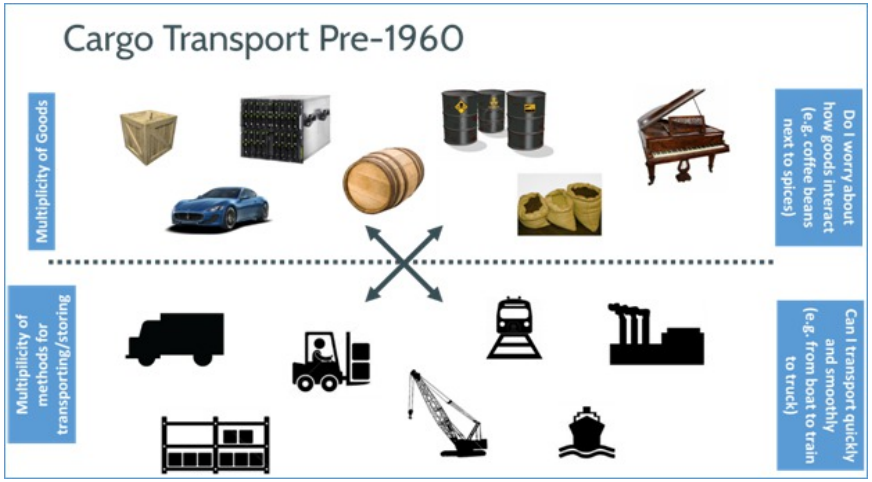
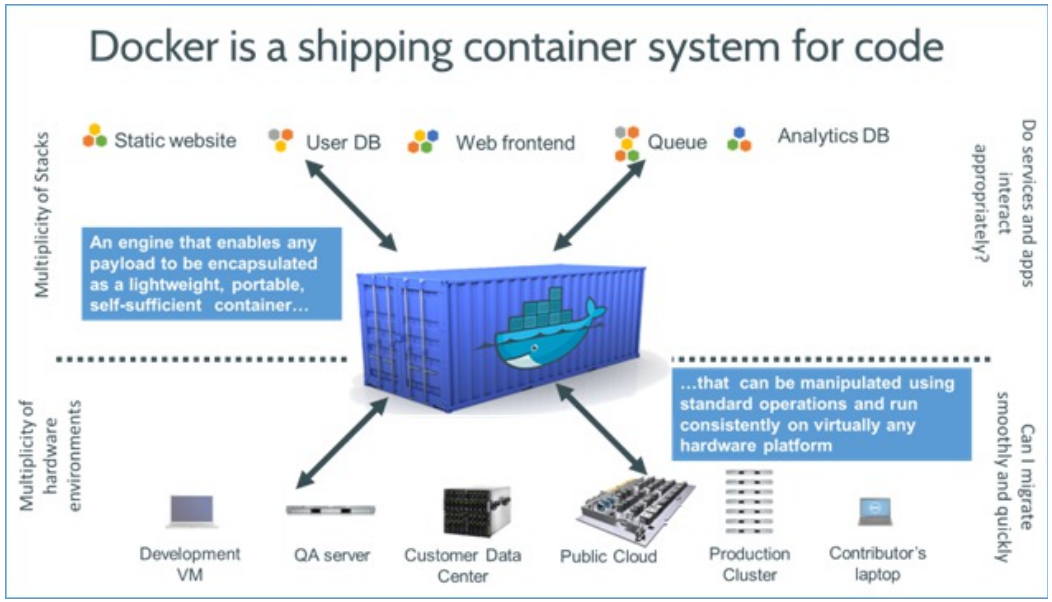
My Experience with Docker

