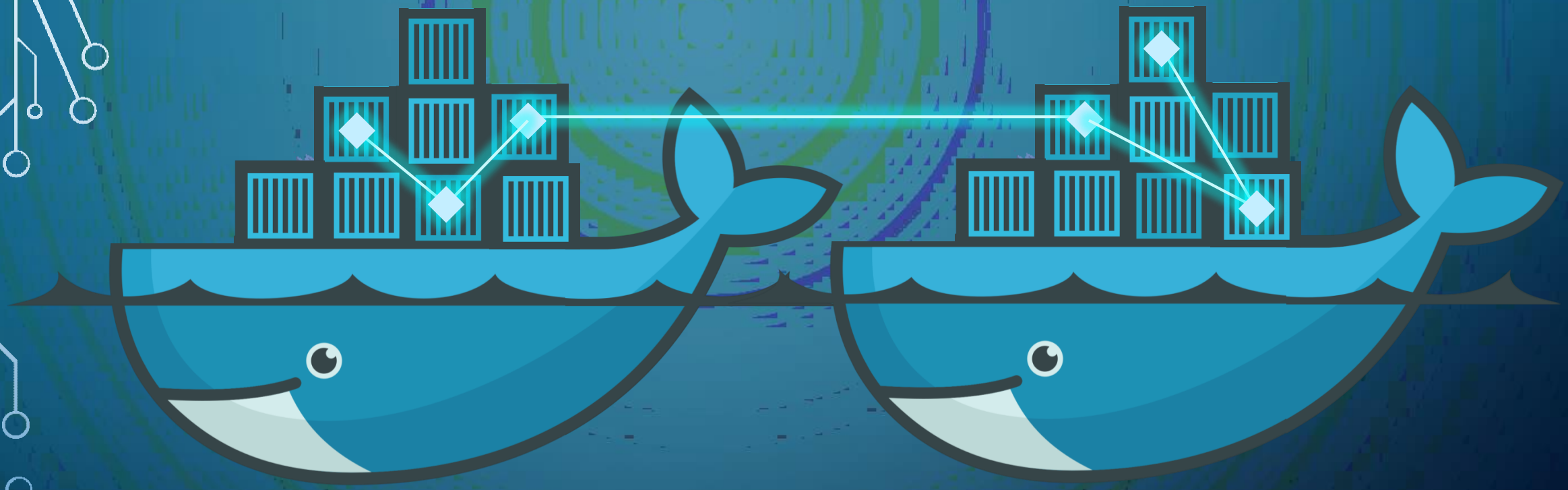
docker

Advanced



docker

Advanced

DOCKER ADVANCED

A deeper look into Docker

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INTRODUCTION

- Lecture
- Demos
- Coding Exercises
- Assignment

PRE-REQUISITES

- Basic System Administration
- Basic Docker Commands
- Docker Files
- Docker Compose
- Docker Networking

OBJECTIVES

- ☑ Docker Overview
- ☑ Running Docker Containers
- ☑ Creating a Docker Image
- ☑ Docker Compose
- ☑ Docker Swarm
- ☑ Networking in Docker

- ❑ Docker Concepts in Depth
- ❑ Docker For Windows
- ❑ Docker Service
- ❑ Docker Swarm
- ❑ Overlay Networks
- ❑ Load Balancing
- ❑ CI/CD Integration

DOCKER STORY

Founder: Solomon Hykes

Release: March 2013

Downloads: 13 Billion

dotCloud

DOCKER ON WINDOWS

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DOCKER ON WINDOWS

- Docker on Windows using Docker Toolbox
- Docker for Windows

1. DOCKER TOOLBOX

- 64-bit operating
- Windows 7 or higher.
- Virtualization is enabled

- Oracle Virtualbox
- Docker Engine
- Docker Machine
- Docker Compose
- Kitematic GUI

2. DOCKER FOR WINDOWS

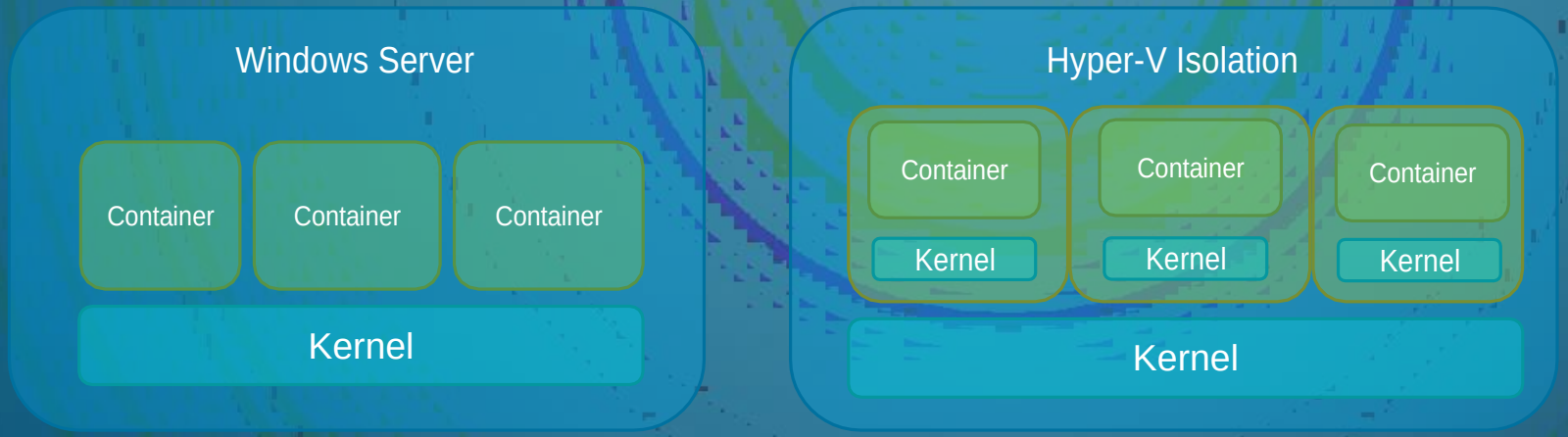
Microsoft
Hyper-V

Support: Windows 10 Enterprise/Professional Edition
Windows Server 2016

Linux Containers (Default)
Or
Windows Containers

WINDOWS CONTAINERS

Container Types:



Base Images:

- Windows Server Core
- Nano Server

Support

- Windows Server 2016
- Nano Server
- Windows 10 Professional and Enterprise (Hyper-V Isolated Containers)

DEMO

DOCKER ENGINE

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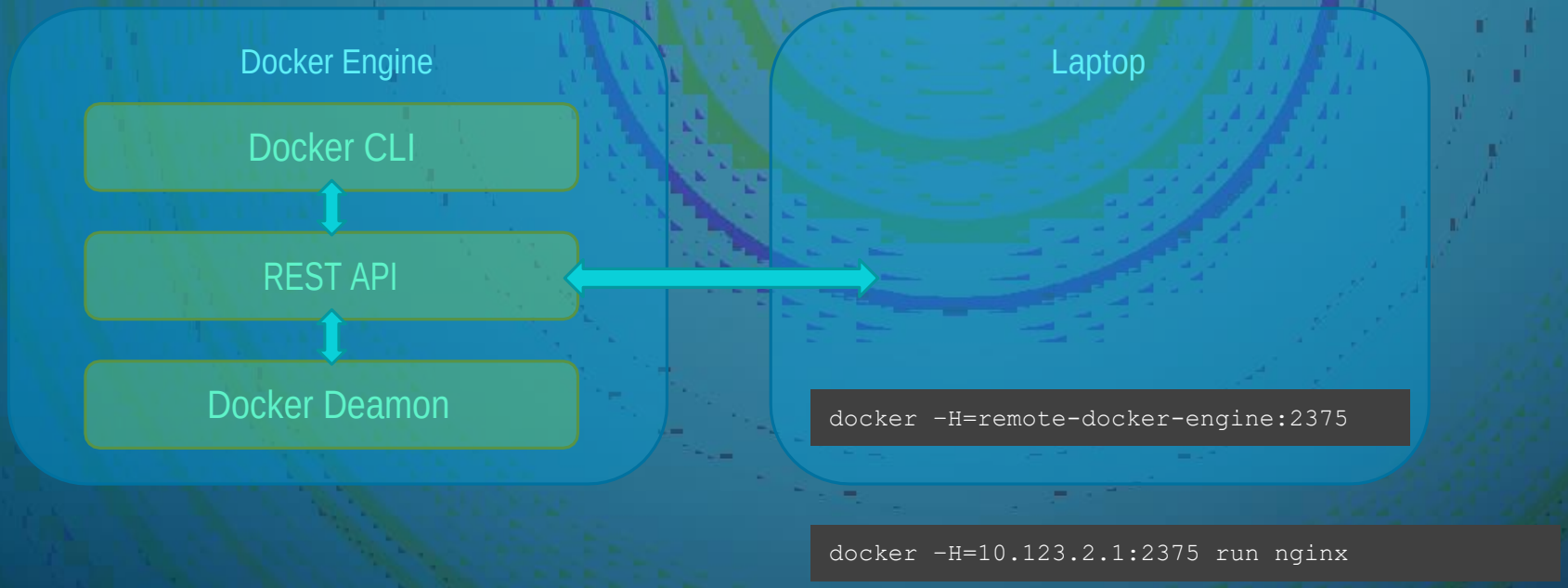
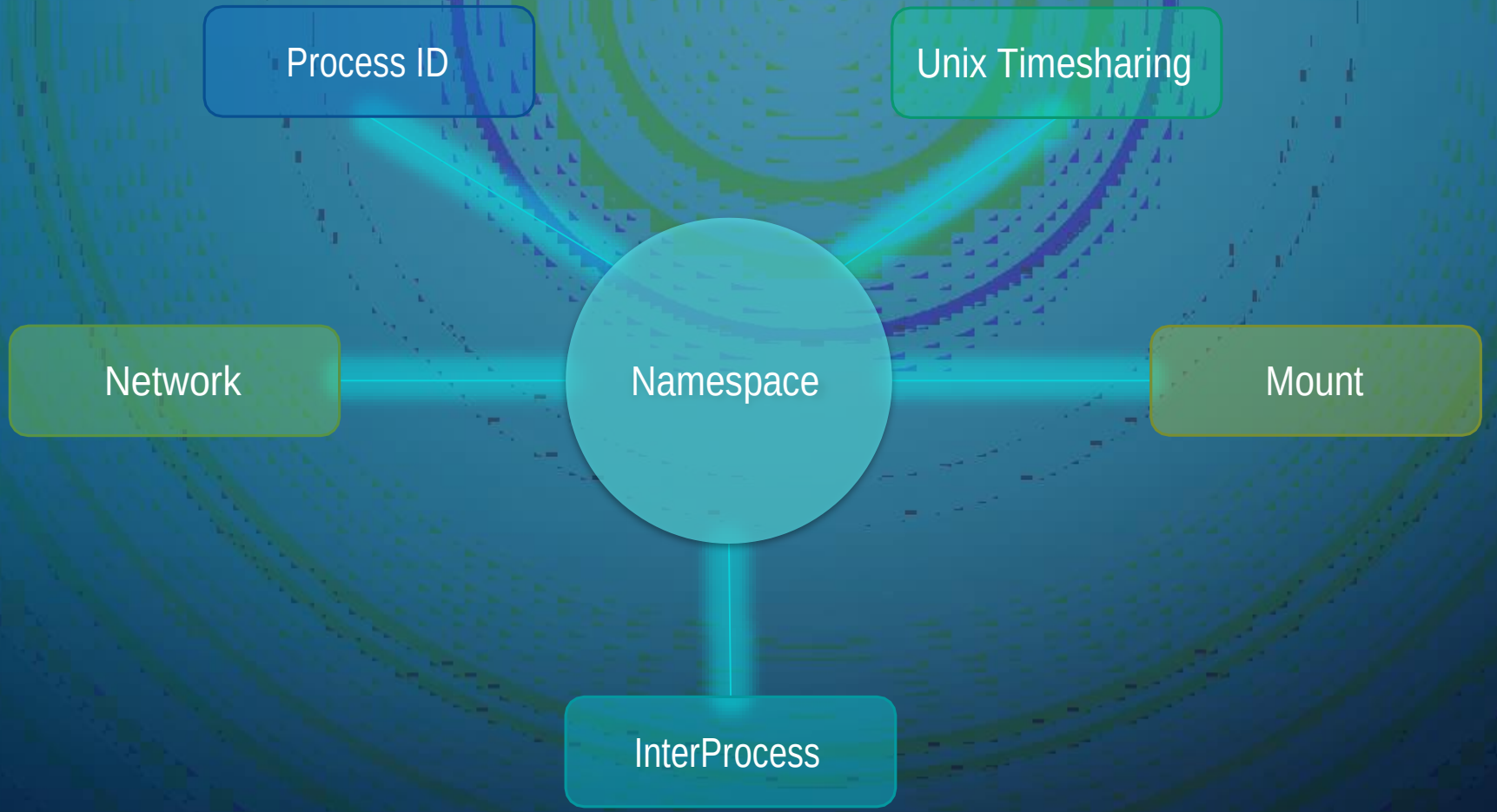
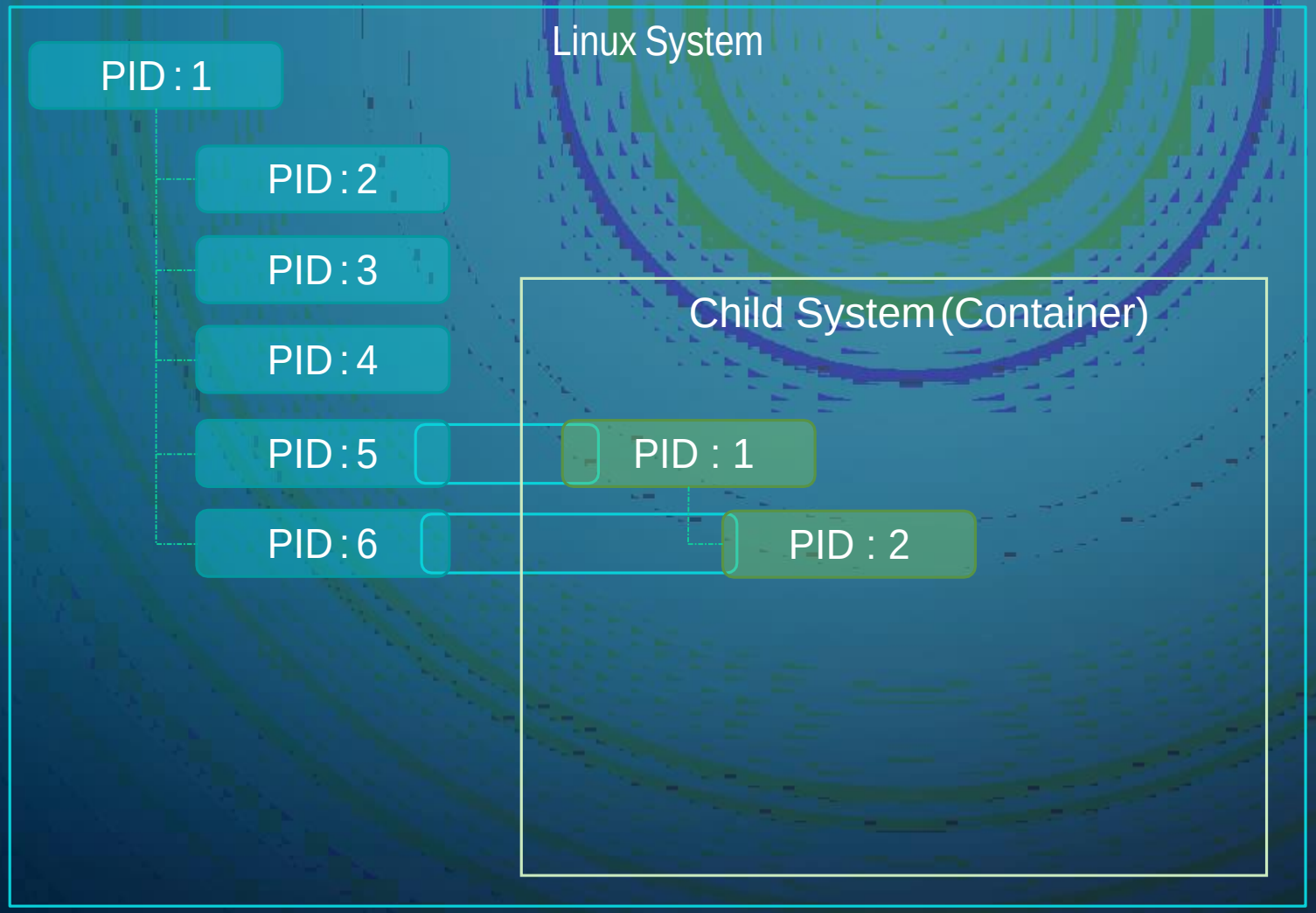
DOCKER ENGINE



