

# Docker Introduction



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O'REILLY®

A detailed black and white illustration of a spiny lizard, specifically a horned lizard, resting on a purple rectangular background. The lizard has a textured, scaly body with several prominent spines along its back and tail.

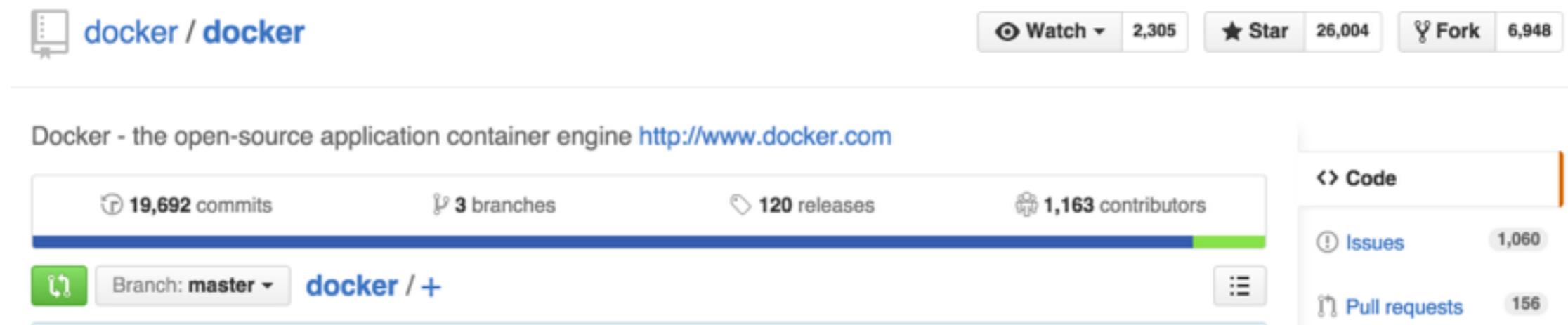
# Minecraft Modding with Forge

A FAMILY-FRIENDLY GUIDE TO BUILDING FUN MODS IN JAVA

Arun Gupta & Aditya Gupta

# What is Docker?

- Open source project and company

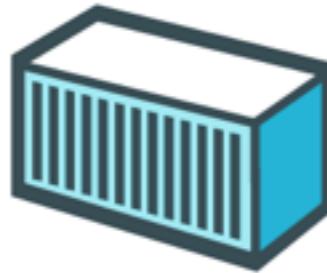


- Used to create containers for software applications
- Package Once Deploy Anywhere (PODA)



## Build

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



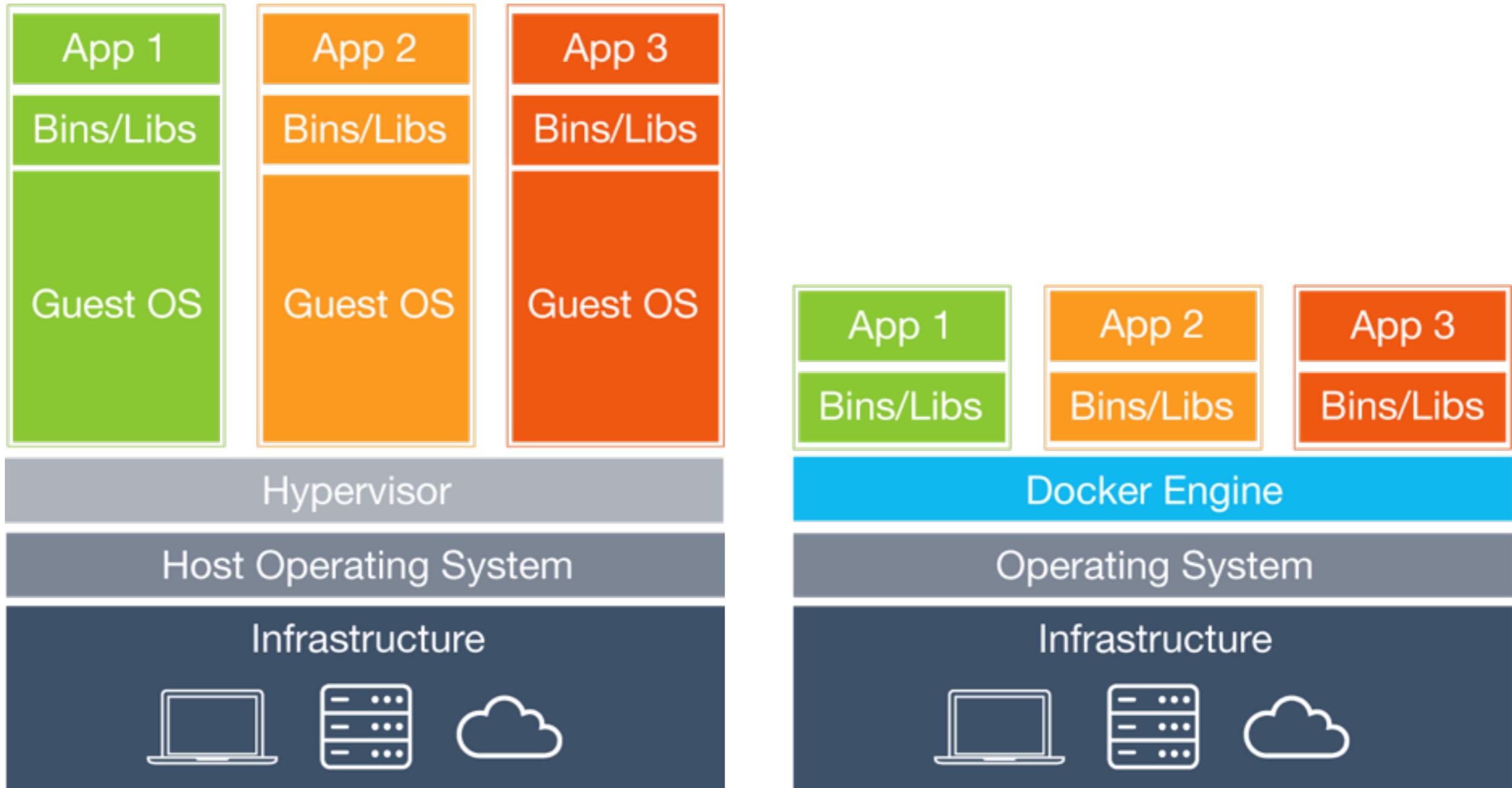
## Ship

Ship the “Dockerized” app and dependencies  
anywhere - to QA, teammates, or the cloud -  
without breaking anything.



## Run

Scale to 1000s of nodes, move between data  
centers and clouds, update with zero  
downtime and more.