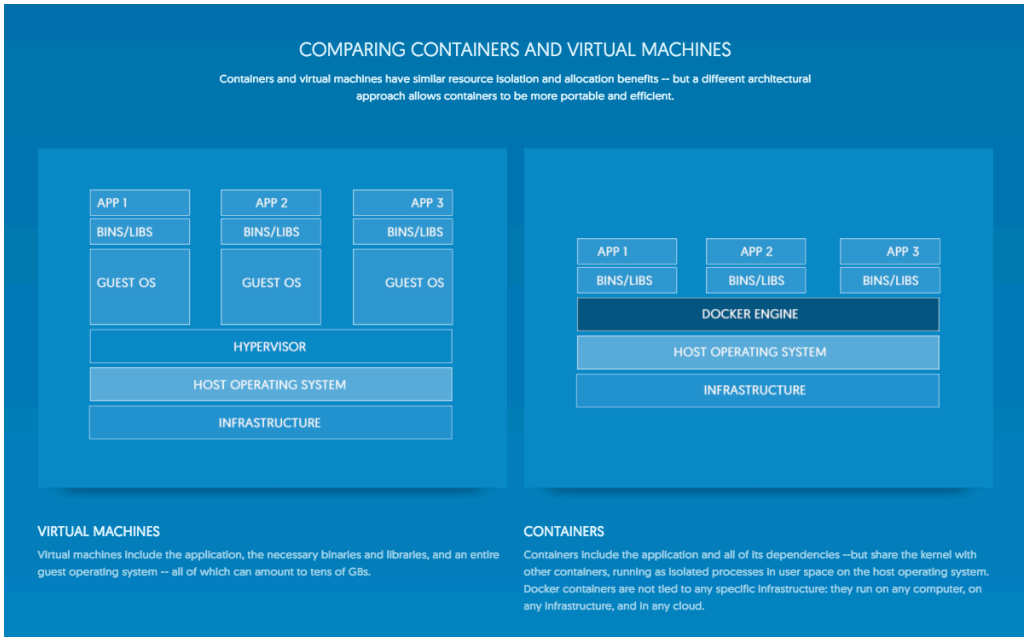
Premanand Achuthan

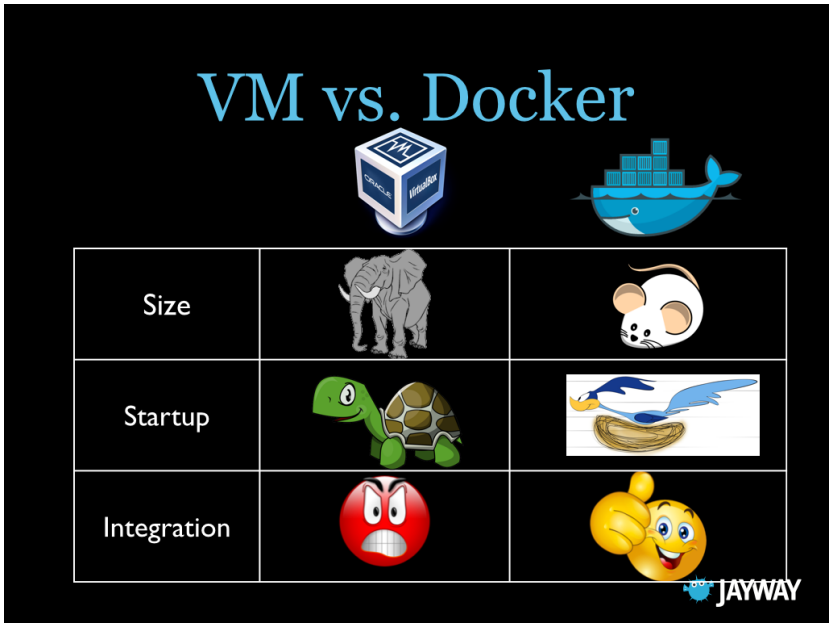
Docker Introduction



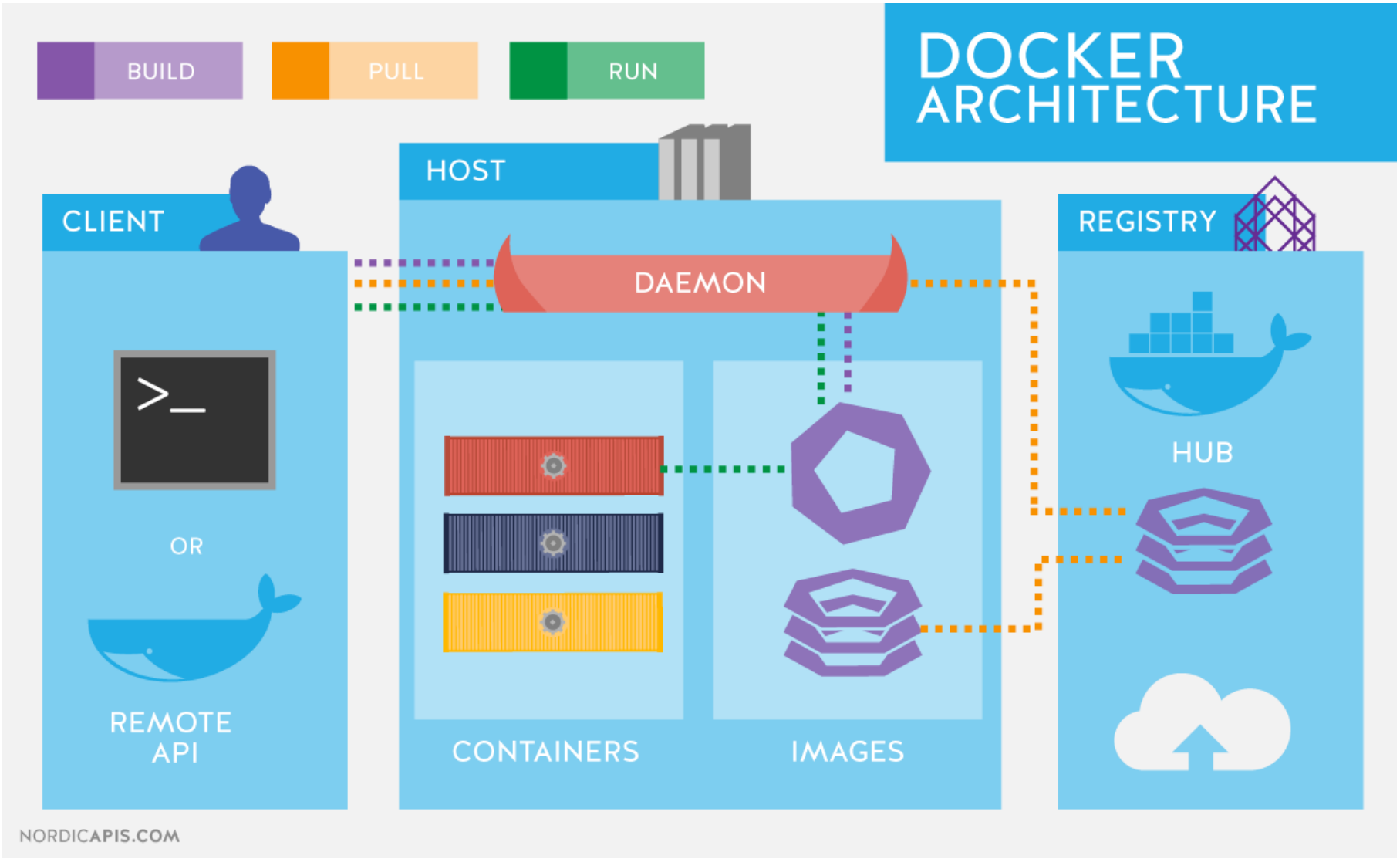


VM vs Docker


COMPARING CONTAINERS AND VIRTUAL MACHINES
Containers and virtual machines have similar resource isolation and allocation benefits -- but a different architectural approach allows containers to be more portable and efficient.
APP 1
BINS/LIBS
GUEST OS
APP 2
BINS/LIBS
GUEST OS
APP 3
BINS/LIBS
GUEST OS
HYPERVISOR
HOST OPERATING SYSTEM
INFRASTRUCTURE
APP 1
BINS/LIBS
APP 2
BINS/LIBS
APP 3
BINS/LIBS
DOCKER ENGINE
HOST OPERATING SYSTEM
INFRASTRUCTURE
VIRTUAL MACHINES
Virtual machines include the application, the necessary binaries and libraries, and an entire guest operating system -- all of which can amount to tens of GBs.
CONTAINERS