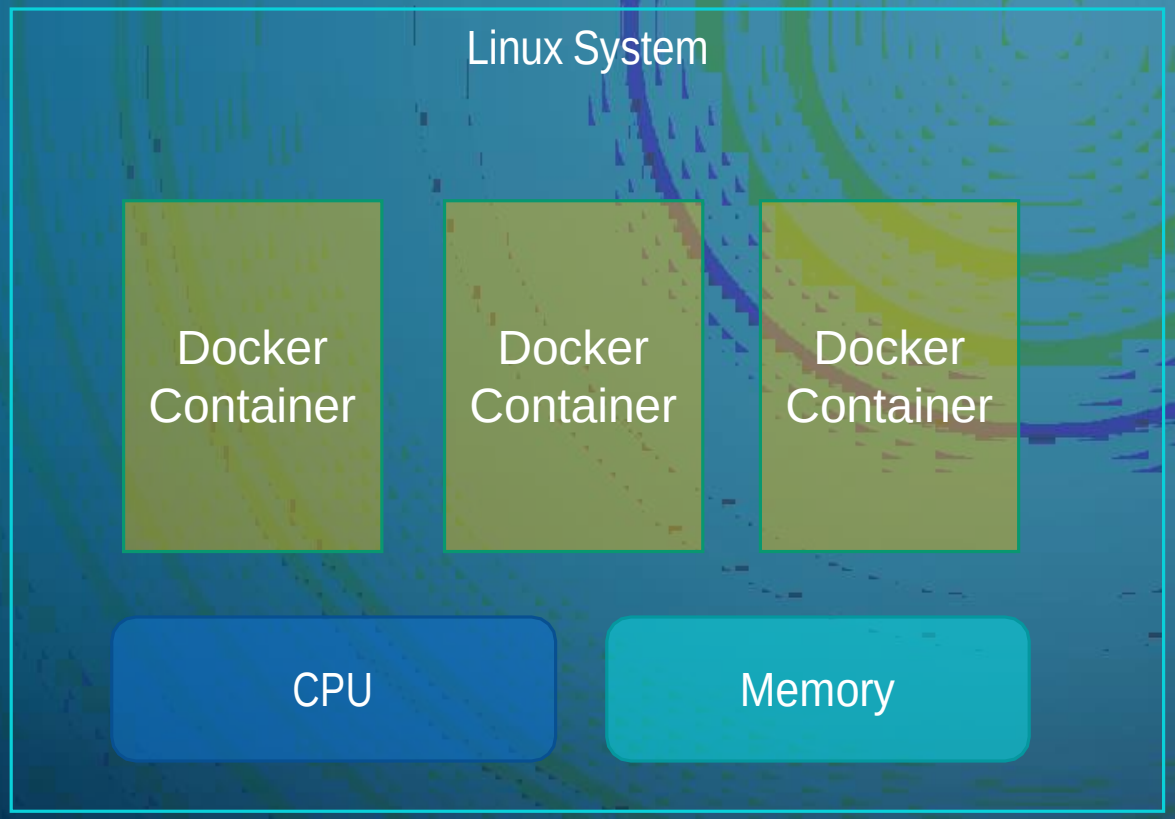
CONTAINERIZATION



NAMESPACE - PID



CGROUPS




```
docker run --cpus=.5 ubuntu
```

```
docker run --memory=100m ubuntu
```

DOCKER STORAGE

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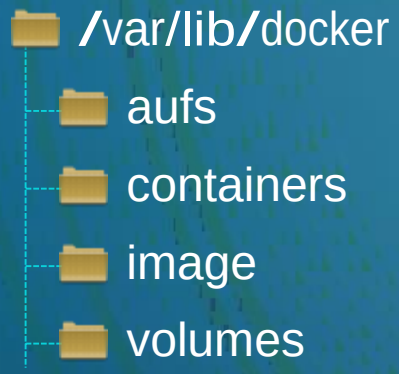
FILE SYSTEM



LAYERED ARCHITECTURE

Dockerfile

```
FROM Ubuntu

RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY . /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run
```

```
docker build Dockerfile -t mmumshad/my-custom-app
```

- Layer 1. Base Ubuntu Layer — 120 MB
- Layer 2. Changes in apt packages — 306 MB
- Layer 3. Changes in pip packages — 6.3 MB
- Layer 4. Source code — 229 B
- Layer 5. Update Entrypoint — 0 B

Dockerfile2

```
FROM Ubuntu

RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY app2.py /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app2.py flask run
```

```
docker build Dockerfile2 -t mmumshad/my-custom-app-2
```

- Layer 1. Base Ubuntu Layer — 0 MB
- Layer 2. Changes in apt packages — 0 MB
- Layer 3. Changes in pip packages — 0 MB
- Layer 4. Source code — 229 B
- Layer 5. Update Entrypoint — 0 B

LAYERED ARCHITECTURE

Container Layer

Read Write

Layer 6. Container Layer

```
docker run mmumshad/my-custom-app
```

Image Layers

Read Only

Layer 5. Update Entrypoint with “flask” command

Layer 4. Source code

Layer 3. Changes in pip packages

Layer 2. Changes in apt packages

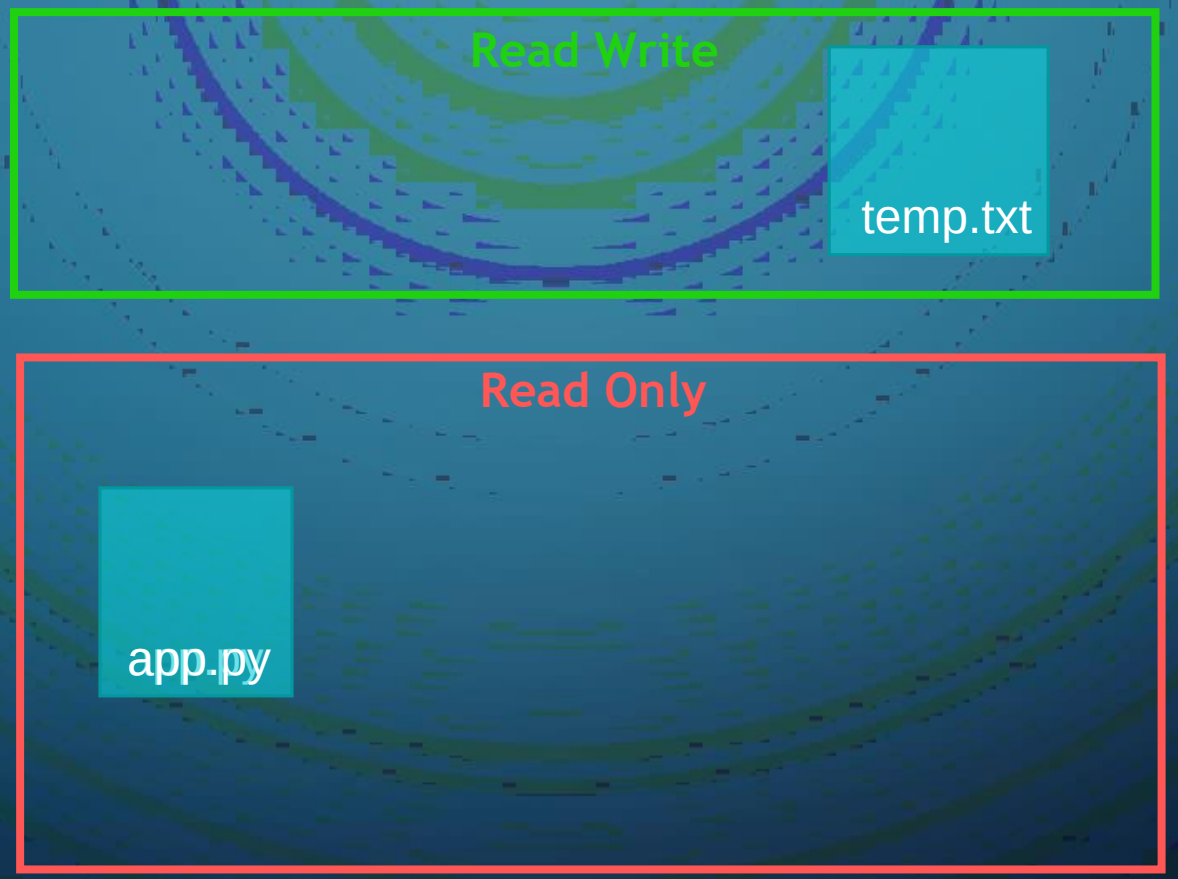
Layer 1. Base Ubuntu Layer

```
docker build Dockerfile -t mmumshad/my-custom-app
```