Build

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

- Image defined in text-based **Dockerfile**
- List of commands to build the image

```
FROM fedora:latest

CMD echo "Hello world"
```

```
FROM jboss/wildfly

RUN curl -L https://github.com/javaee-
samples/javaee7-hol/raw/master/solution/
movieplex7-1.0-SNAPSHOT.war -o /opt/jboss/
wildfly/standalone/deployments/
movieplex7-1.0-SNAPSHOT.war
```

## 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

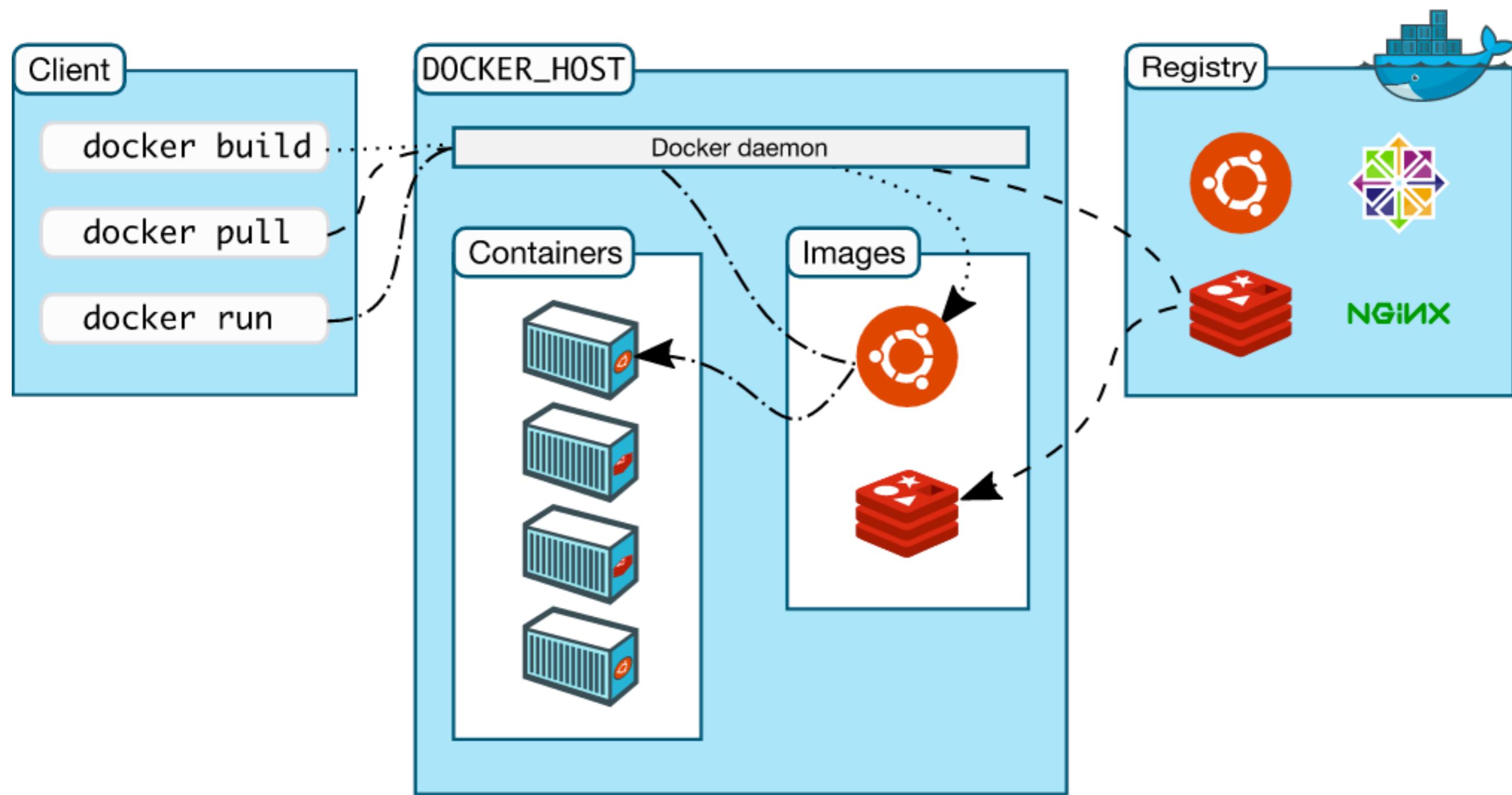
ARG

ONBUILD

STOP SIGNAL

Dockerfile examples

# Docker Workflow



# Union File System

Image	jboss/wildfly
Image	jboss/base-jdk:8
Image	jboss/base
Base Image	centos:7
Bootfs/Kernel	



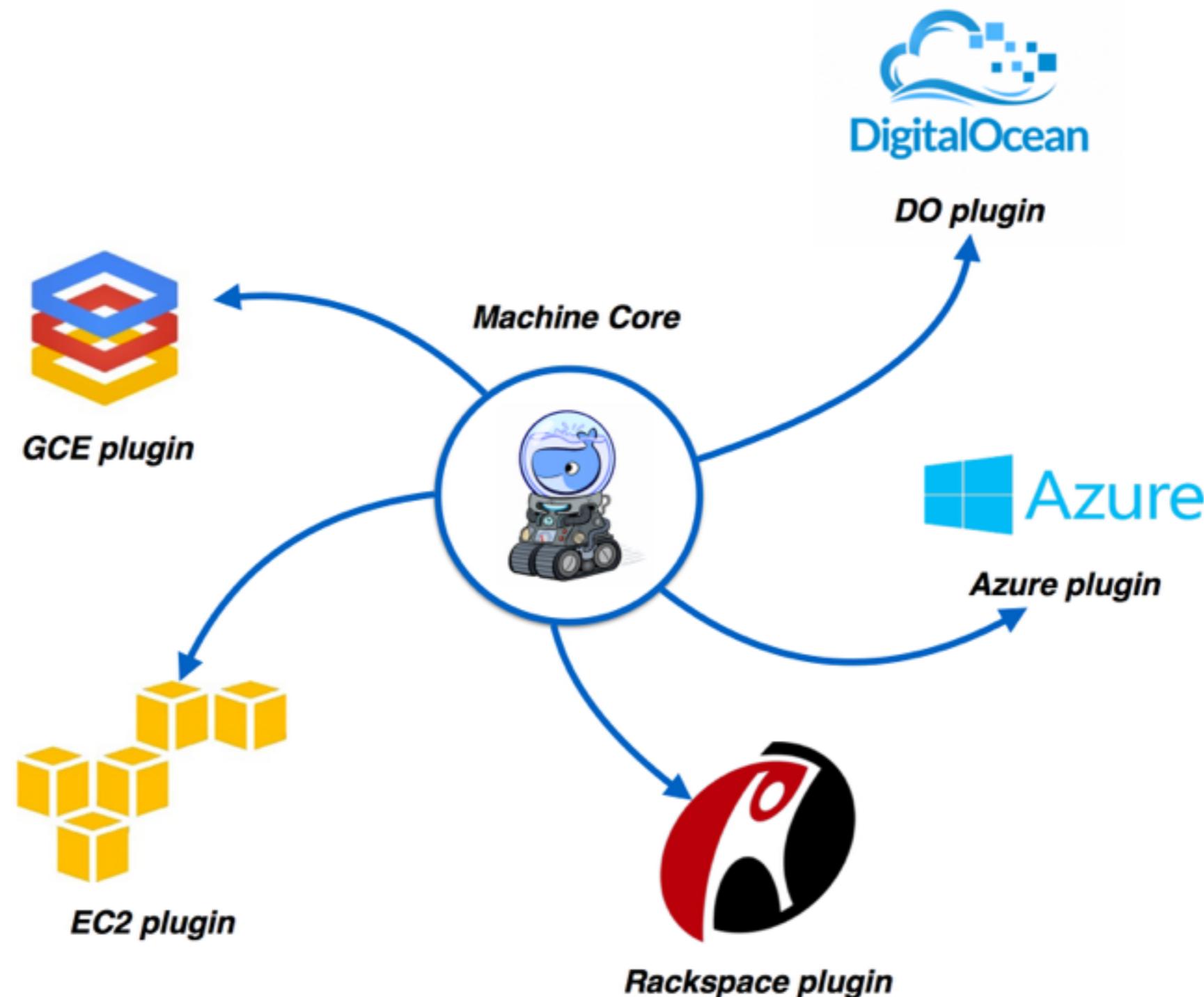
# Docker Machine

- 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
- Not recommended for production yet