Containers include the application and all of its dependencies --but share the kernel with other containers, running as isolated processes in user space on the host operating system. Docker containers are not tied to any specific infrastructure: they run on any computer, on any infrastructure, and in any cloud.

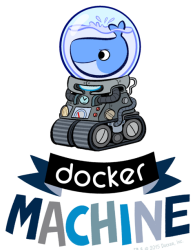

VM vs. Docker
Size
Startup
Integration
JAYWAY

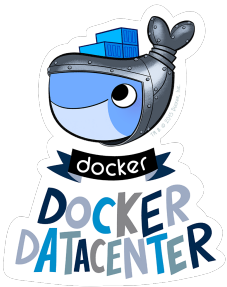
An *image* is a filesystem and parameters to use at runtime.
A *container* is a running instance of an image.



Docker eco-system

docker





Hello world


```
$ docker run ubuntu /bin/echo 'Hello world'

Hello world
```

Hello world ubuntu container

```
$ docker run -t -i ubuntu /bin/bash

root@af8bae53bdd3:/#
```

Interactive container

```
root@af8bae53bdd3:/# pwd

/

root@af8bae53bdd3:/# ls

bin boot dev etc home lib lib64 media mnt opt proc root run sbin srv sys tmp usr var
```

```
$ docker run -d ubuntu /bin/sh -c "while true; do echo hello world; sleep 1; done"

1e5535038e285177d5214659a068137486f96ee5c2e85a4ac52dc83f2ebe4147
```