COPY-ON-WRITE

Container Layer

Image Layers



VOLUMES

```
docker volume create data_volume
```

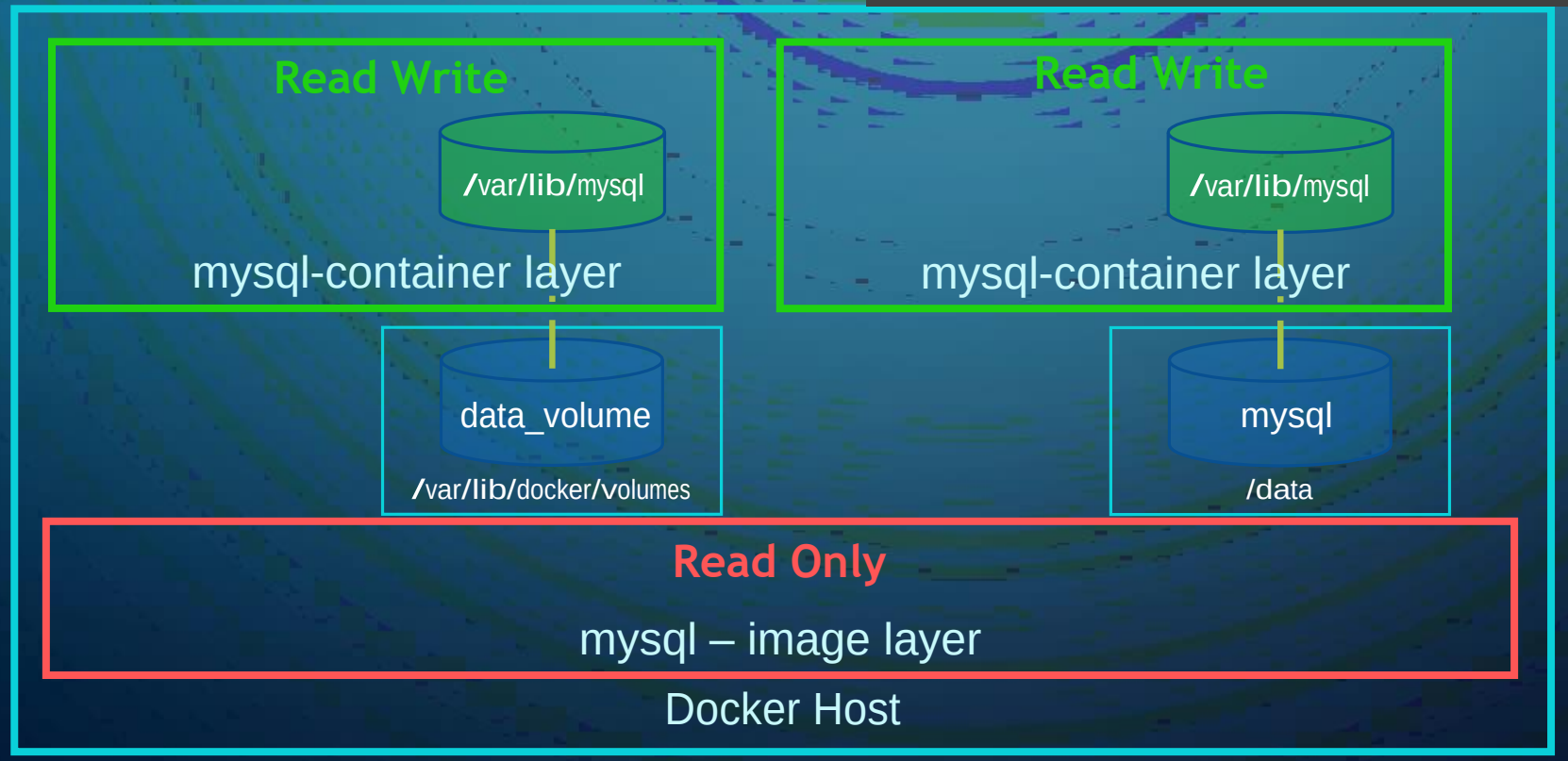
- /var/lib/docker
  - volumes
    - data_volume

```
docker run -v data_volume:/var/lib/mysql mysql
```

```
docker run -v data_volume2:/var/lib/mysql mysql
```

```
docker run -v /data/mysql:/var/lib/mysql mysql
```

```
docker run \
--mount type=bind,source=/data/mysql,target=/var/lib/mysql mysql
```



STORAGE DRIVERS

- AUFS
- ZFS
- BTRFS
- Device Mapper
- Overlay
- Overlay2

DOCKER SWARM

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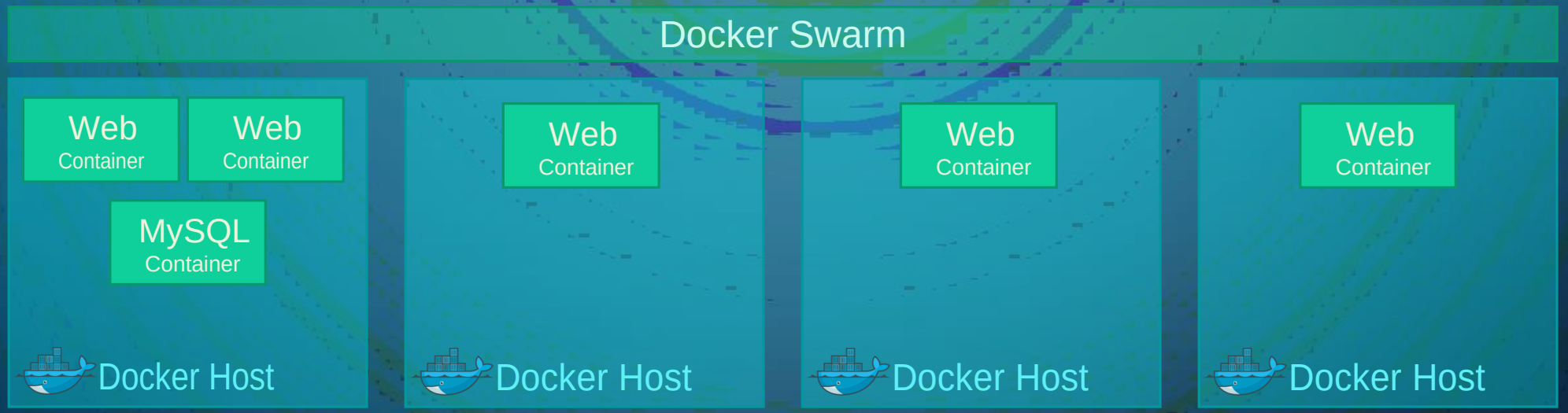
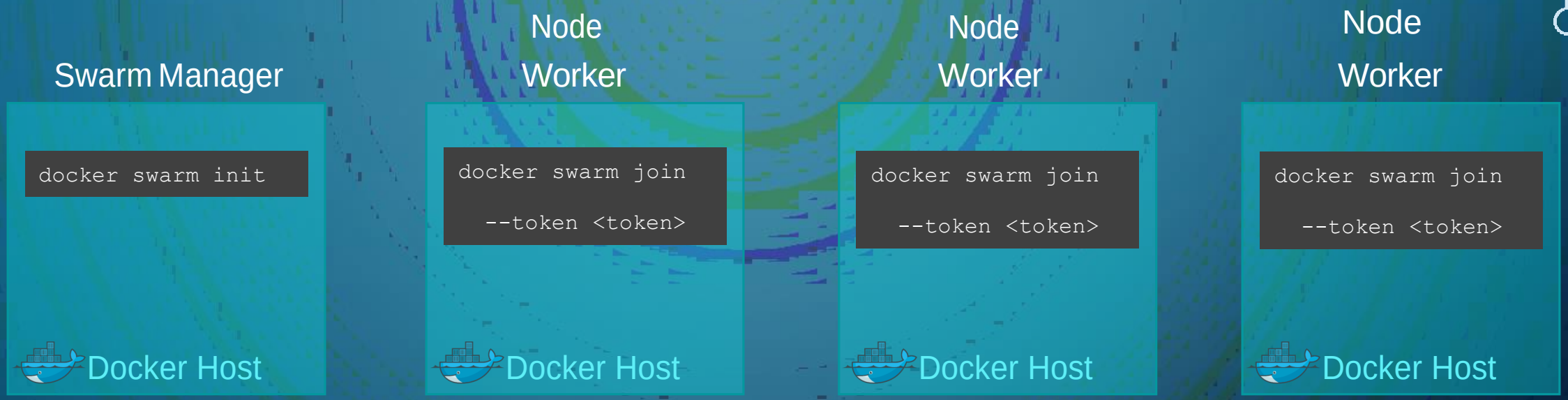
DOCKER SWARM



SETUP SWARM




```
root@osboxes:/root/simple-webapp-docker # docker swarm init --advertise-addr 192.168.1.12
Swarm initialized: current node (0j76dum2r56p1xfne4ub1ps2c) is now a manager.

To add a worker to this swarm, run the following command:

    docker swarm join --token SWMTKN-1-35va8b3fi5krpdskefqqxgttmulw3z828daucri7y526ne0sgu-2eek9qm33d4lxzoq6we9i8izp 192.168.1.12:2377

To add a manager to this swarm, run 'docker swarm join-token manager' and follow the instructions.
```