# Docker Machine Providers



# boot2docker

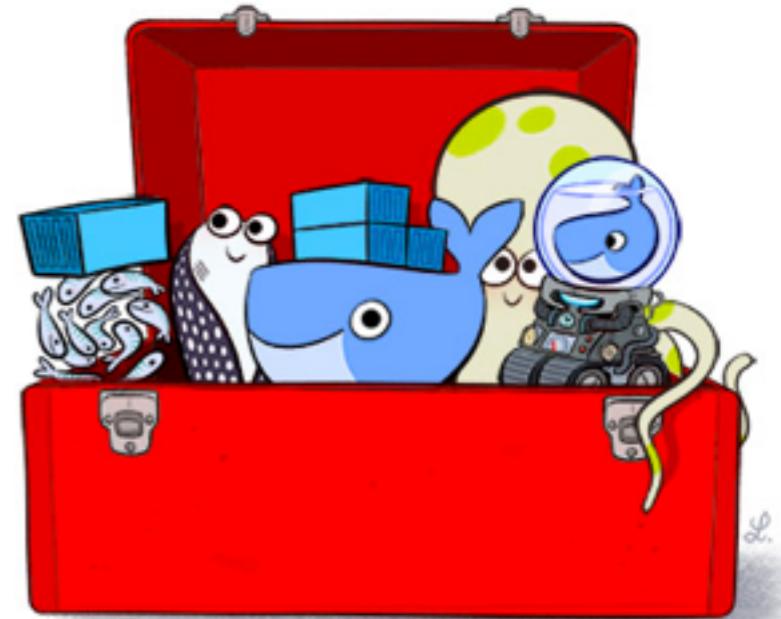
- Migrate to Docker Machine

```
docker-machine
create -d virtualbox
--virtualbox-import-boot2docker-vm
boot2docker-vm docker-vm
```

boot2docker	docker-machine	description
init	create	Creates a new docker host.
up	start	Starts a stopped machine.
ssh	ssh	Runs a command or interactive ssh session on the machine.
save	-	Not applicable.
down	stop	Stops a running machine.
poweroff	stop	Stops a running machine.
reset	restart	Restarts a running machine.
config	inspect	Prints machine configuration details.
status	ls	Lists all machines and their status.
info	inspect	Displays a machine's details.
ip	ip	Displays the machine's ip address.
shellinit	env	Displays shell commands needed to configure your shell to interact with a machine
delete	rm	Removes a machine.
download	-	Not applicable.
upgrade	upgrade	Upgrades a machine's Docker client to the latest stable release.

# Docker Toolbox

- Docker Client 1.9.0
- Docker Machine 0.5.0
- Docker Compose 1.5.0 (~~Mac only~~)
- Docker Kitematic 0.9.3
- Boot2Docker ISO 1.9.0
- Virtualbox 5.0.8





```
docker run  
--name mysqlDb  
-e MYSQL_USER=mysql  
-e MYSQL_PASSWORD=mysql  
-e MYSQL_DATABASE=sample  
-e MYSQL_ROOT_PASSWORD=supersecret  
-d  
mysql
```

```
docker run  
--name mywildfly  
--link mysqlDb:db  
-p 8080:8080  
-d  
arungupta/wildfly-mysql-javaee7
```

# 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.yml

```
mysqldb:  
  image: mysql  
  environment:  
    MYSQL_DATABASE: sample  
    MYSQL_USER: mysql  
    MYSQL_PASSWORD: mysql  
    MYSQL_ROOT_PASSWORD: supersecret  
  
mywildfly:  
  image: arungupta/wildfly-mysql-javaee7  
  links:  
    - mysqldb:db
```

# Links - JDBC Connection

```
data-source add
--name=mysqlDS
--driver-name=mysql
--jndi-name=java:jboss/datasources/
ExampleMySQLDS
--connection-url=jdbc:mysql://
$DB_PORT_3306_TCP_ADDR:
$DB_PORT_3306_TCP_PORT/sample?
useUnicode=true&characterEncoding=
UTF-8
--user-name=mysql
--password=mysql
--use-ccm=false
--max-pool-size=25
--blocking-timeout-wait-millis=5000
--enabled=true
```