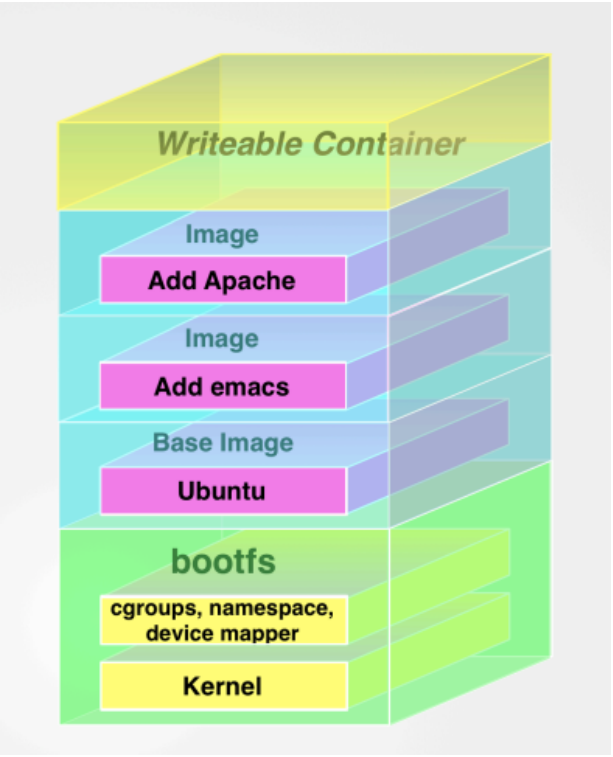
Demonized container

Hello world

An *image* is a filesystem and parameters to use at runtime.
A *container* is a runtime instance of an image.

```
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS               NAMES
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu

aed15891ba52: Pull complete
773ae8583d14: Pull complete
d1d48771f782: Pull complete
cd3d6cd6c0cf: Pull complete
8ff6f8a9120c: Pull complete
Digest: sha256:35bc48a1ca97c3971611dc4662d08d131869daa692acb281c7e9e052924e38b1
Status: Downloaded newer image for ubuntu:latest
Hello world
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
ubuntu              latest              e4415b714b62        7 days ago          128.1 MB
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE               COMMAND                  CREATED             STATUS                      PORTS               NAMES
1c19e1f5129a        ubuntu              "/bin/echo 'Hello wor"   37 seconds ago      Exited (0) 36 seconds ago                       thirsty_leavitt
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
ubuntu              latest              e4415b714b62        7 days ago          128.1 MB
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE               COMMAND                  CREATED             STATUS                      PORTS               NAMES
726baaa18f8e        ubuntu              "/bin/echo 'Hello wor"   5 seconds ago       Exited (0) 4 seconds ago                        hopeful_hawking
34c742d78f14        ubuntu              "/bin/echo 'Hello wor"   9 seconds ago       Exited (0) 8 seconds ago                        awesome_goldwasser
58cb4db5fcb8        ubuntu              "/bin/echo 'Hello wor"   16 seconds ago      Exited (0) 15 seconds ago                       desperate_einstein
e34d66353af7        ubuntu              "/bin/echo 'Hello wor"   3 minutes ago       Exited (0) 3 minutes ago                        infallible_blackwell
1c19e1f5129a        ubuntu              "/bin/echo 'Hello wor"   4 minutes ago       Exited (0) 4 minutes ago                        thirsty_leavitt
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
ubuntu              latest              e4415b714b62        7 days ago          128.1 MB
prem-ml:docker_trials prem$
```

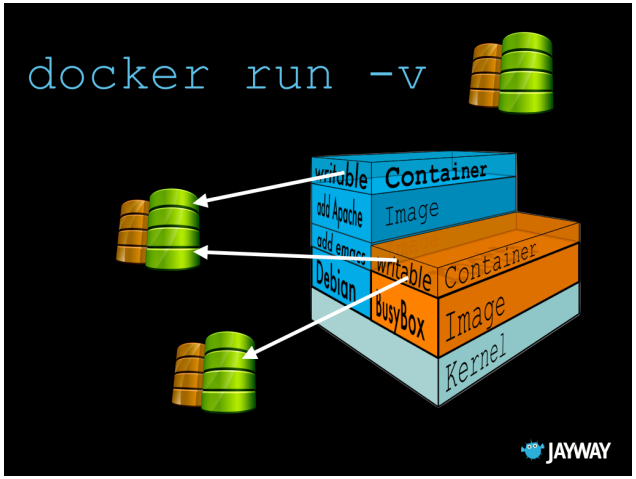


Docker Storage

- Each image is stored as read-only layer
- Each layer of the FS is mounted on top of prior layers
- The first layer is the base image
- The top layer is the only modifiable layer – it's termed the container
- Image and containers are managed by the Docker storage driver. Driver types (e.g. aufs, overlay, vfs, zfs)
- Containers are ephimeral

Persistence achieved through volume:

