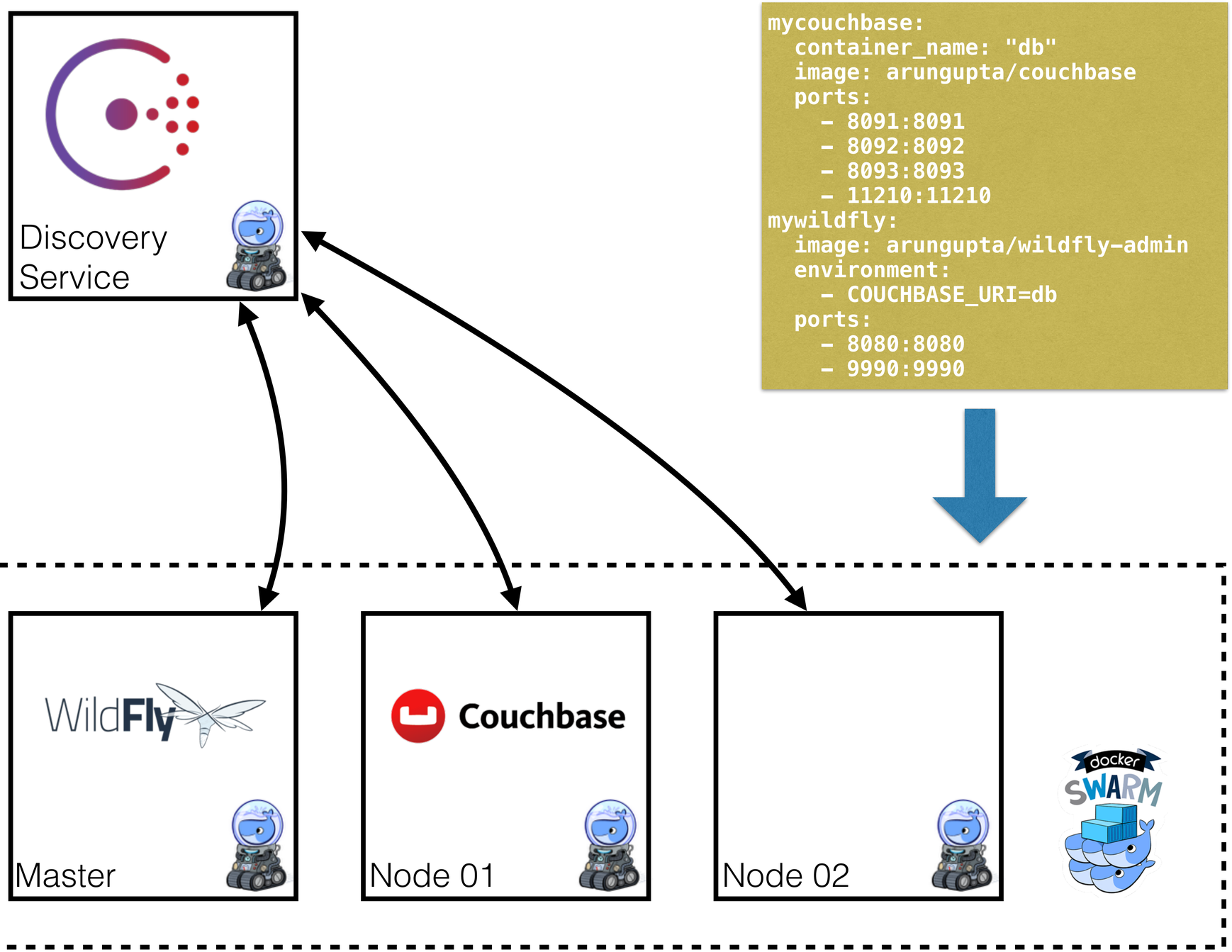












http://blog.arungupta.me/docker-machine-swarm-compose-couchbase-wildfly/

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.