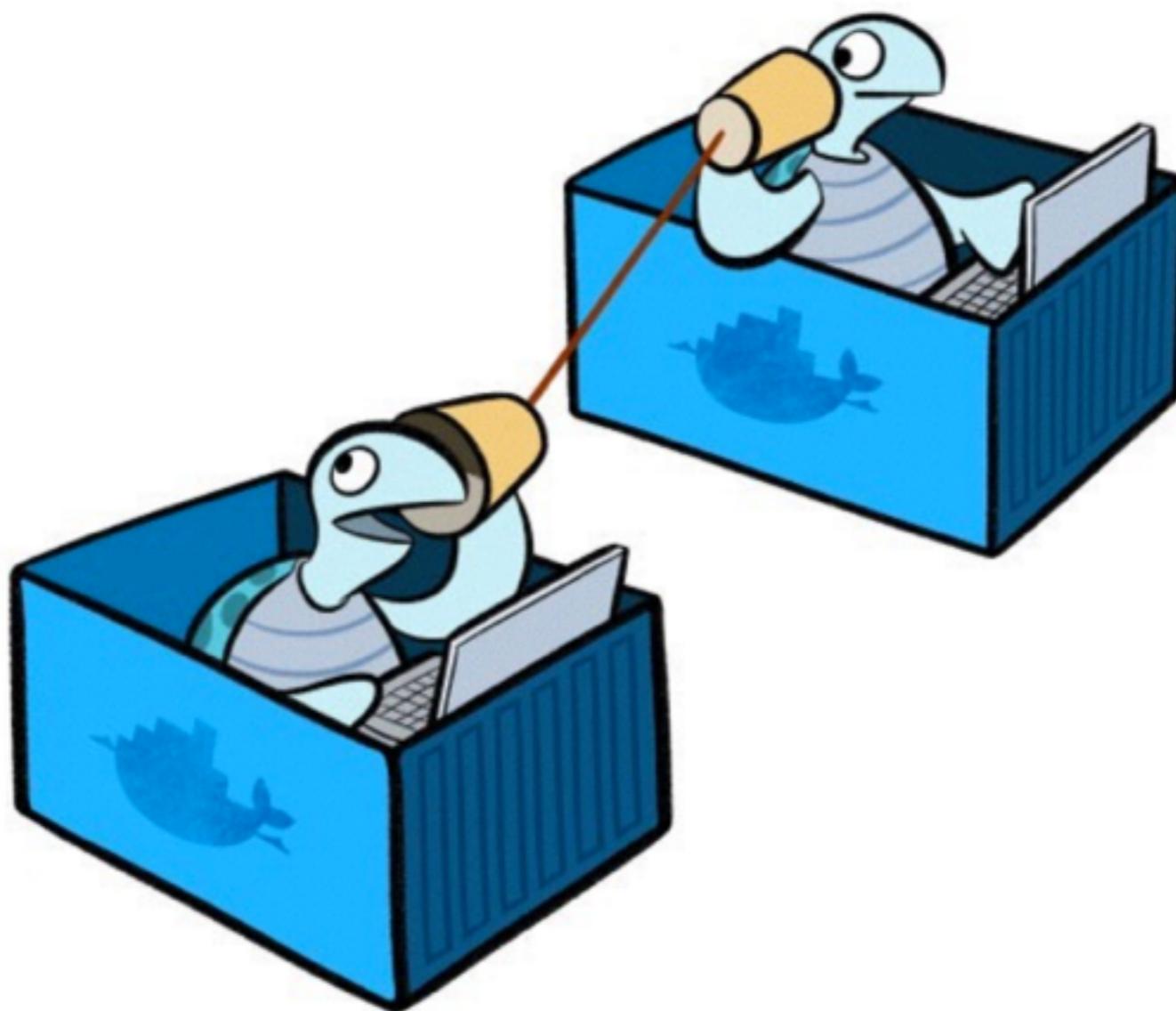
```
<connection url>jdbc:mysql://
172.17.0.2:3306/sample?
useUnicode=true&characterEncod
ing=UTF-8</connection>
```

# Couchbase Cluster using Docker Compose

```
couchbase1:  
  image: couchbase/server  
  volumes:  
    - ~/couchbase/node1:/opt/couchbase/var  
couchbase2:  
  image: couchbase/server  
  volumes:  
    - ~/couchbase/node2:/opt/couchbase/var  
couchbase3:  
  image: couchbase/server  
  volumes:  
    - ~/couchbase/node3:/opt/couchbase/var  
  ports:  
    - 8091:8091  
    - 8092:8092  
    - 8093:8093  
    - 11210:11210
```



# Multi Host Networking



# Multi-host Networking

- Create virtual networks and attach containers
  - Software defined networking
- **Bridge** network spans single host
- **Overlay** network spans multiple hosts
- Works with Swarm and Compose
  - Experimental in Compose
- Pluggable: Calico, Cisco, Weave, . . .

# Networking vs Links

- Connect containers to each other across different physical or virtual hosts
- Containers can be easily stopped, started and restarted w/o disrupting connection to other containers
- Can be created in any order

# Links

```
mysqldb:  
  image: mysql  
  environment:  
    MYSQL_DATABASE: sample  
    MYSQL_USER: mysql  
    MYSQL_PASSWORD: mysql  
    MYSQL_ROOT_PASSWORD: supersecret  
mywildfly:  
  image: arungupta/wildfly-mysql-javaee7  
  links:  
    - mysqldb:db
```

# Networking

```
mysqldb:  
  container_name: "db"  
  image: mysql:latest  
  environment:  
    MYSQL_DATABASE: sample  
    MYSQL_USER: mysql  
    MYSQL_PASSWORD: mysql  
    MYSQL_ROOT_PASSWORD: supersecret  
mywildfly:  
  image: arungupta/wildfly-mysql-javaee7  
  environment:  
    - MYSQL_URI=db:3306  
  ports:  
    - 8080:8080
```

# Networking - JDBC Connection

```
data-source add
--name=mysqlDS
--driver-name=mysql
--jndi-name=java:jboss/datasources/
ExampleMySQLDS
--connection-url=jdbc:mysql://
$MYSQL_URI/sample?
useUnicode=true&characterEncoding=UTF-8
--user-name=mysql
--password=mysql
--use-ccm=false
--max-pool-size=25
--blocking-timeout-wait-millis=5000
--enabled=true
```

```
<connection-url>jdbc:mysql://db:3306/
sample?
useUnicode=true&amp;characterEncoding=UTF-8</connection-url>
```