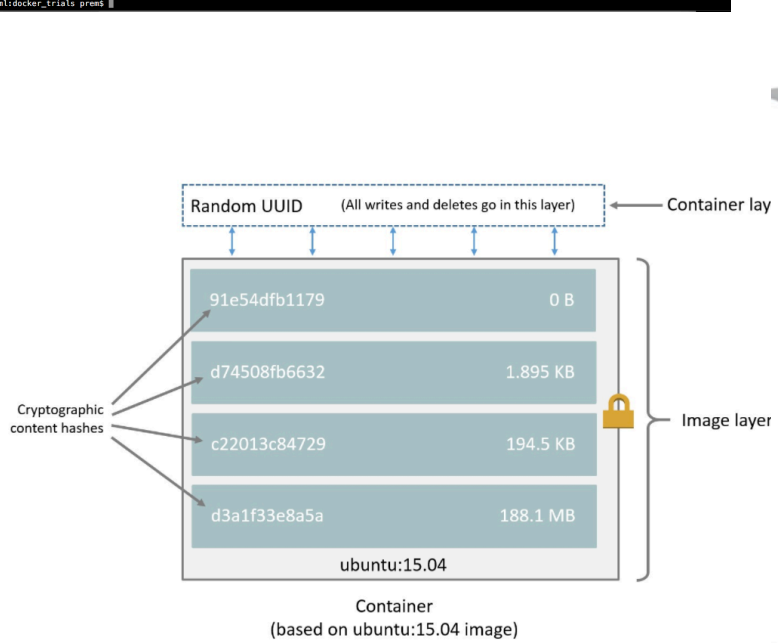
A volume is simply a directory on the Docker host that exists outside of the directory structure managed by the storage driver.