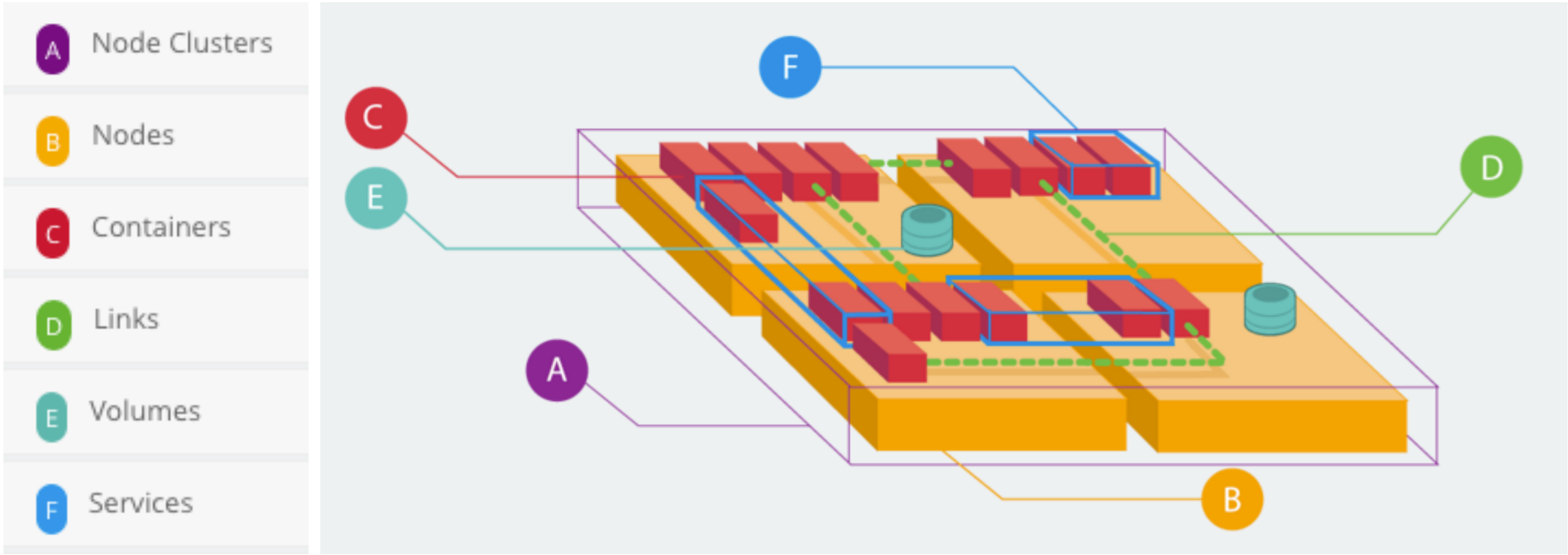
Deploy

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

Manage

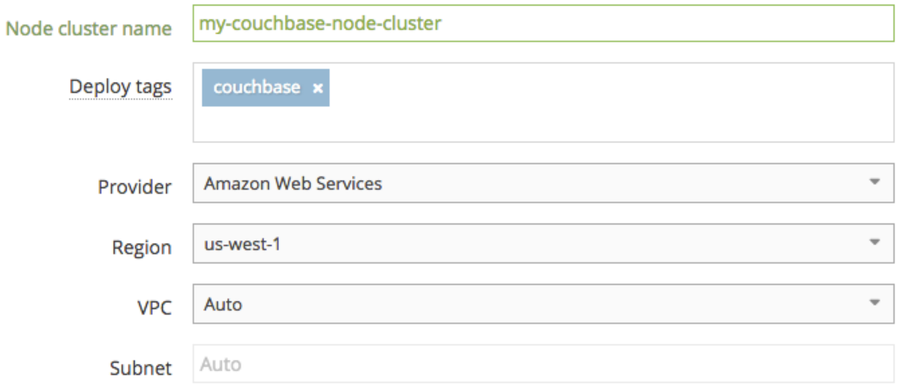
Simplify operations, focus on your code, and forget about managing servers.