# 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: couchbase/server  
  ports:  
    - . . .  
  
mywildfly:  
  image: arungupta/wildfly-couchbase-javaee7  
  environment:  
    - COUCHBASE_URI=db-dev:8093  
  ports:  
    - 8080:8080
```

docker-compose.yml

docker-compose up -d

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

production.yml

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

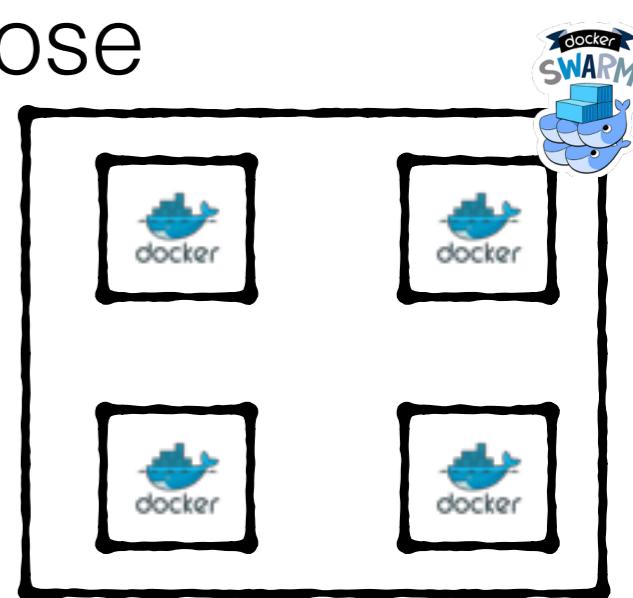
# Compose in Production

- Primarily aimed at development and testing environments
- May be for smaller deployments
- Not suitable for larger deployments

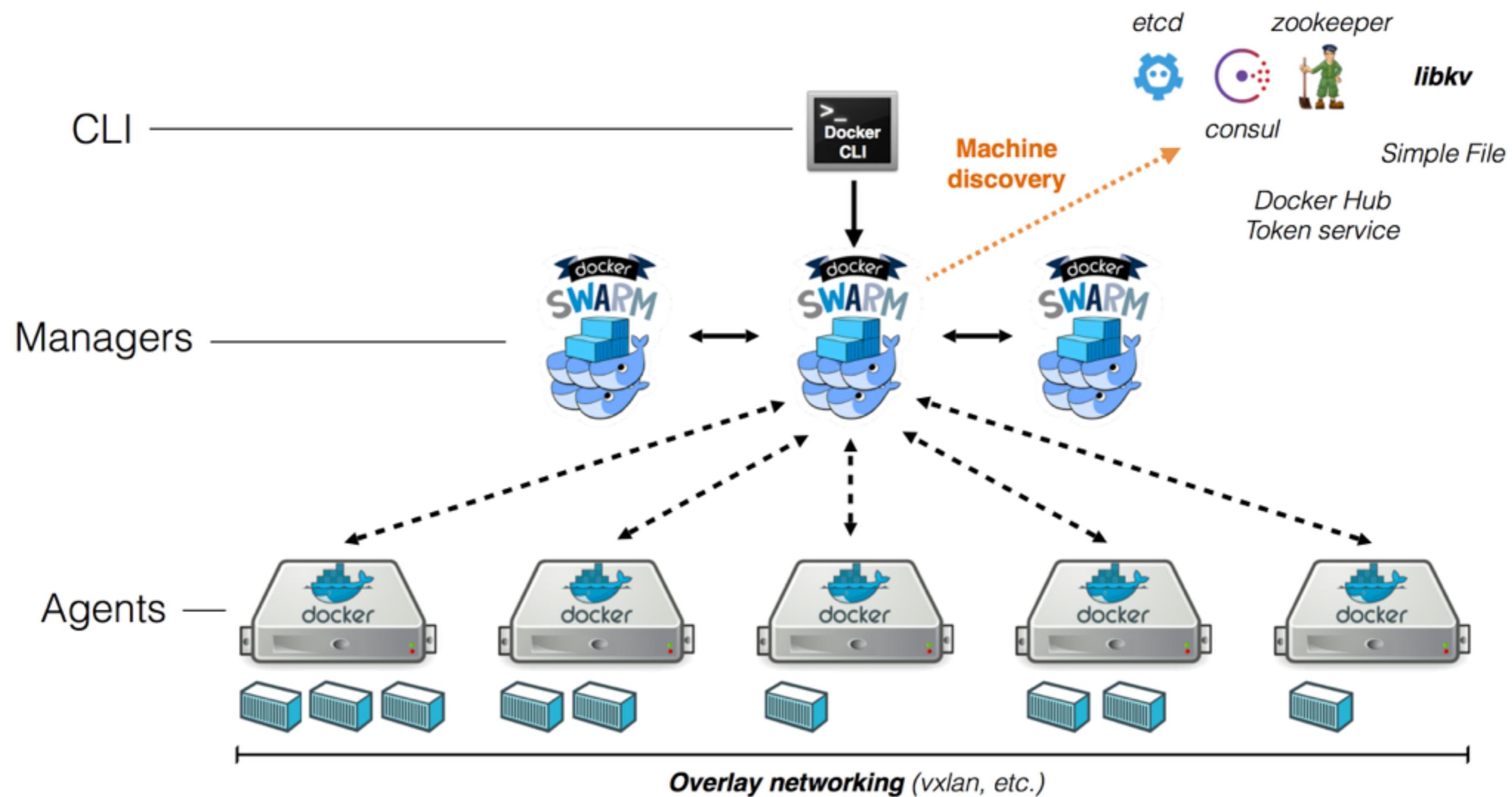


# Docker Swarm

- 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
- 1.0.0 - Ready for production?



Stress tested on 1000 EC2 nodes, ~30k containers



# Node Discovery

```
docker-machine create  
--engine-opt --cluster-advertise=<value>  
--engine-opt --cluster-store=<value>  
--engine-opt -cluster-store-opt=<value>  
-d=virtualbox  
myMachine
```

# 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

# Limiting CPU resources

```
docker run --help | grep cpu  
--cpu-shares=0  
--cpu-period=0  
--cpu-quota=0  
--cpuset-cpus=  
--cpuset-mems=
```

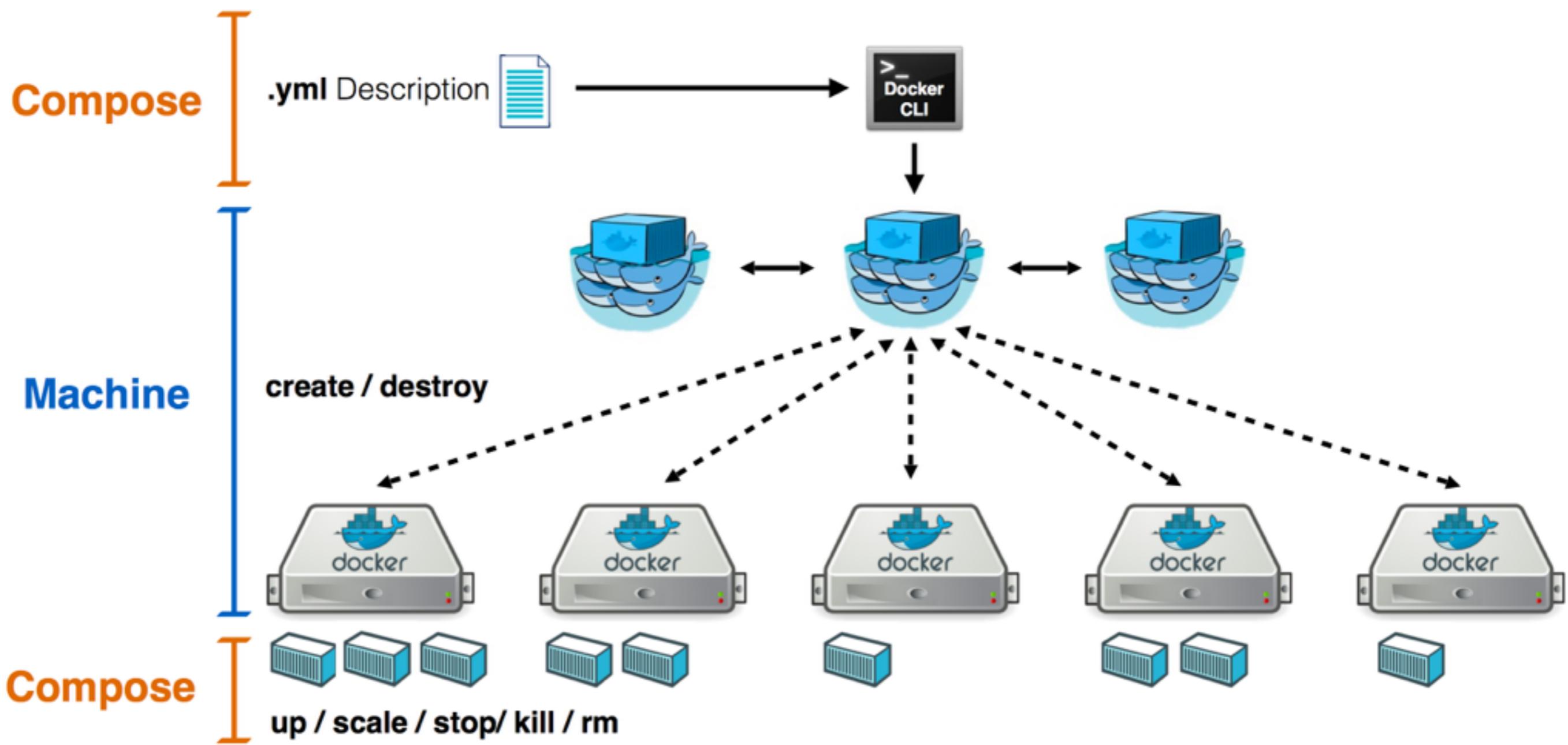
**CPU shares (relative weight)**  
Limit CPU CFS (Completely Fair Scheduler) period  
Limit CPU CFS (Completely Fair Scheduler) quota  
CPUs in which to allow execution (0-3, 0,1)  
MEMs in which to allow execution (0-3, 0,1)

-c=1024

-c=512

-c=512

# 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**  
**inspect**  
**ls**  
**rm**

**Create a volume**  
**Return low-level information on a volume**  
**List volumes**  
**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/server
```