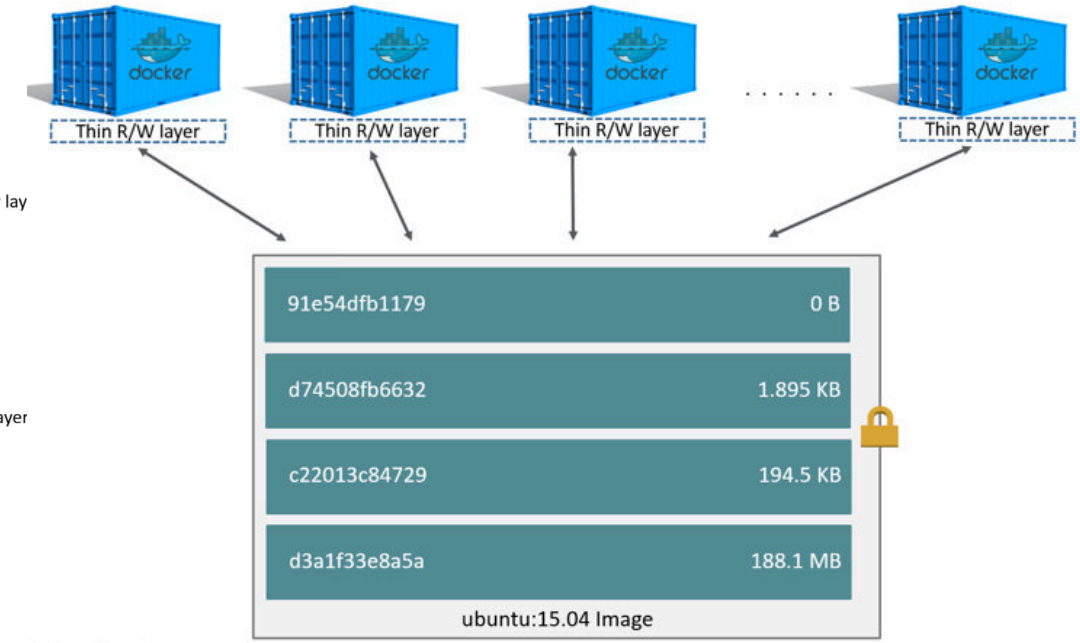


Docker Storage - Copy-on-write (COW)

```
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS               NAMES
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu

aed15891ba52: Pull complete
773ae8583d14: Pull complete
d1d48771f782: Pull complete
cd3d6cd6c0cf: Pull complete
8ff6f8a9120c: Pull complete
Digest: sha256:35bc48a1ca97c3971611dc4662d08d131869daa692acb281c7e9e052924e38b1
Status: Downloaded newer image for ubuntu:latest
Hello world
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
ubuntu              latest              e4415b714b62        7 days ago          128.1 MB
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS                      PORTS               NAMES
1c19e1f5129a        ubuntu              "/bin/echo 'Hello wor"   37 seconds ago      Exited (0) 36 seconds ago                       thirsty_leavitt
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
ubuntu              latest              e4415b714b62        7 days ago          128.1 MB
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker run ubuntu /bin/echo 'Hello world'
Hello world
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS                      PORTS               NAMES
726baaa18f8e        ubuntu              "/bin/echo 'Hello wor"   5 seconds ago       Exited (0) 4 seconds ago                        hopeful_hawking
34c742df8f14        ubuntu              "/bin/echo 'Hello wor"   9 seconds ago       Exited (0) 8 seconds ago                        awesome_goldwasser
58cb40b5fcb8        ubuntu              "/bin/echo 'Hello wor"   16 seconds ago      Exited (0) 15 seconds ago                       desperate_einstein
e34d66353ef7        ubuntu              "/bin/echo 'Hello wor"   3 minutes ago       Exited (0) 3 minutes ago                        infallible_blackwell
1c19e1f5129a        ubuntu              "/bin/echo 'Hello wor"   4 minutes ago       Exited (0) 4 minutes ago                        thirsty_leavitt