DOCKER MANAGERS

MANAGER NODES

Swarm Manager

Docker Host

Swarm Manager

Leader

Docker Host

Swarm Manager

Docker Host

Worker

Docker Host

Worker

Docker Host

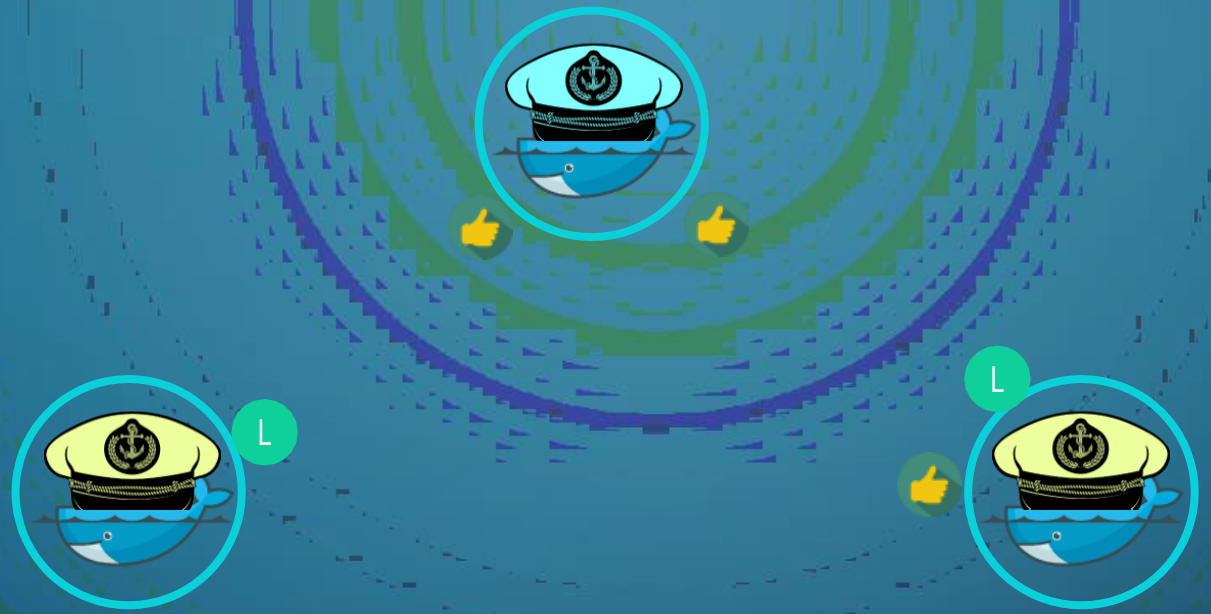
Worker

Docker Host

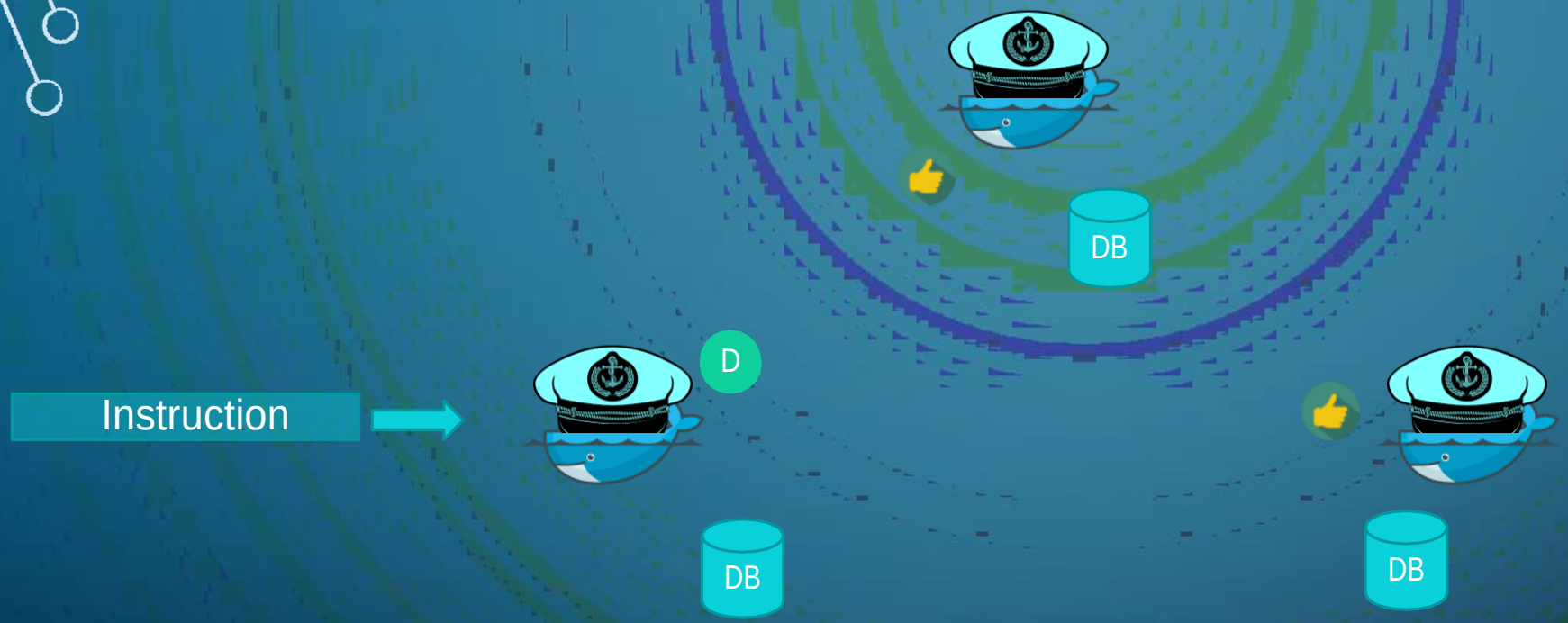
Worker

Docker Host

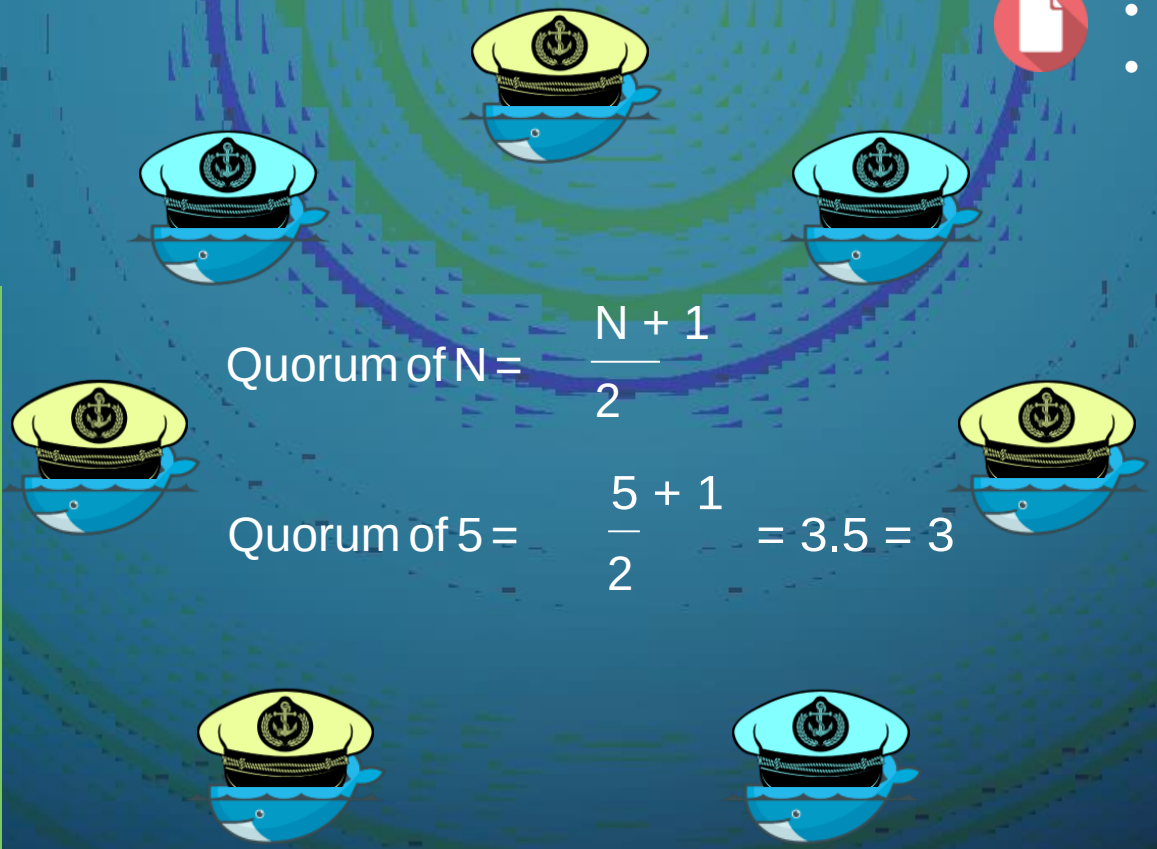
DISTRIBUTED CONSENSUS -RAFT



DISTRIBUTED CONSENSUS - RAFT



HOW MANY MANAGER NODES?



- Docker Recommends – 7 Managers
- No limit on Managers

Managers	Majority	Fault Tolerance
1	1	0
2	2	0
3	2	1
4	3	1
5	3	2
6	4	2
7	4	3

$$\text{Quorum of } N = \frac{N + 1}{2}$$

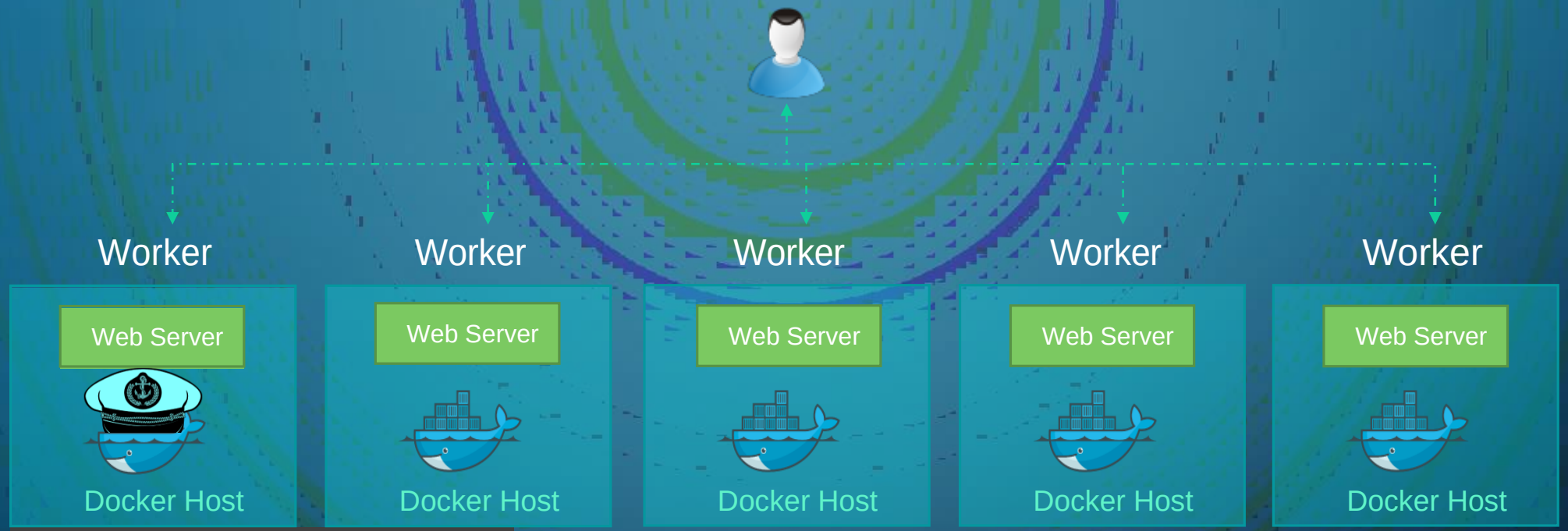
$$\text{Quorum of } 5 = \frac{5 + 1}{2} = 3.5 = 3$$

$$\text{Fault Tolerance of } N = \frac{N - 1}{2}$$

ODD OR EVEN?

Managers	Majority	Fault Tolerance
1	1	0
2	2	0
3	2	1
4	3	1
5	3	2
6	4	2

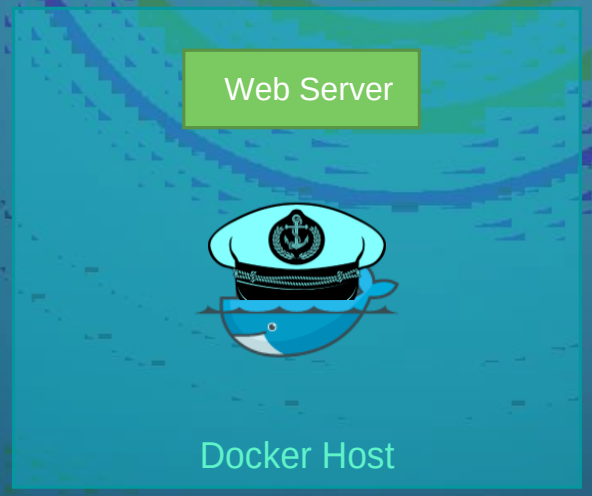
WHAT HAPPENS WHEN IT FAILS?




```
docker node promote
```

```
docker swarm init --force-new-cluster
```

CAN MANAGER WORK?




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

QUIZ

DOCKER SERVICE

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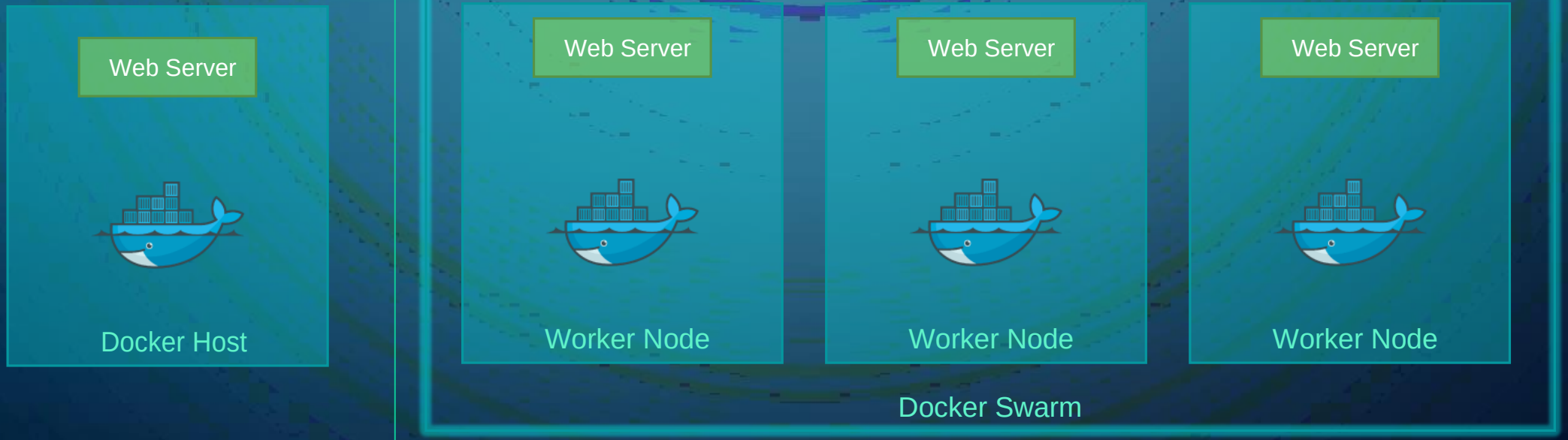
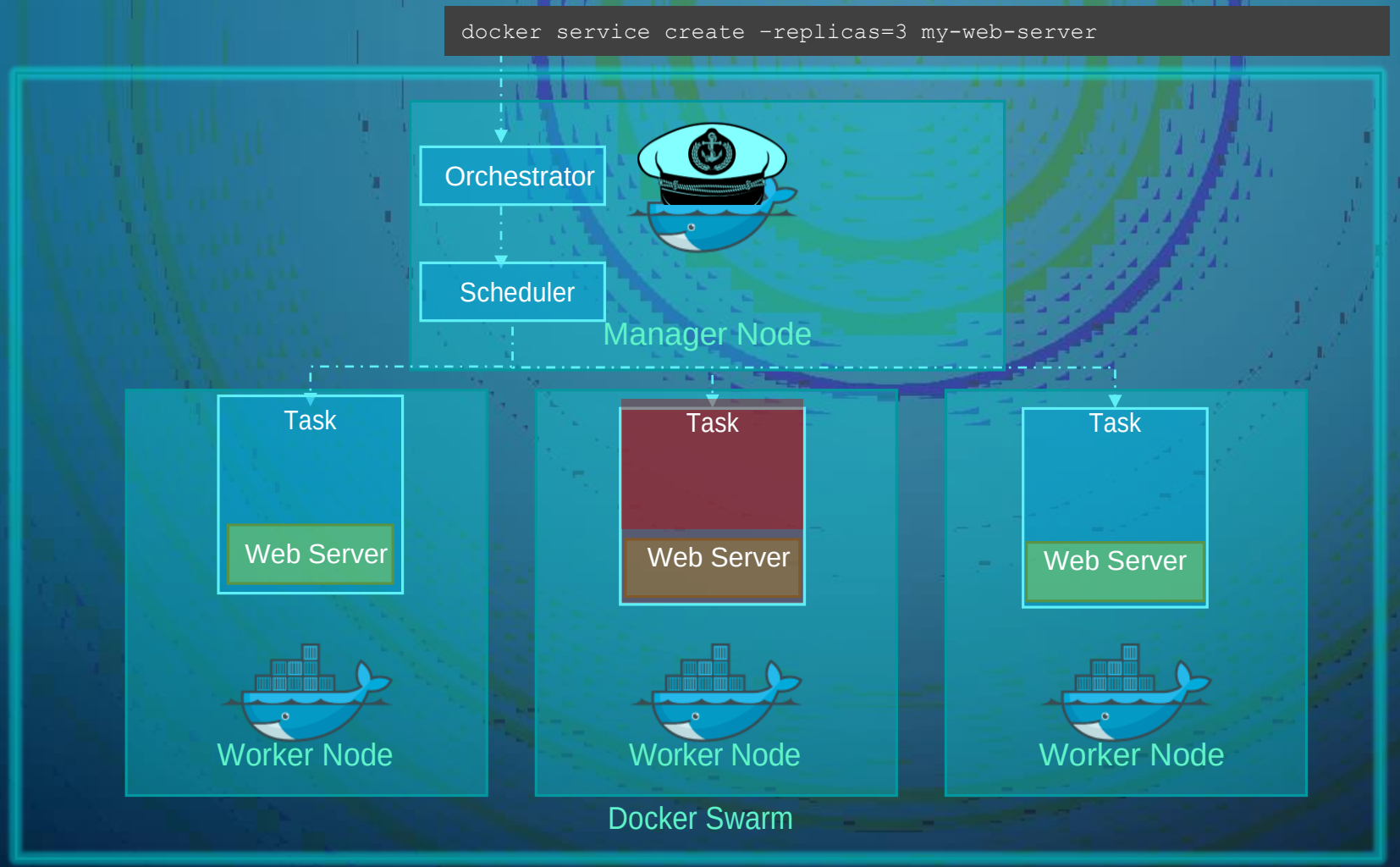
DOCKER SERVICE

```
docker run my-web-server
```

```
docker service create -replicas=3 my-web-server
```