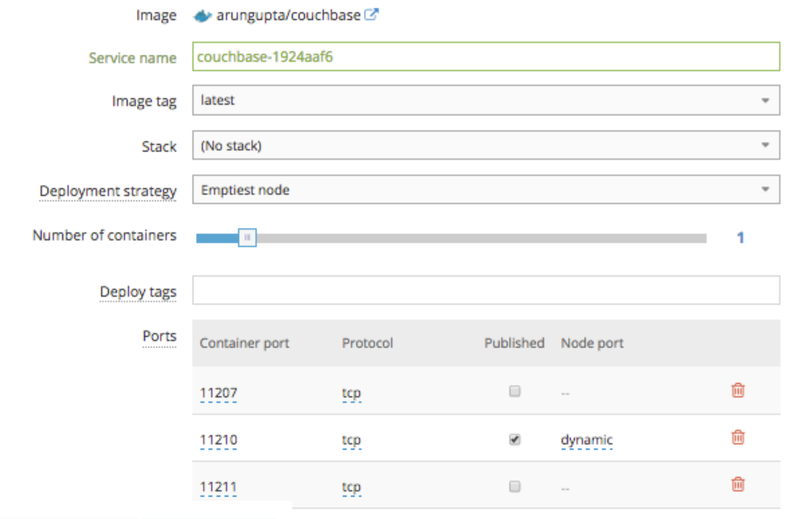
Docker Cloud Architecture

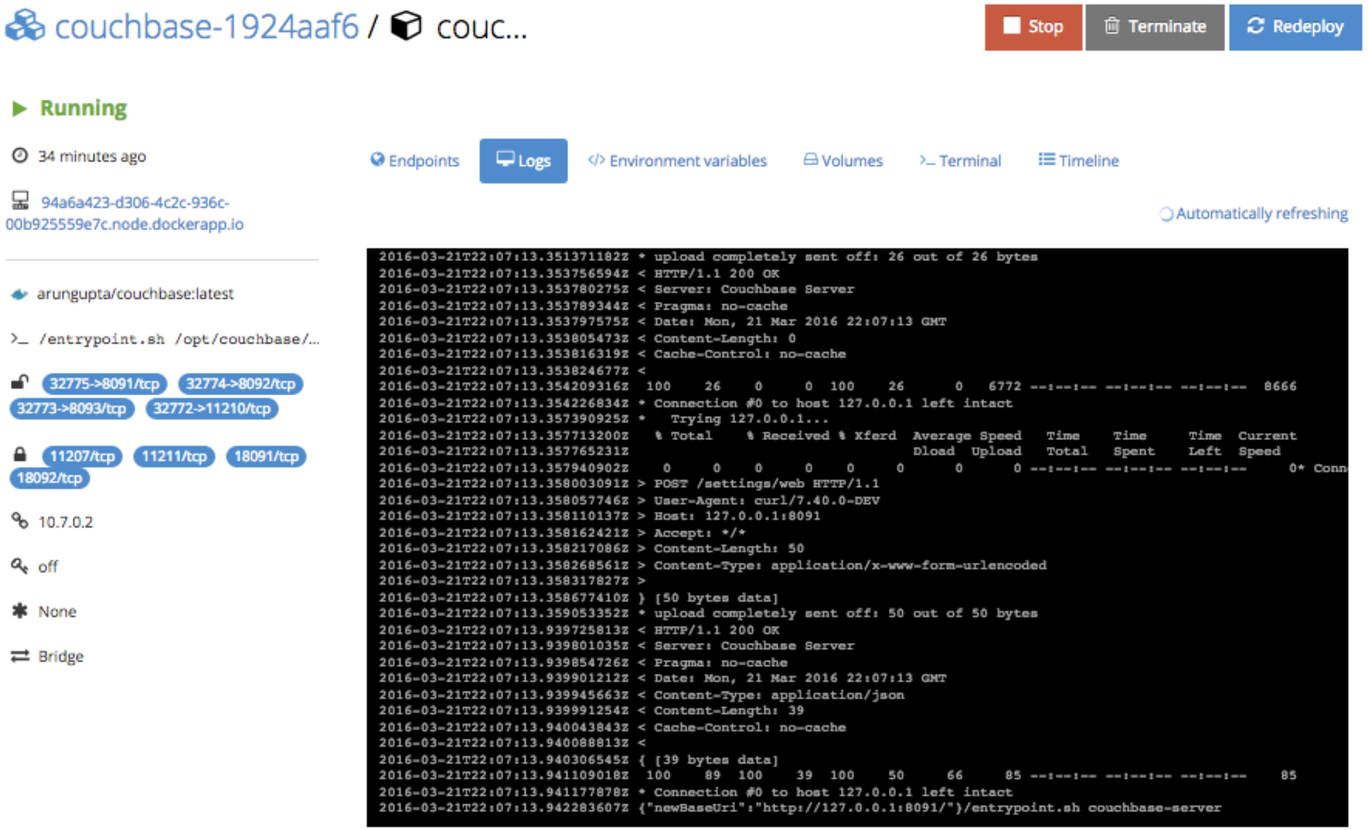


https://www.tutum.co/how/

Create a node cluster







http://blog.couchbase.com/2016/march/getting-started-docker-cloud

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'
```


http://blog.couchbase.com/2016/march/getting-started-docker-cloud

Docker Registry

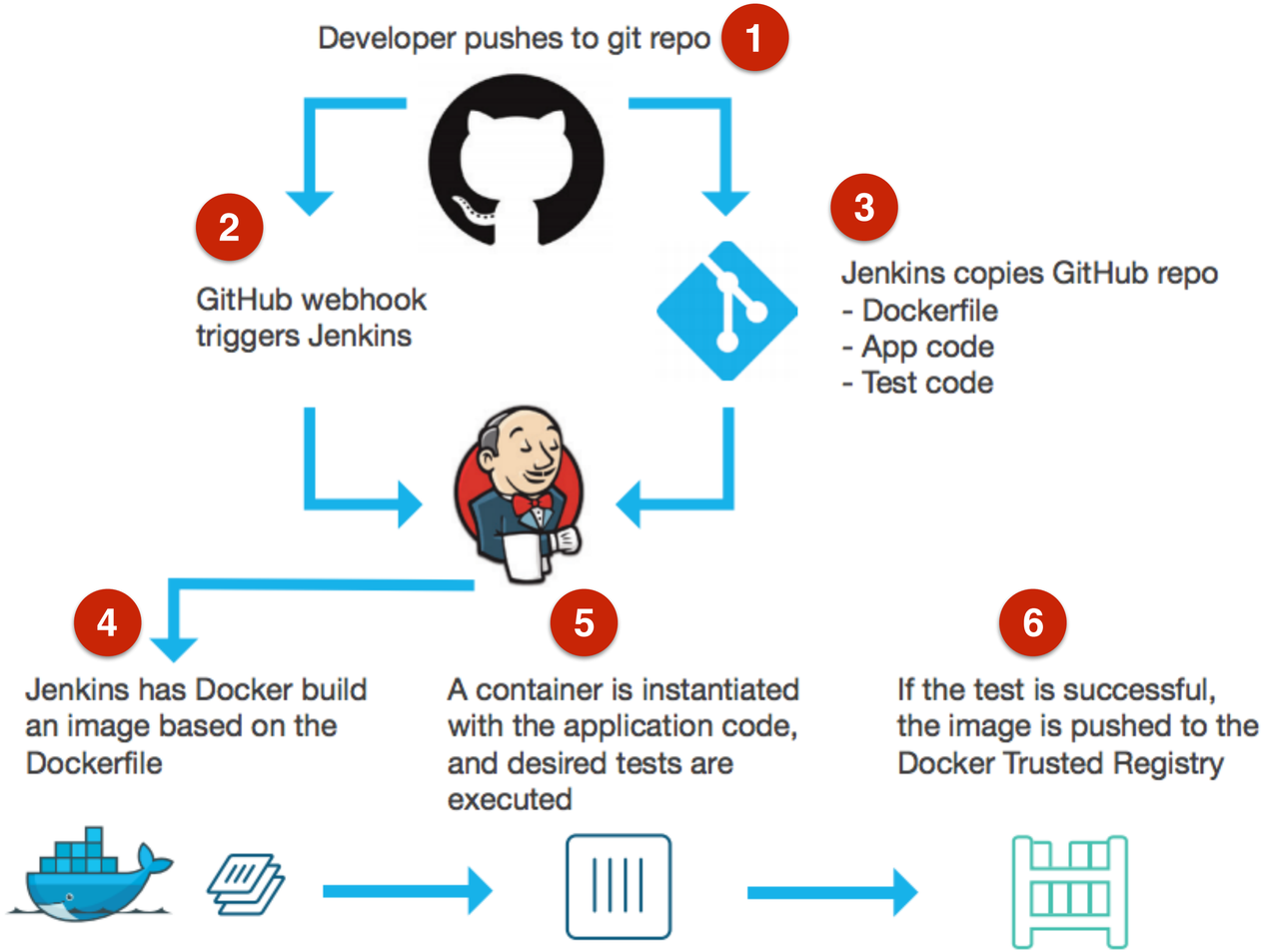
- Store and distribute Docker images