prem-ml:docker_trials prem$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
ubuntu              latest              e4415b714b62        7 days ago          128.1 MB
prem-ml:docker_trials prem$
```





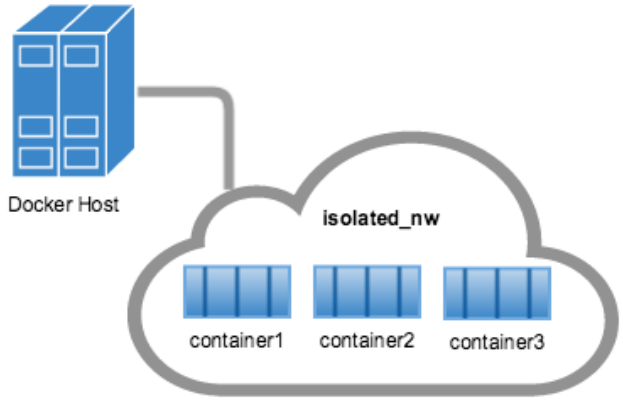
EMBL-EBI

Docker Networking

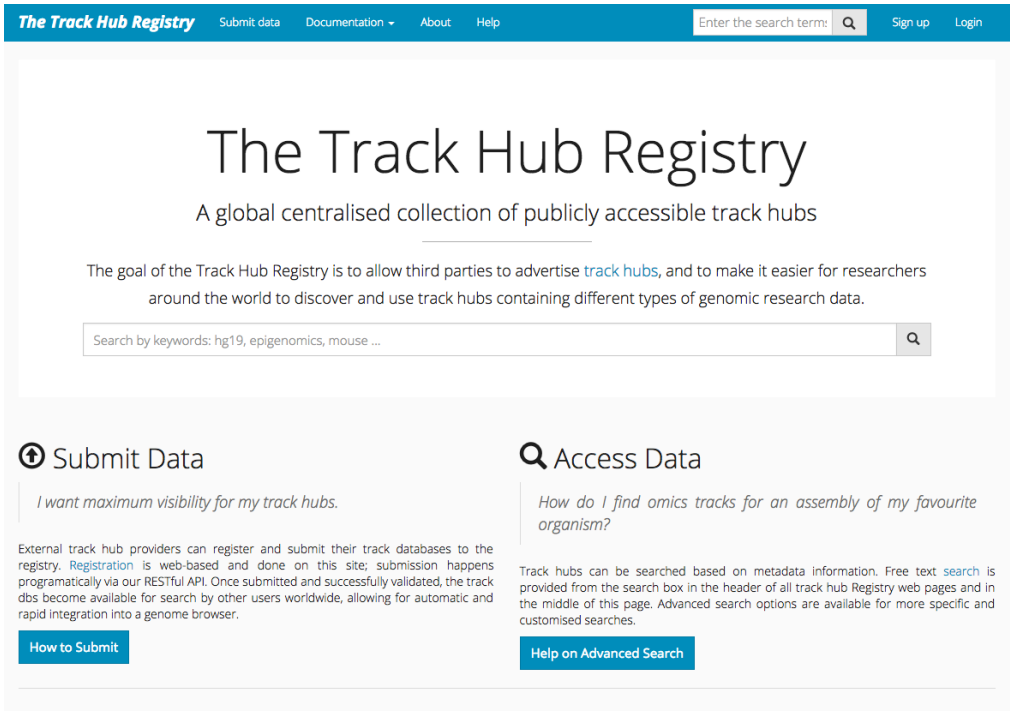
```
docker run --network=isolated_nw -itd --name=container3 busybox
docker run –d –p 80:5000 training/webapp
```

```
trackhub-registry — root@e87446fa0609: / — -bash — 158×45

prem-ml:trackhub-registry prem$ docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
bd465f32c065        bridge              bridge              local
1cbecde81dd6        dockerelk_docker_elk   bridge              local
6da10f79d6d3        dockerthr_default      bridge              local
4c81f446bcaa        host                host                local
245d284d93d9        none                null                local
ff8939ac7a24        thrdocker_default      bridge              local
prem-ml:trackhub-registry prem$ docker network inspect bridge
[
    {
        "Name": "bridge",
        "Id": "bd465f32c0659190e1e04f4a451bf0ef5fe3feea99e19cc47de58faee443e442",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": null,
            "Config": [
                {
                    "Subnet": "172.17.0.0/16",
                    "Gateway": "172.17.0.1"
                }
            ]
        },
        "Internal": false,
        "Containers": {},
        "Options": {
            "com.docker.network.bridge.default_bridge": "true",
            "com.docker.network.bridge.enable_icc": "true",
            "com.docker.network.bridge.enable_ip_masquerade": "true",
            "com.docker.network.bridge.host_binding_ipv4": "0.0.0.0",
            "com.docker.network.bridge.name": "docker0",
            "com.docker.network.driver.mtu": "1500"
        },
        "Labels": {}
    }
]
prem-ml:trackhub-registry prem$
```