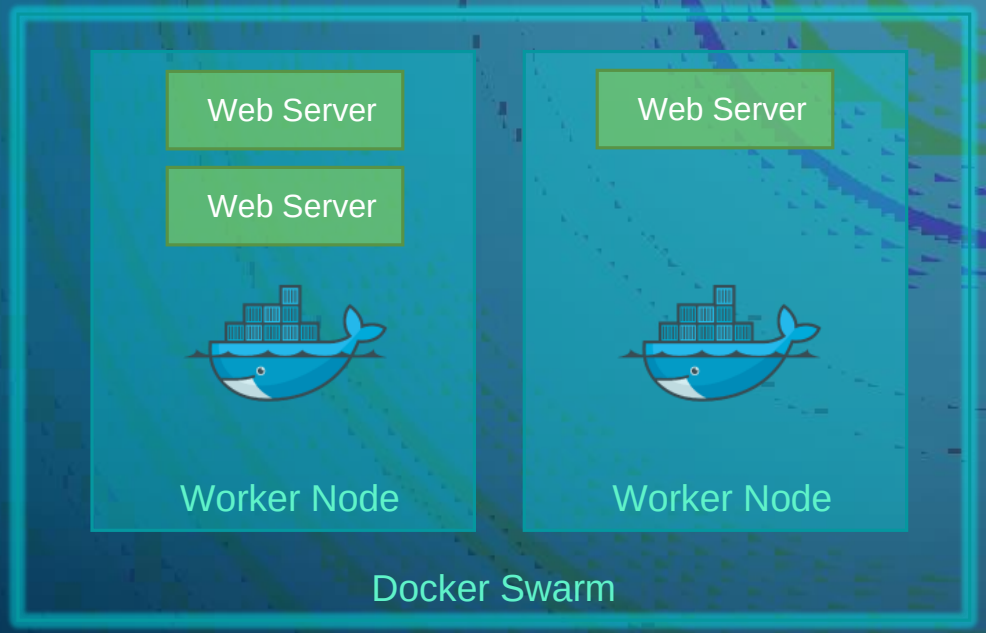


TASKS


docker service create -replicas=3 my-web-server
Orchestrator
Scheduler
Manager Node
Task
Web Server
Worker Node
Task
Web Server
Worker Node
Task
Web Server
Worker Node
Docker Swarm

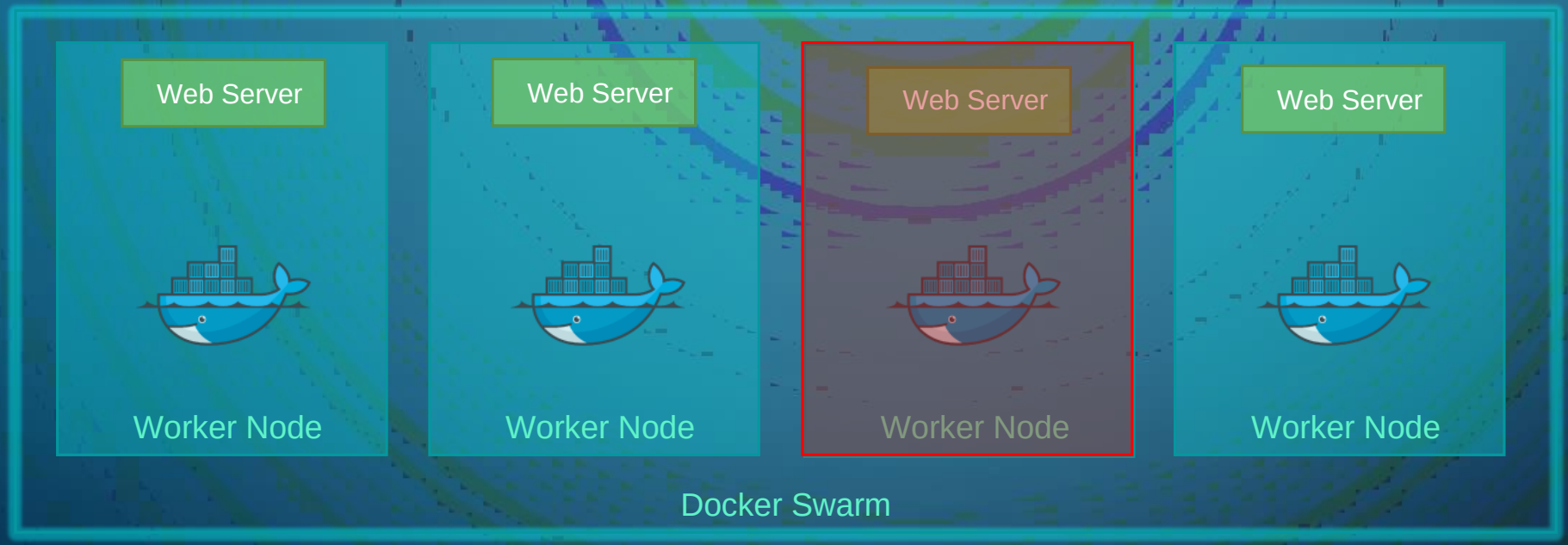
REPLICAS

```
docker service create -replicas=3 my-web-server
```



REPLICAS

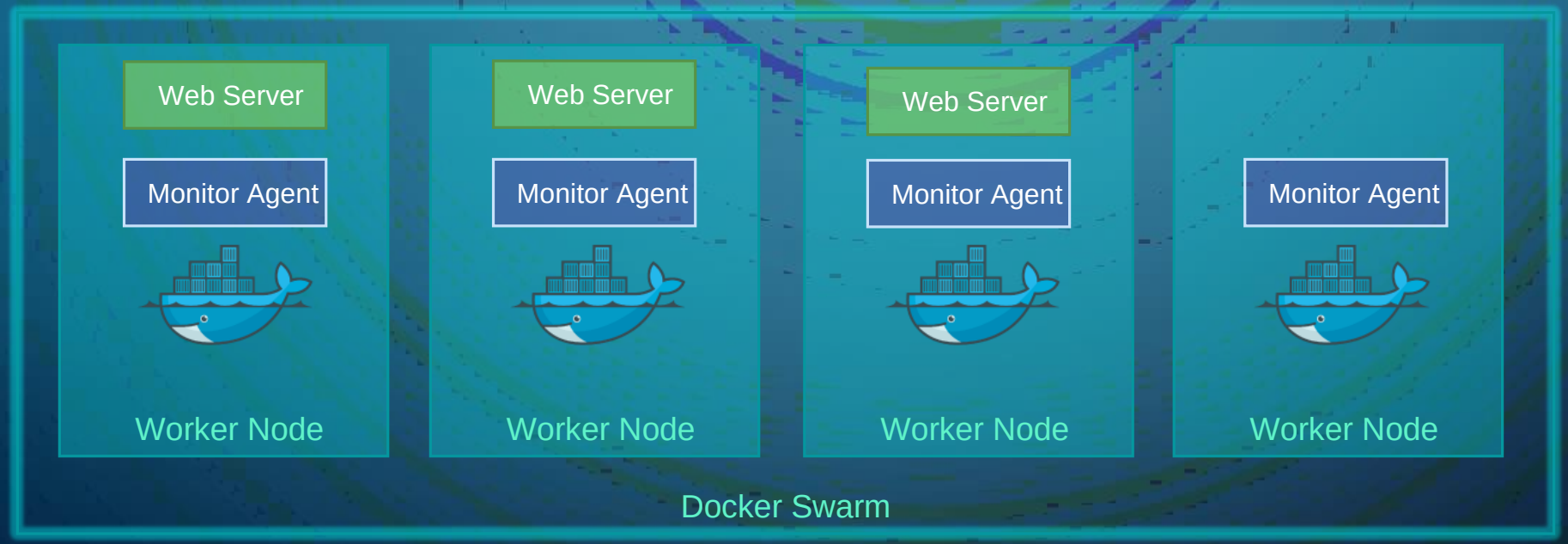
```
docker service create -replicas=3 my-web-server
```



REPLICAS VS GLOBAL

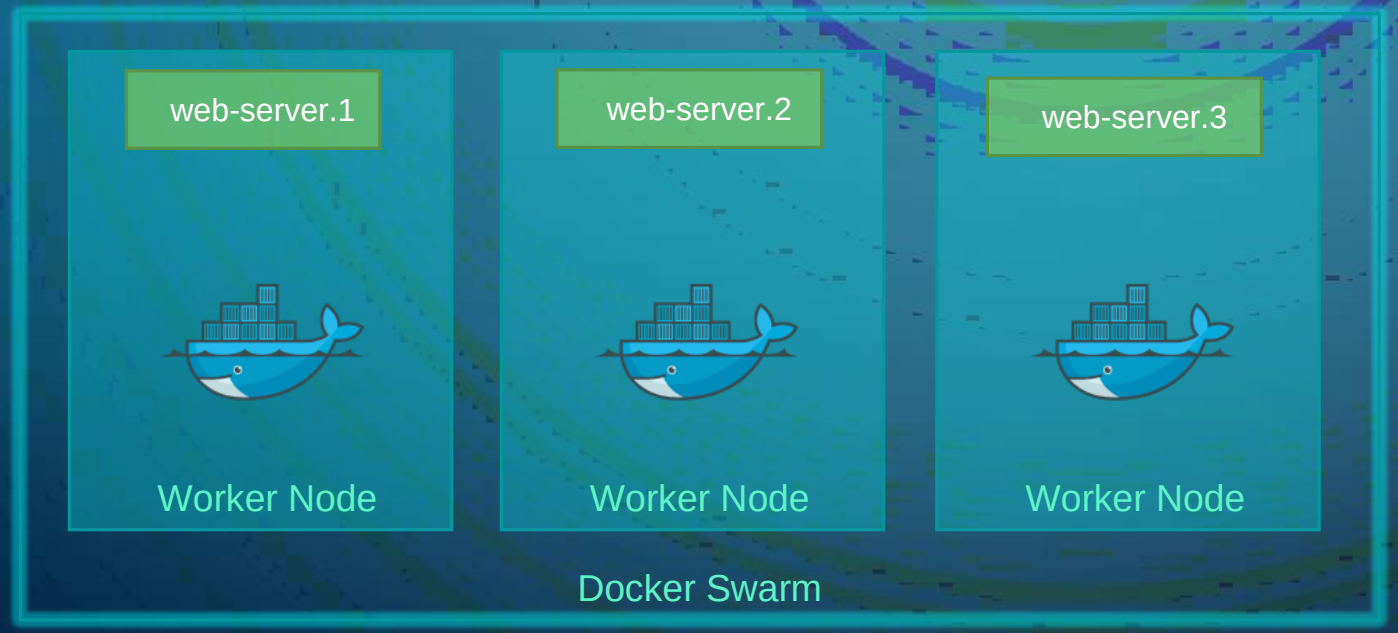
```
docker service create --replicas=3 my-web-server
```

```
docker service create --mode global my-monitoring-agent
```