  - Control where images are stored
  - Own image distribution pipeline
  - Integrate image storage/distribution in dev workflow
- Docker Hub
  - Free-to-use and hosted
- Docker Trusted Registry
  - Commercially supported
  - RBAC, LDAP/AD integration, updates, etc

Registry Usage

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

CI/CD with Docker + Jenkins

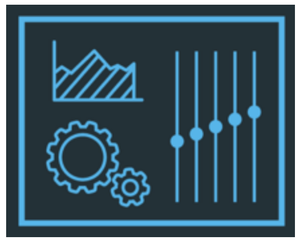
1. Push a commit to GitHub
2. GitHub webhook
3. Jenkins copies artifacts
4. Jenkins builds Docker image
5. Runs test on Docker container
6. Pushes to DTR



https://www.docker.com/sites/default/files/UseCase/RA_CI%20with%20Docker_08.25.2015.pdf

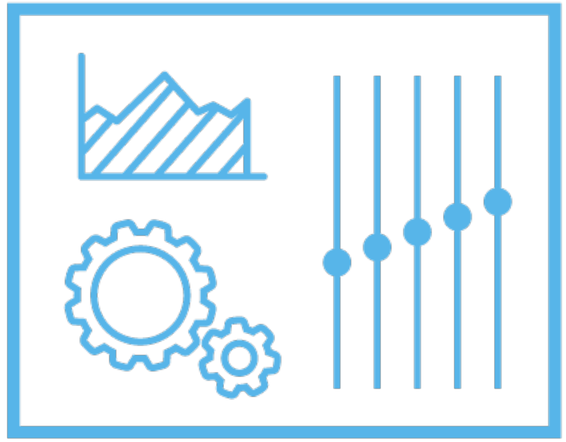
Monitoring Docker Containers

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

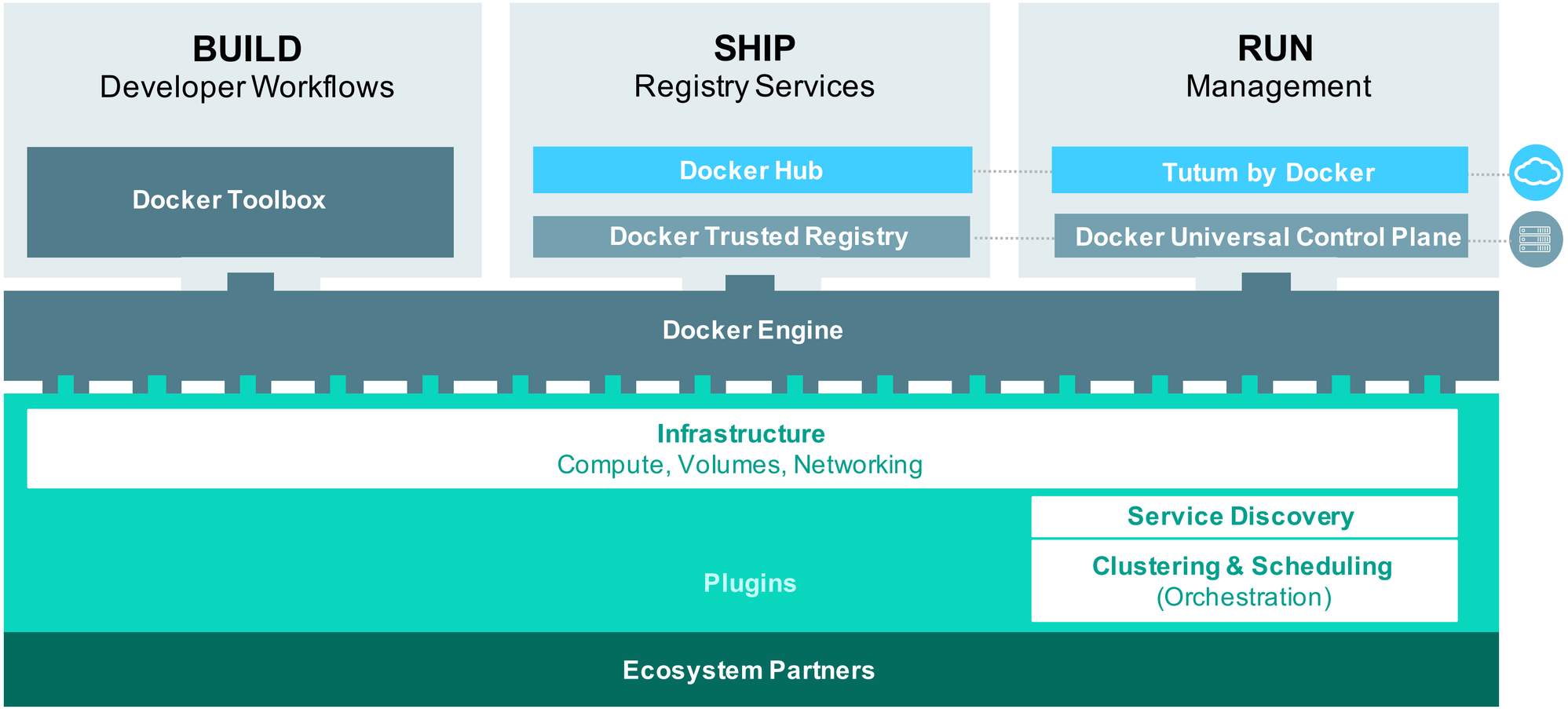


Docker Universal Control Plane

- 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 Documentation: docs.docker.com