# docker network

```
docker network --help
```

**Usage:** docker network [OPTIONS] COMMAND [OPTIONS]

**Commands:**

- disconnect**
- inspect**
- ls**
- rm**
- create**
- connect**

- Disconnect container from a network**
- Display detailed network information**
- List all networks**
- Remove a network**
- Create a network**
- Connect container to a network**

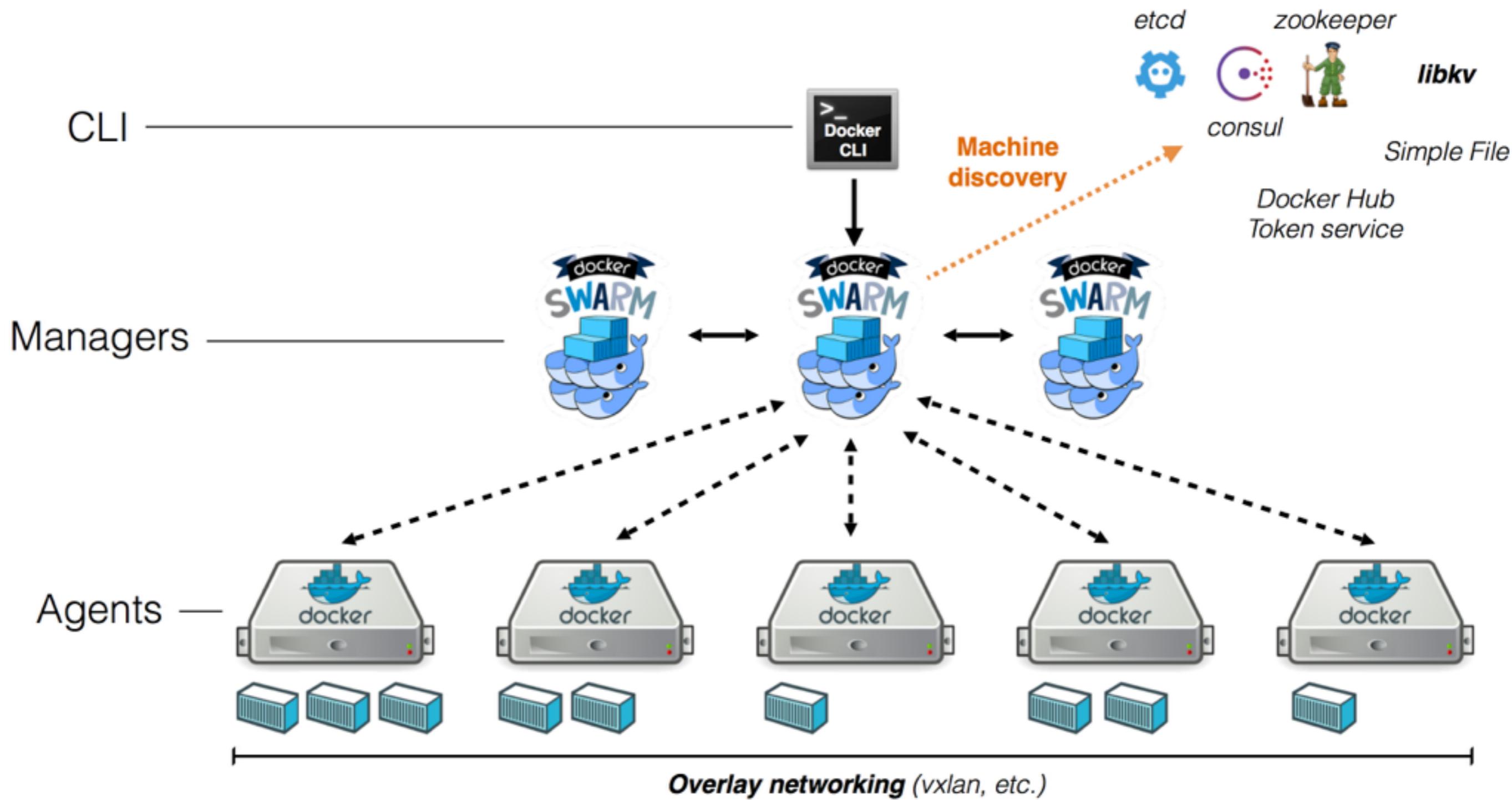
# Docker Compose and Networking

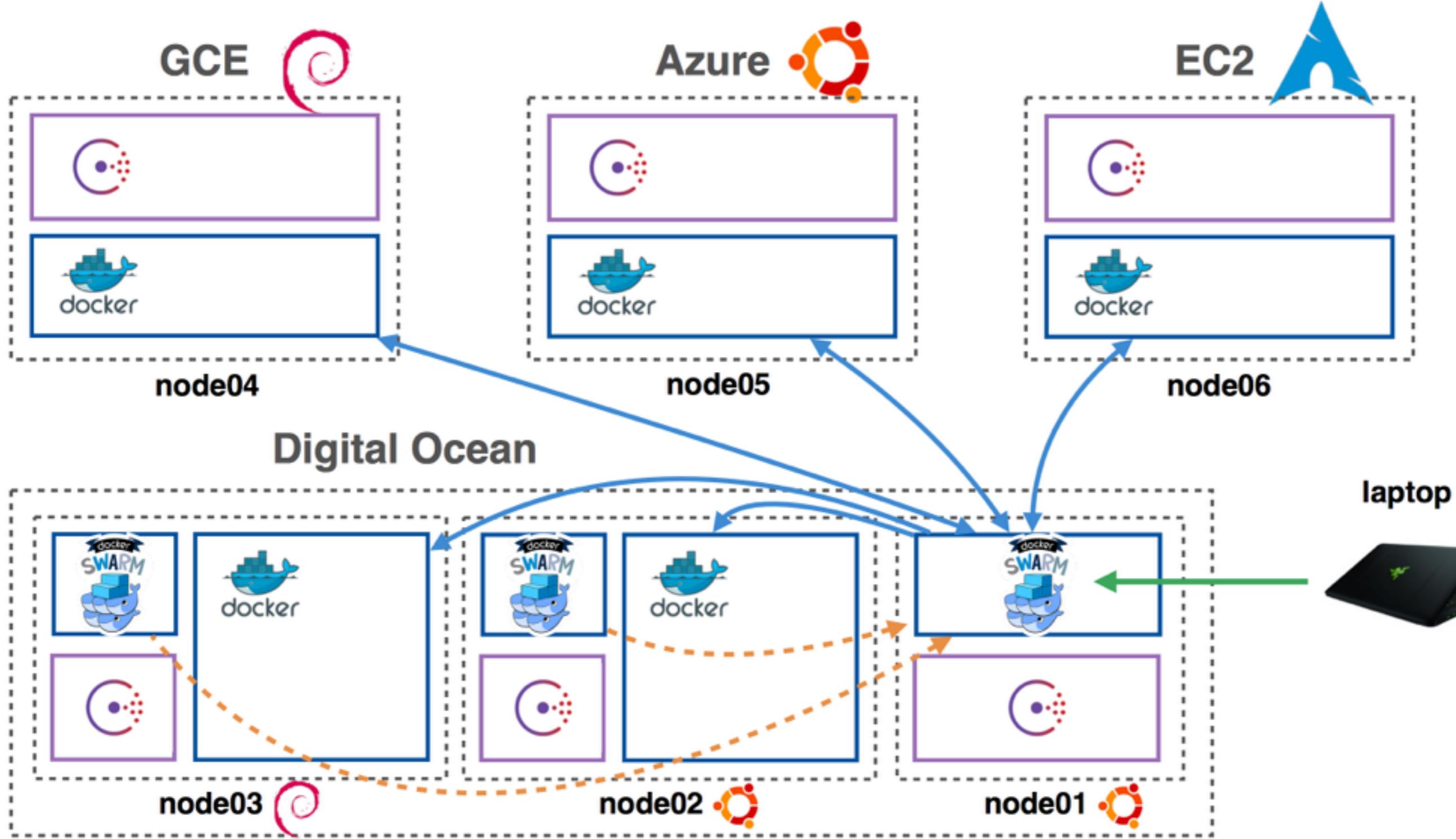
- `docker network ls`

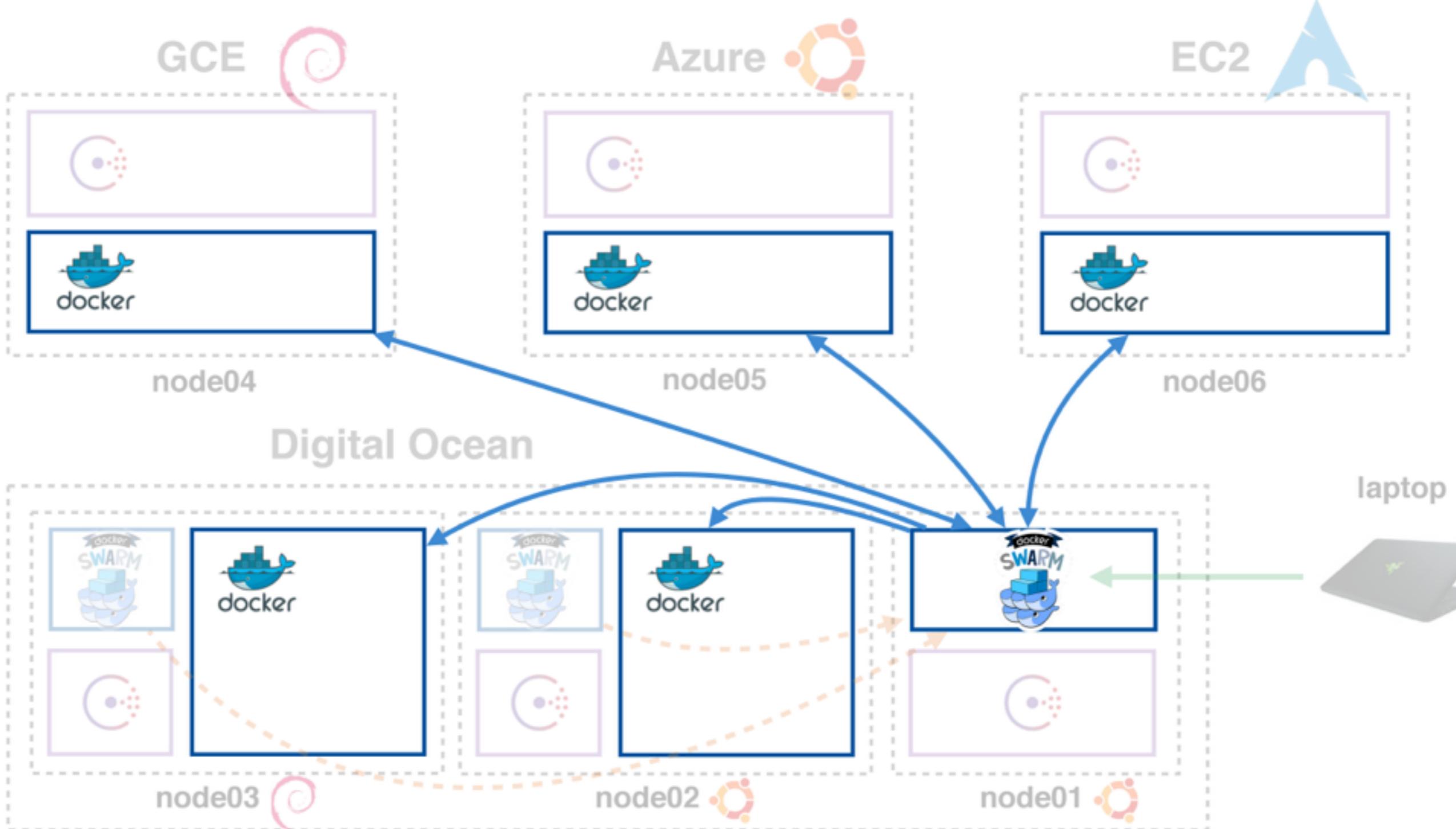
NETWORK ID	NAME	DRIVER
1d4d4152b99a	bridge	bridge
8396171e6bbc	none	null
8b50dda5fe61	host	host