SERVICE NAME

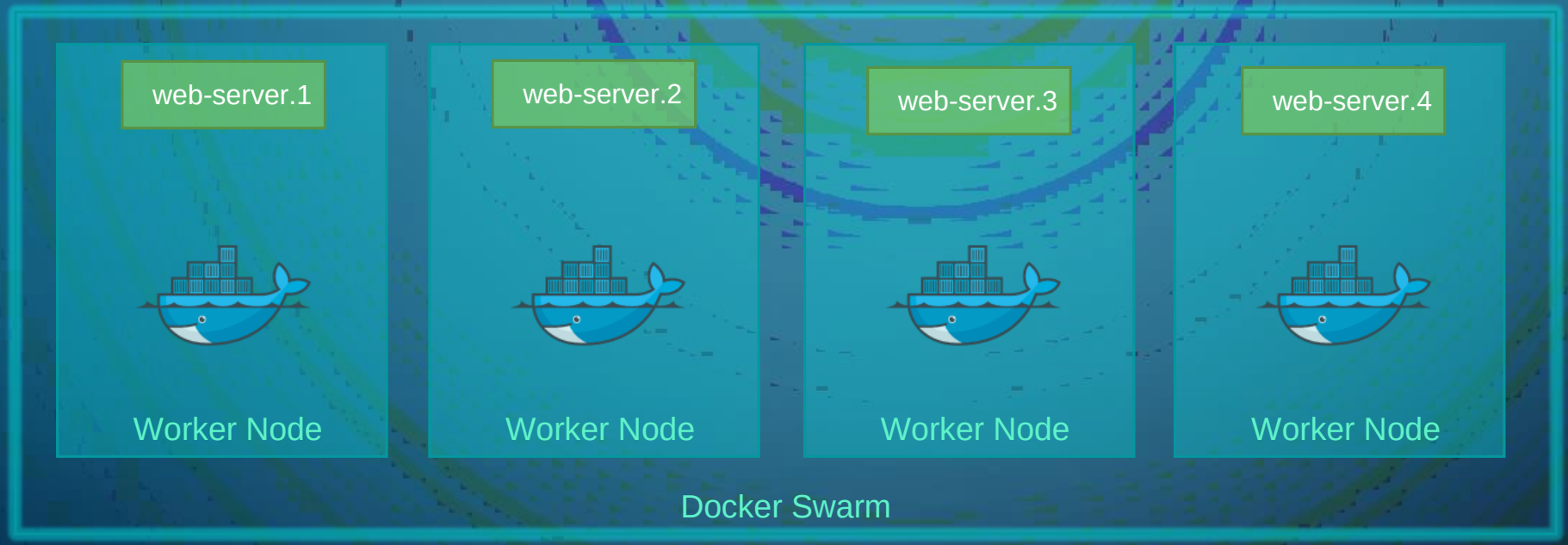
```
docker service create --replicas=3 --name web-server
```



SERVICE UPDATE

```
docker service create -replicas=3 --name web-server my-web-server
```

```
docker service update -replicas 4 web-server
```



CODING EXERCISES

- Docker Service Commands

QUIZ

DOCKER STACKS

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DOCKER COMPOSE

```
docker run mmumshad/simple-webapp
```

```
docker run mongodb
```

```
docker run redis:alpine
```

```
docker run ansible
```

Public Docker registry - dockerhub

docker-compose.yml

```
services:
     web:
        image: "mmumshad/simple-webapp"
     database:
        image: "mongodb"
     messaging:
        image: "redis:alpine"
     orchestration:
        image:  "ansible"
```

```
docker-compose up
```

DOCKER COMPOSE

```
docker run mmumshad/simple-webapp
```

```
docker run mongodb
```

```
docker run redis:alpine
```

```
docker run ansible
```

docker-compose.yml

```
services:
     web:
        image: "mmumshad/simple-webapp"
     database:
        image: "mongodb"
     messaging:
        image: "redis:alpine"
     orchestration:
        image:  "ansible"
```

```
docker-compose up
```

```
docker service create mmumshad/simple-webapp
```

```
docker service create mongodb
```

```
docker service create redis
```

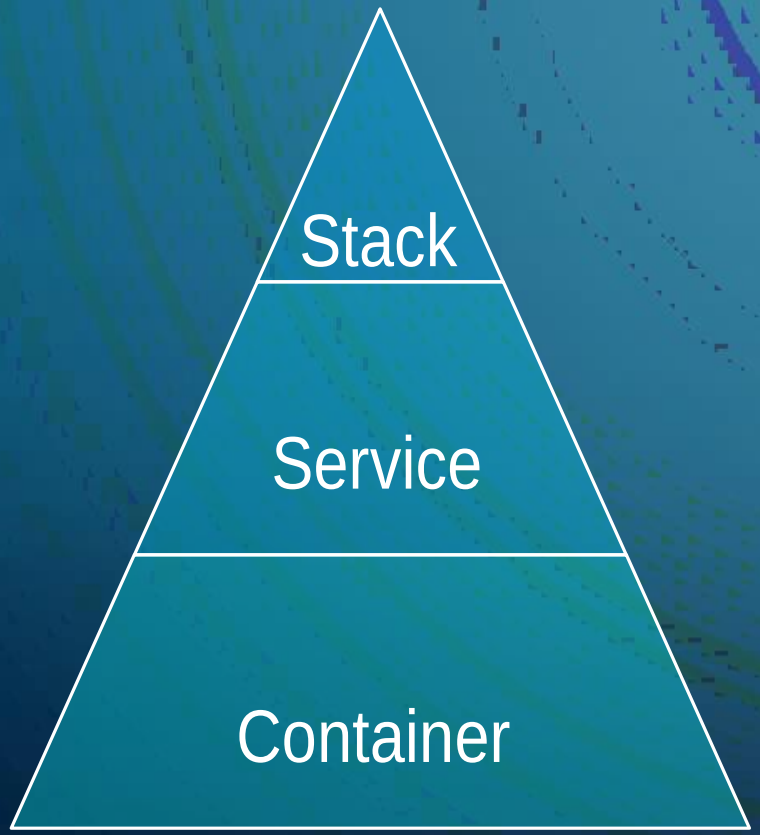
```
docker service create ansible
```

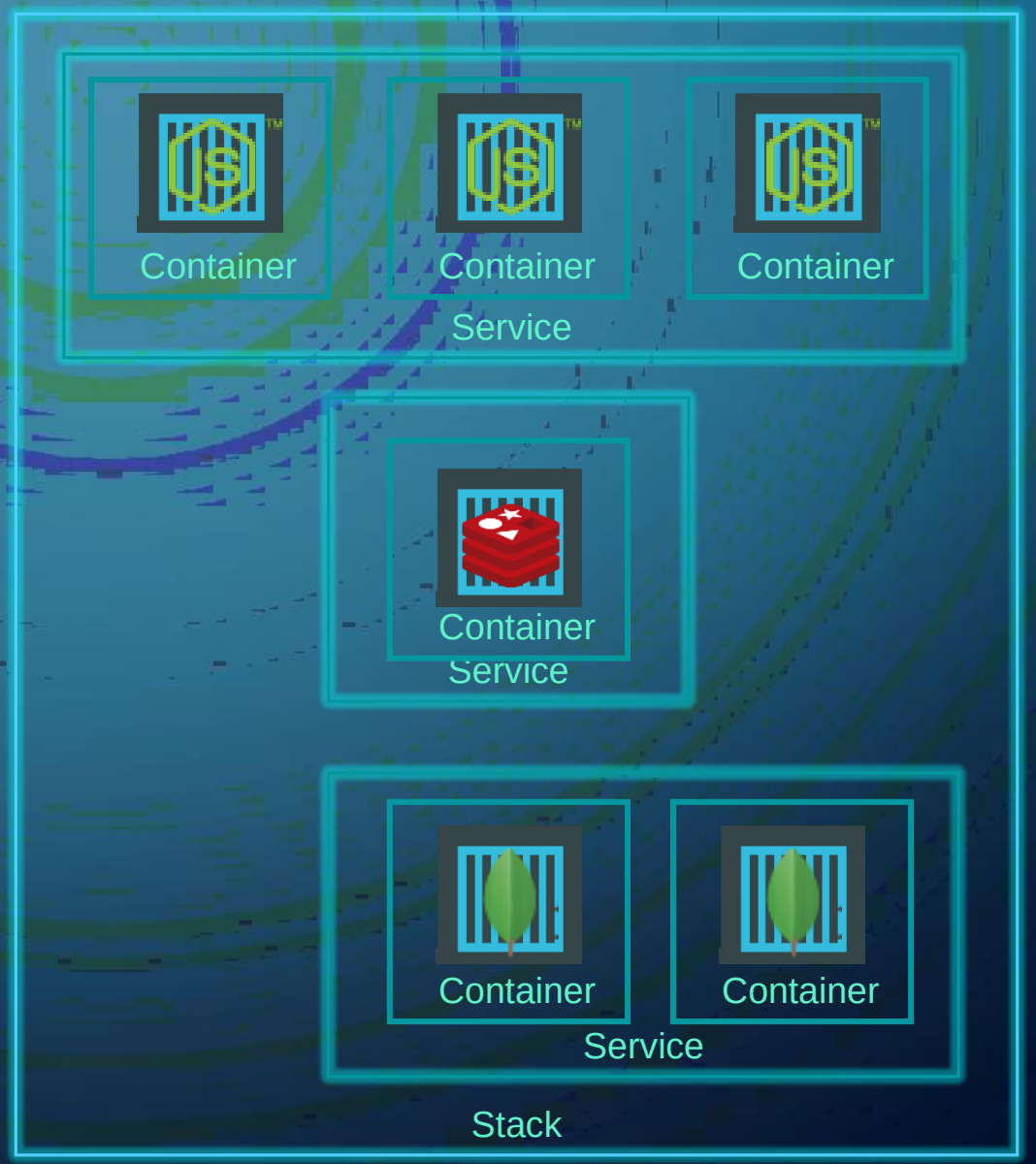
docker-compose.yml

```
services:
     web:
        image: "mmumshad/simple-webapp"
     database:
        image: "mongodb"
     messaging:
        image: "redis:alpine"
     orchestration:
        image:  "ansible"
```

```
docker stack deploy
```

STACK


Stack
Service
Container


Container
Container
Container
Service
Container
Service
Container
Container
Service
Stack

STACK DEFINITION

```
docker service create mmumshad/simple-webapp
```

```
docker service create mongodb
```

```
docker service create redis
```

```
docker service create ansible
```

docker-compose.yml

```
services:
     web:
        image: "mmumshad/simple-webapp"
     database:
        image: "mongodb"
     messaging:
        image: "redis:alpine"
     orchestration:
        image: "ansible"
```

```
docker stack deploy
```

DOCKER NETWORKING

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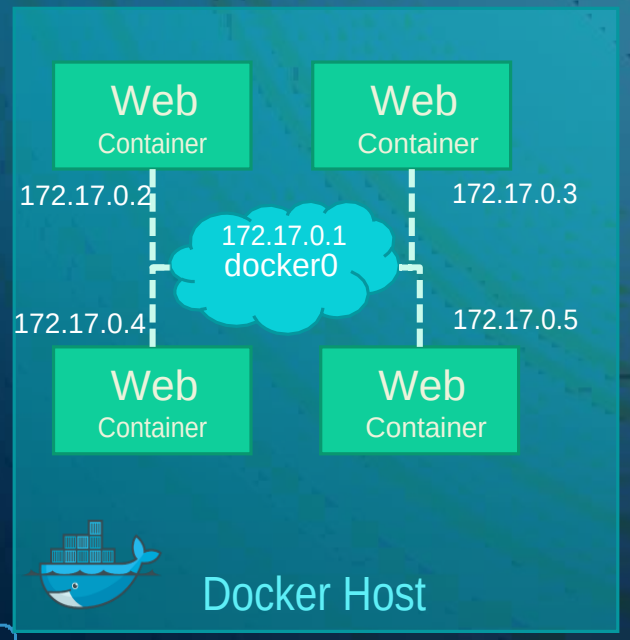
DEFAULT NETWORKS

Bridge

```
docker run ubuntu
```

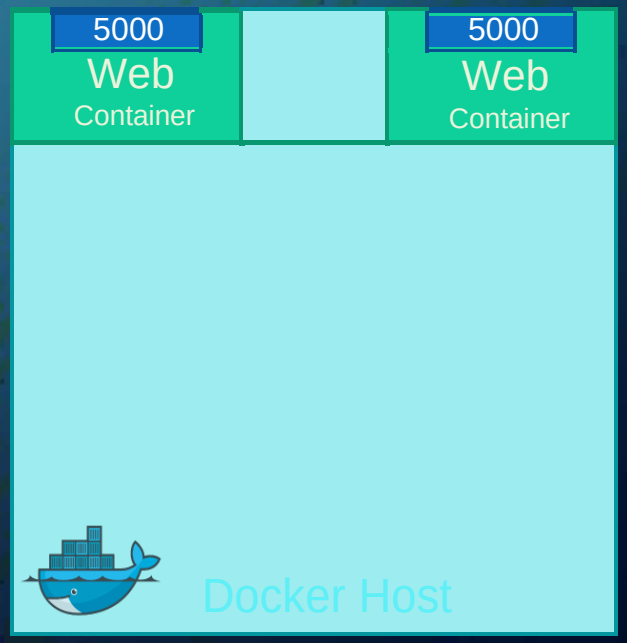


none

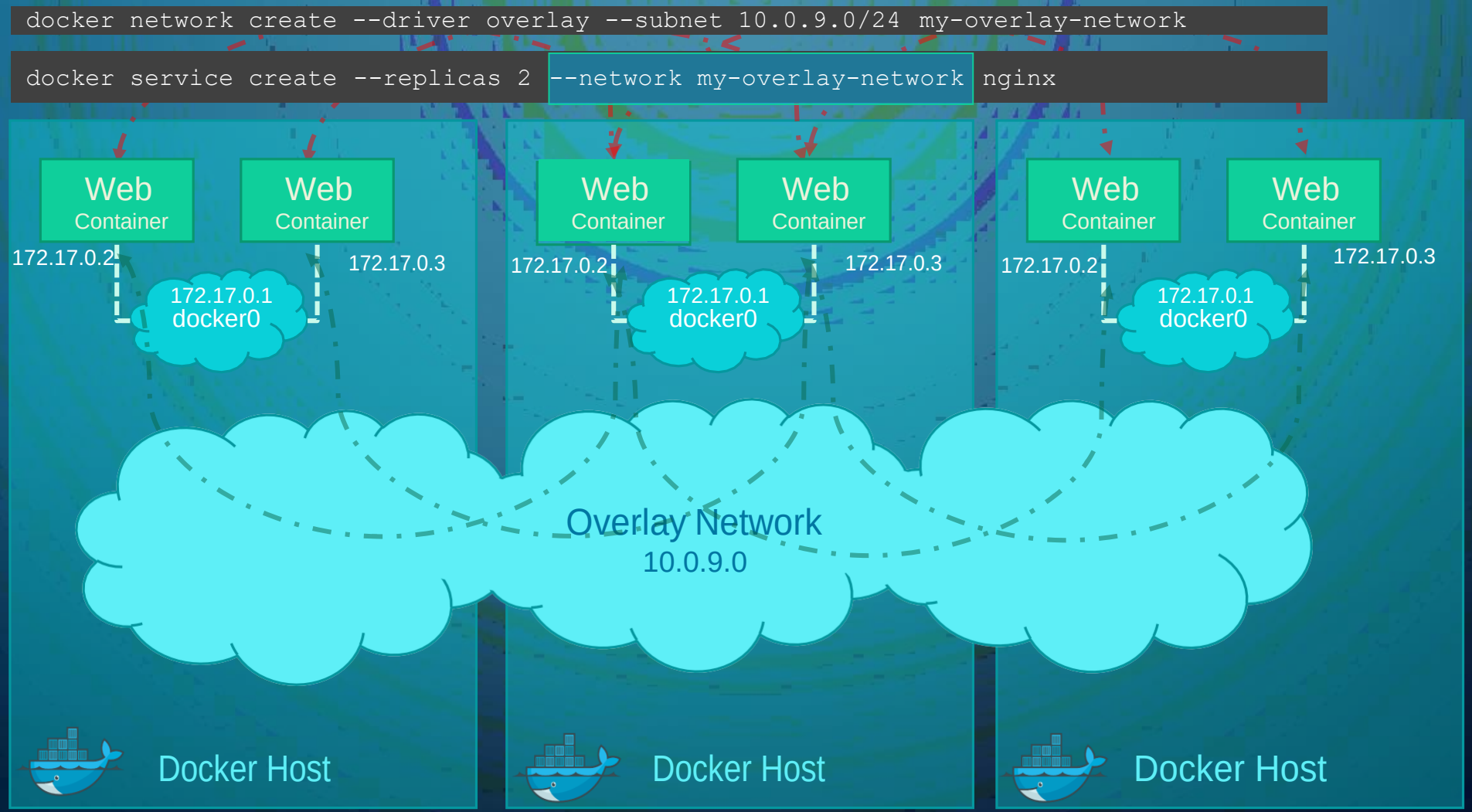
```
docker run Ubuntu --network=none
```

host

```
docker run Ubuntu --network=host
```



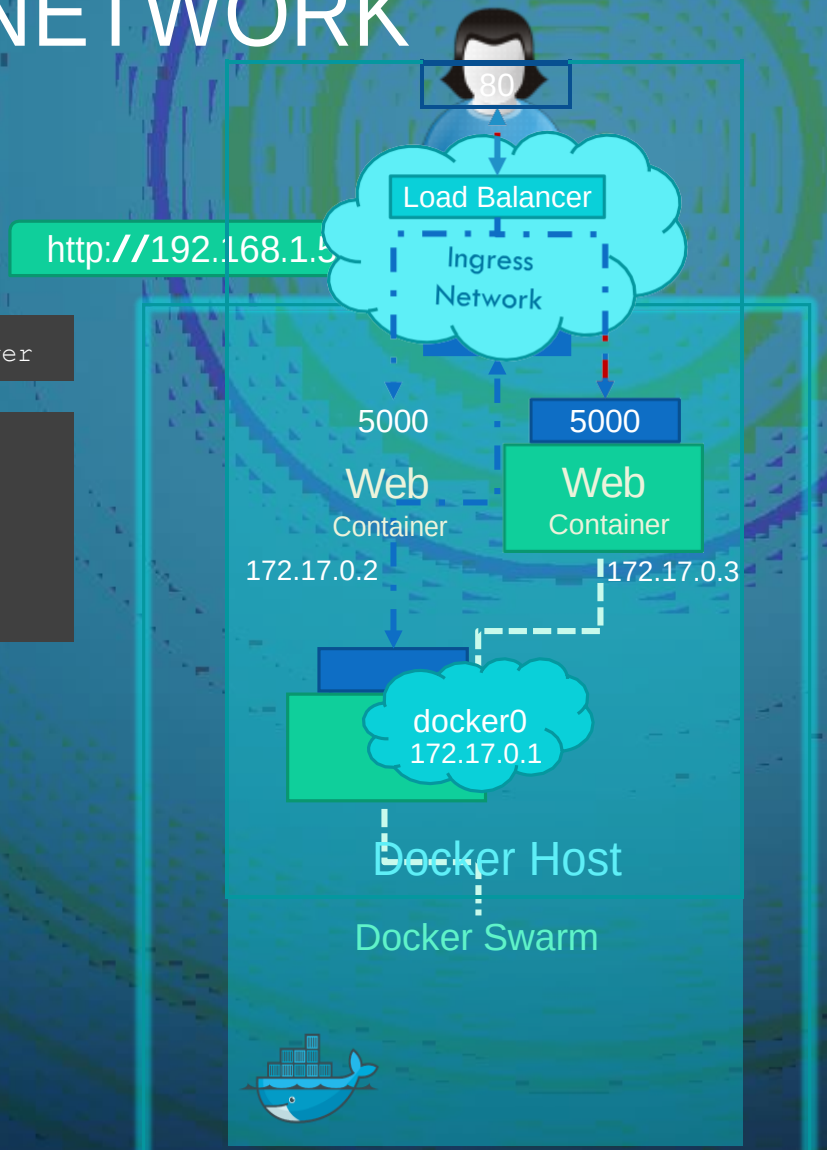
OVERLAY NETWORK



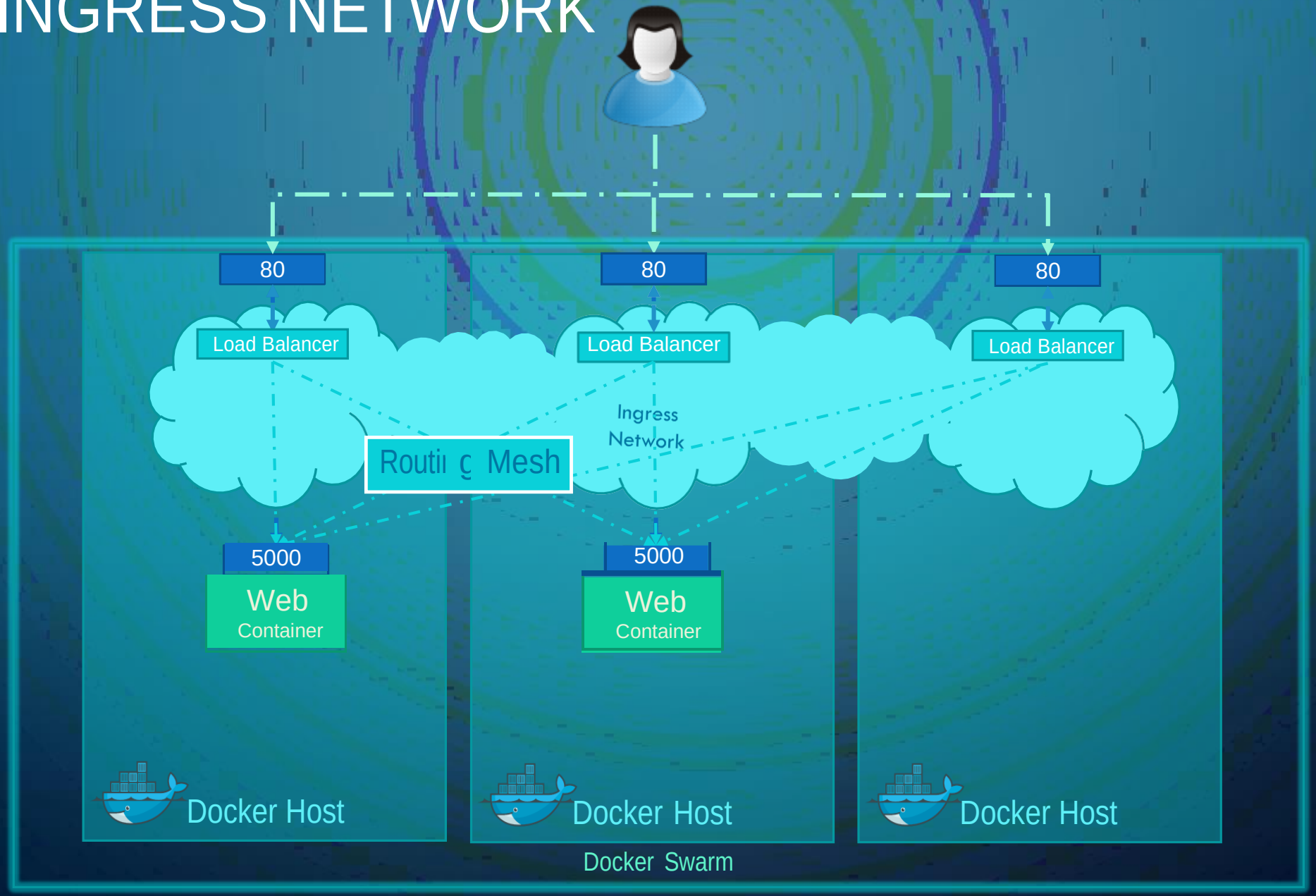
INGRESS NETWORK

```
docker run -p 80:5000 my-web-server
```

```
docker service create \
      --replicas=2 \
      -p 80:5000 \
      my-web-server
```