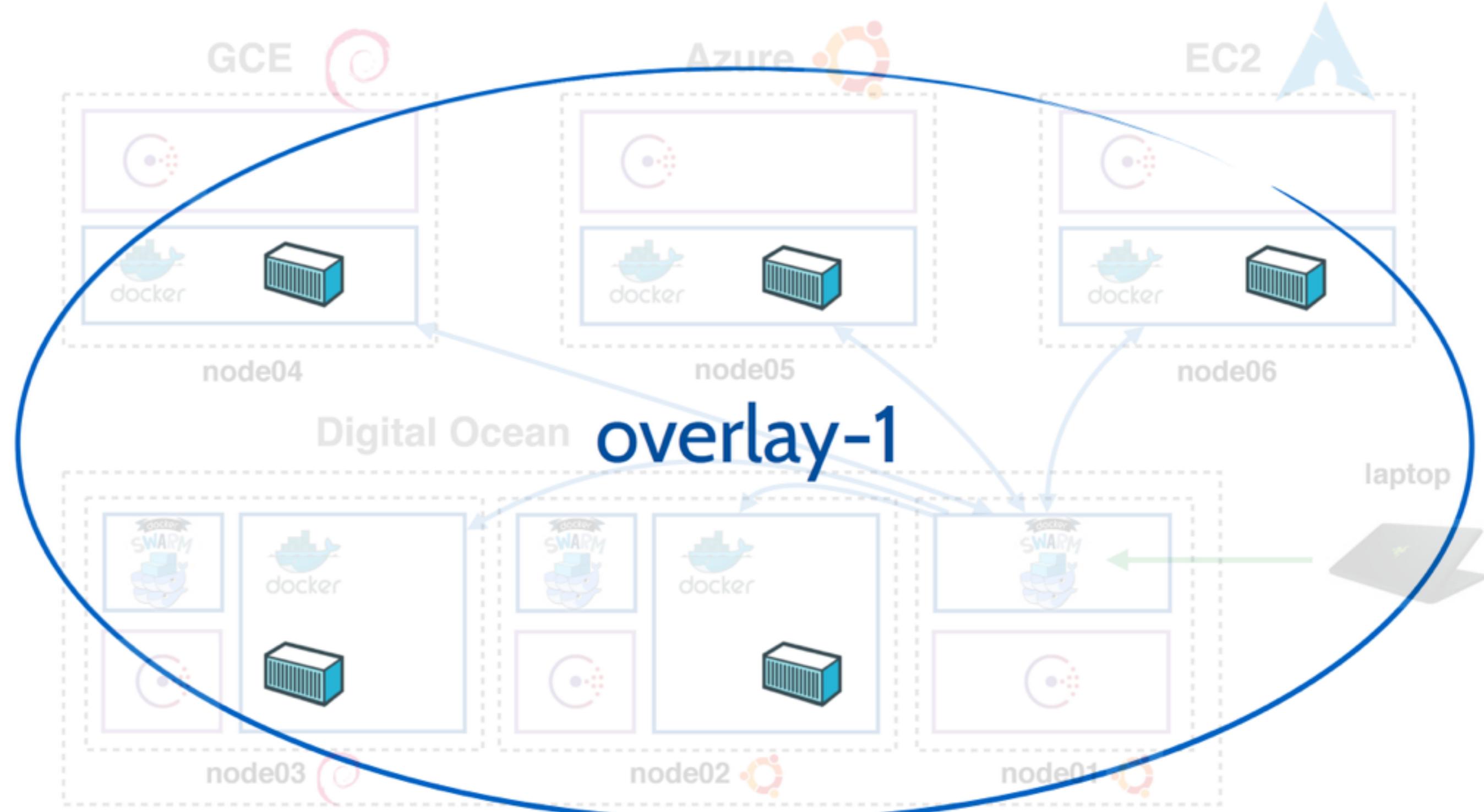
- `docker-compose --x-networking up -d`
- `docker network ls`

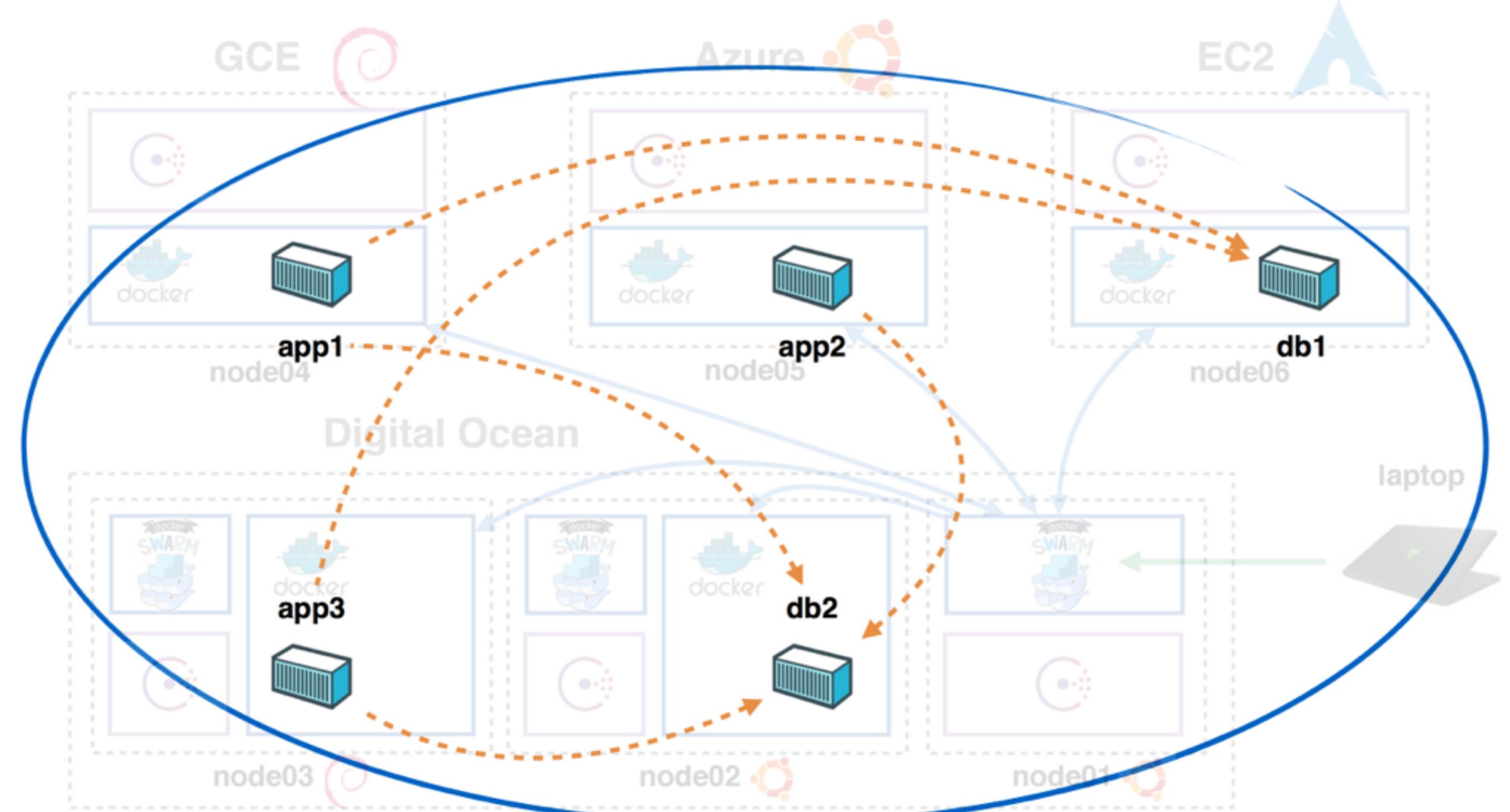
NETWORK ID	NAME	DRIVER
1d4d4152b99a	bridge	bridge
8396171e6bbc	none	null
8b50dda5fc61	host	host
b1770955e5aa	wildflymysqljavaee7	bridge











# References

- [github.com/javaee-samples/docker-java](https://github.com/javaee-samples/docker-java)
- [docs.docker.com](https://docs.docker.com)