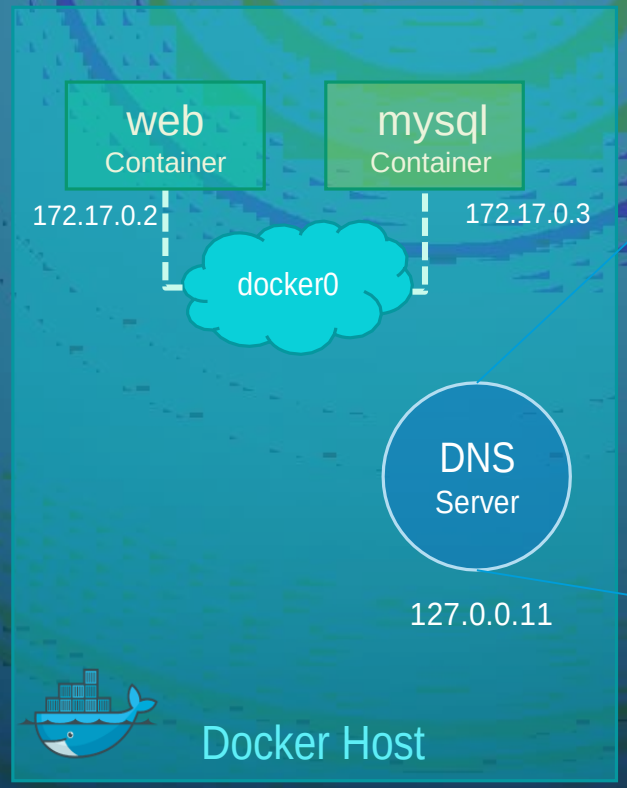


INGRESS NETWORK



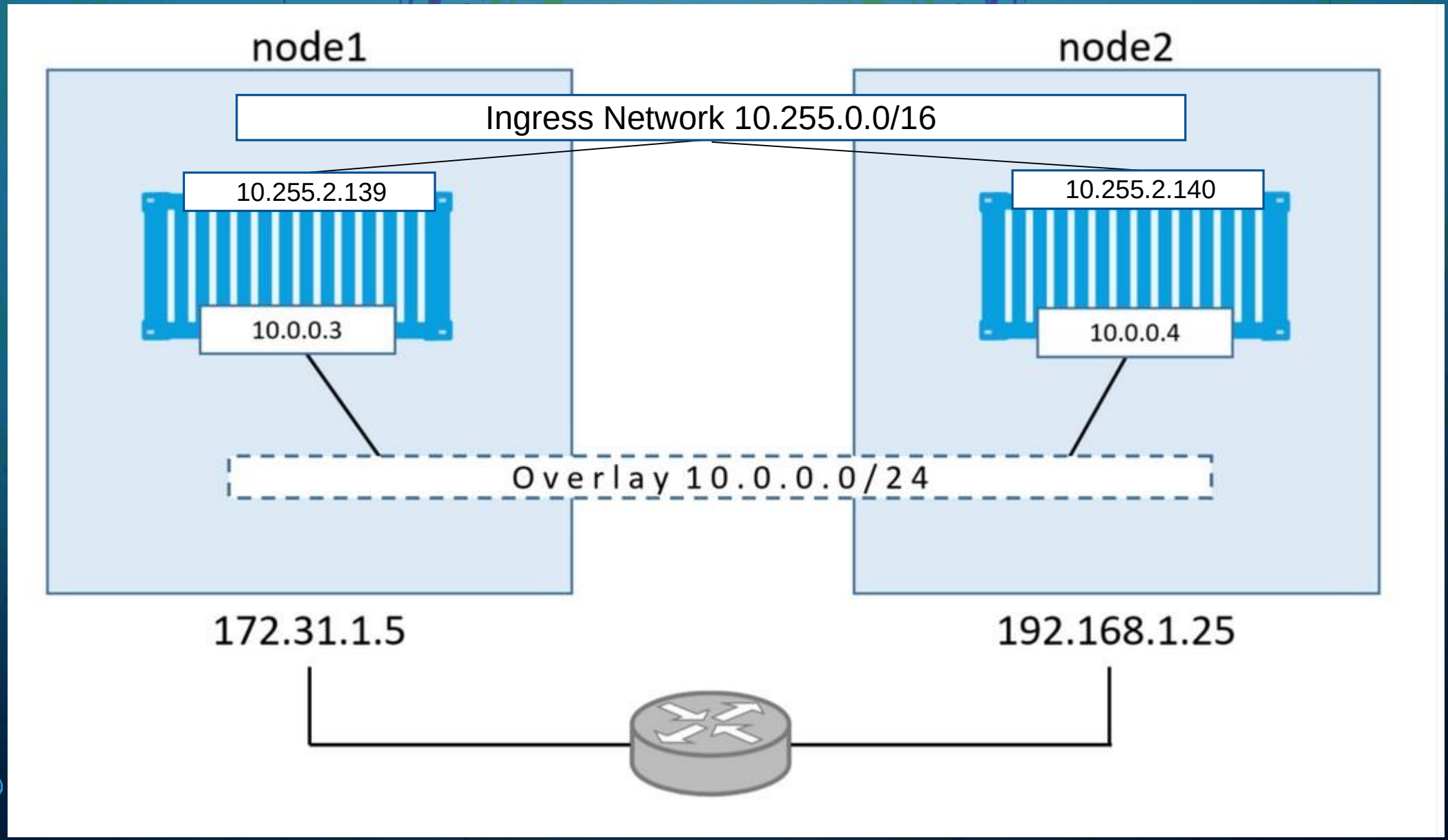
EMBEDDED DNS

```
mysql.connect( mysql )
```



Host	IP
web	172.17.0.2
mysql	172.17.0.3

LEARN MORE


node1
node2
Ingress Network 10.255.0.0/16
10.255.2.139
10.255.2.140
10.0.0.3
10.0.0.4
Overlay 10.0.0.0/24
172.31.1.5
192.168.1.25

CI/CD

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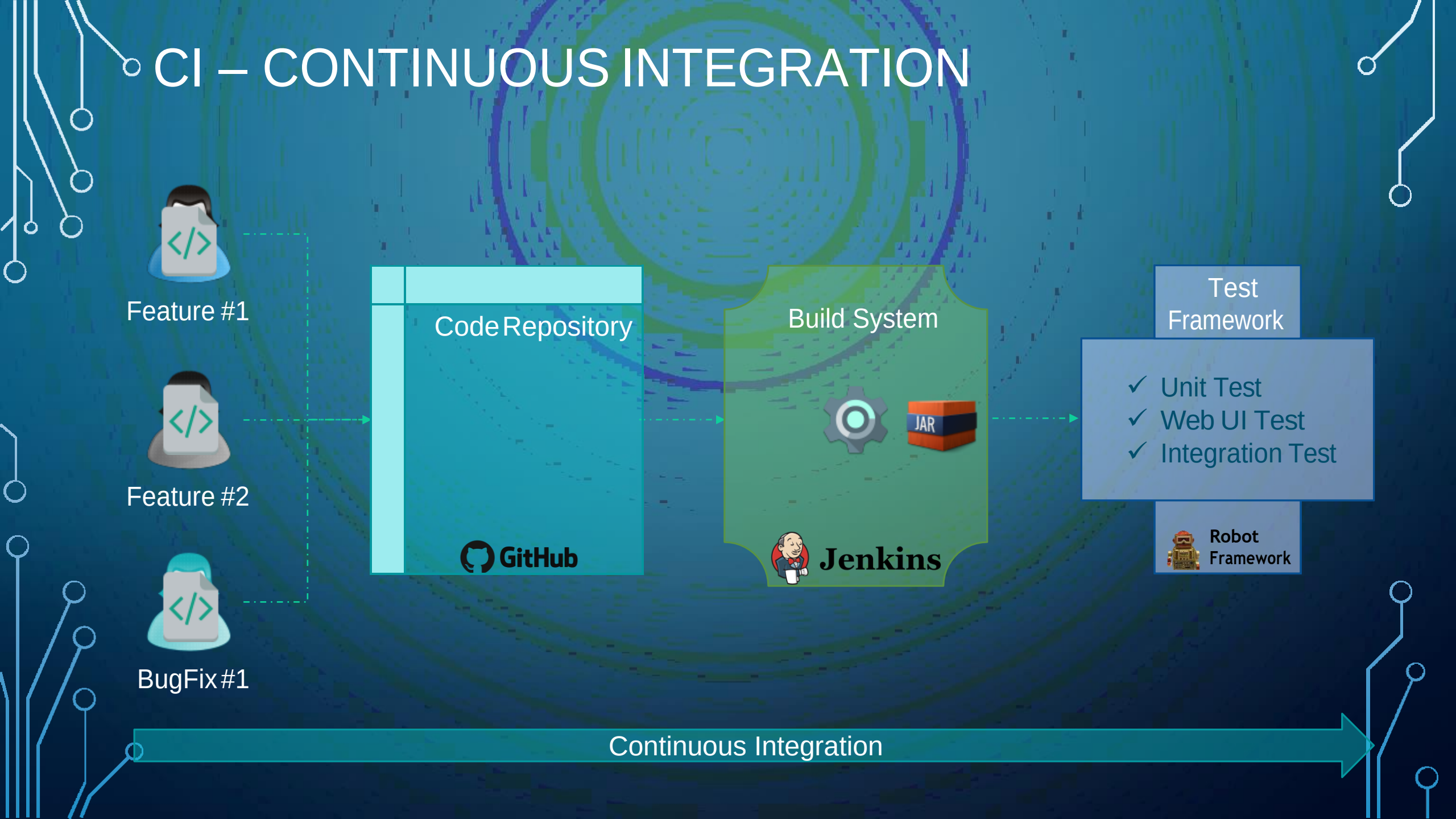
CI – CONTINUOUS INTEGRATION



CD – CONTINUOUS DELIVERY/DEPLOYMENT

CI/CD - DOCKER

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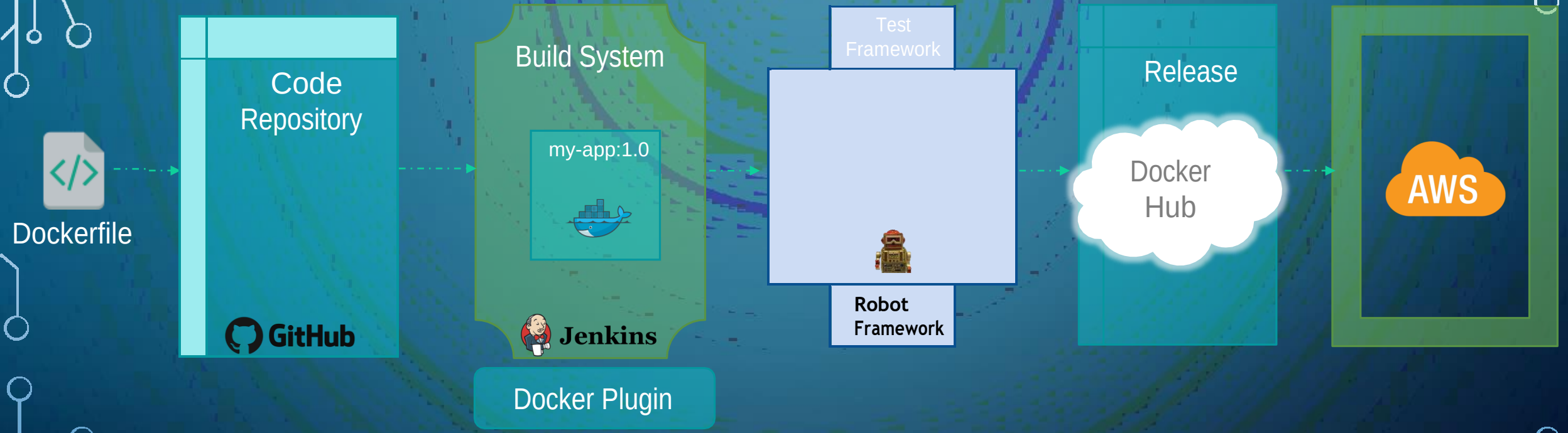
BUILD SYSTEMS – DOCKER SUPPORT



Continuous Integration

Continuous Delivery

PUBLIC CLOUD – DOCKER SUPPORT

Google Cloud Platform

Google Container Engine
(GKE)

kubernetes

AWS

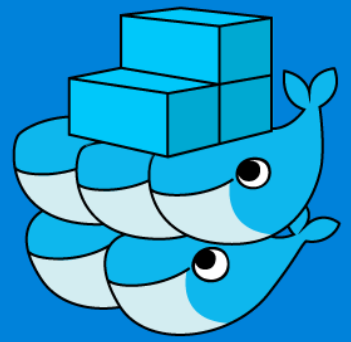
EC2 Container Service
(ECS)

CF

Pivotal CF

Pivotal Container Service
(PKS)

docker cloud



Docker Swarm

DOCKER REGISTRY

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DOCKER REGISTRY

Private Docker Registry

Public Docker registry - dockerhub

```
docker push mmumshad/my-custom-app
```

```
docker build . -t mmumshad/my-custom-app
```

```
docker run -d -p 5000:5000 registry:2
```

```
docker push mmumshad/my-custom-app
```

```
docker build . -t mmumshad/my-custom-app
```