Dockerizing THR



Docker Compose - Single Host - multiple services

docker-compose.yml

```yaml
version: '2'
services:
  elasticsearch:
    image: elasticsearch:latest
    ports:
      - "9201:9200"
    volumes:
      - ./elasticsearch/data:/usr/share/elasticsearch/data

```

OFFICIAL REPOSITORY

elasticsearch ☆

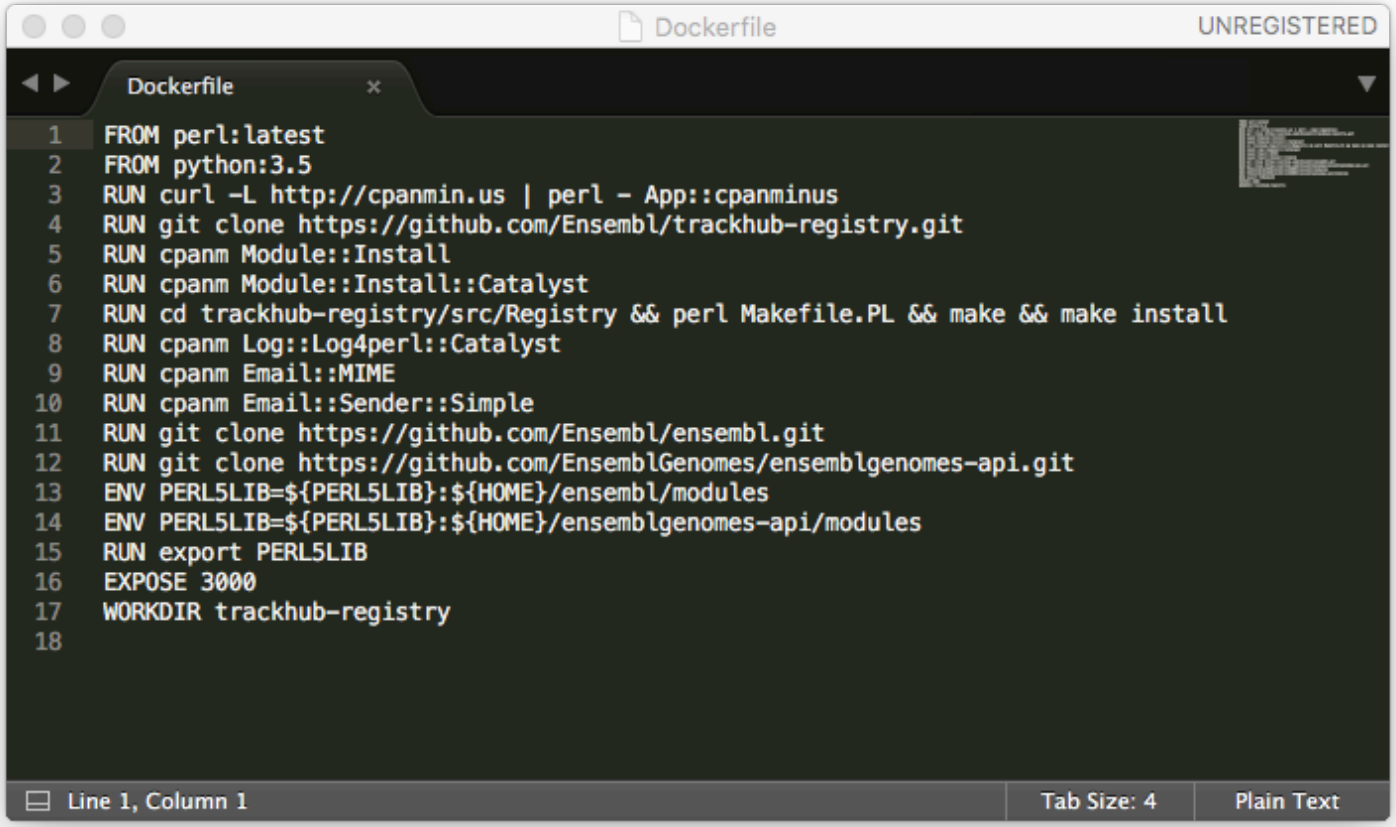
Last pushed: 5 days ago

```
prem-ml:thr_docker prem$ docker-compose up
Starting thrdocker_elasticsearch_1
Attaching to thrdocker_elasticsearch_1
elasticsearch_1  | [2016-11-25T14:23:58,297][INFO ][o.e.n.Node               ] [] initializing ...
elasticsearch_1  | [2016-11-25T14:23:58,582][INFO ][o.e.e.NodeEnvironment    ] [vRQqMjq] using [1] data paths, mounts [[/usr/share/elasticsearch/data (osxfs)]]
, net usable_space [103gb], net total_space [232.6gb], spins? [possibly], types [fuse.osxfs]
elasticsearch_1  | [2016-11-25T14:23:58,583][INFO ][o.e.e.NodeEnvironment    ] [vRQqMjq] heap size [1.9gb], compressed ordinary object pointers [true]
```

```
prem-ml:docker_trials prem$ curl -XGET 'http://prem-ml:9201/_cat/indices?v'
health status index        uuid                   pri rep docs.count docs.deleted store.size pri.store.size
yellow open   test         mZlBP5jqQTOgFTcBfrrbKA   5   1         15            1    259.8kb        259.8kb
yellow open   trackhubs_v1 JOQ4W7vqQnaO8heSIo_oTQ   5   1       3515          508       69mb           69mb
yellow open   users_v1     FUz1bnbfSUahCgzpheAf3A   5   1         34            0     50.7kb         50.7kb
prem-ml:docker_trials prem$ docker ps -a
CONTAINER ID        IMAGE                  COMMAND                  CREATED             STATUS                      PORTS                              NAMES
a8f2b165d10b        elasticsearch:latest   "/docker-entrypoint.s"   55 minutes ago      Up 22 minutes               9300/tcp, 0.0.0.0:9201->9200/tcp   thrdocker_elasticsearch_1
e87446fa0609        ubuntu                 "/bin/bash"              2 hours ago         Exited (0) 2 hours ago                                         sleepy_lalande
726baaa18f8e        ubuntu                 "/bin/echo 'Hello wor"   21 hours ago        Exited (0) 2 hours ago                                         hopeful_hawking
34c742d78f14        ubuntu                 "/bin/echo 'Hello wor"   21 hours ago        Exited (0) 21 hours ago                                        awesome_goldwasser
58cb4db5fcb8        ubuntu                 "/bin/echo 'Hello wor"   21 hours ago        Exited (0) 21 hours ago                                        desperate_einstein
e34d66353af7        ubuntu                 "/bin/echo 'Hello wor"   21 hours ago        Exited (0) 21 hours ago                                        infallible_blackwell
1c19e1f5129a        ubuntu                 "/bin/echo 'Hello wor"   21 hours ago        Exited (0) 21 hours ago                                        thirsty_leavitt
prem-ml:docker_trials prem$ docker exec -it thrdocker_elasticsearch_1 bash
root@a8f2b165d10b:/usr/share/elasticsearch# curl -XGET 'http://localhost:9200/_cat/indices?v'
health status index        uuid                   pri rep docs.count docs.deleted store.size pri.store.size
yellow open   test         mZlBP5jqQTOgFTcBfrrbKA   5   1         15            1    259.8kb        259.8kb
yellow open   trackhubs_v1 JOQ4W7vqQnaO8heSIo_oTQ   5   1       3515          508       69mb           69mb
yellow open   users_v1     FUz1bnbfSUahCgzpheAf3A   5   1         34            0     50.7kb         50.7kb
```

Dockerfile - THR

A Dockerfile is a text document that contains all the commands you would normally execute manually in order to build a Docker image




```
docker build -t prem/thr_master_docker .
```

Docker-compose (THR + elastic)

docker-compose.yml

```yaml
version: '2'
services:
  thr_registy:
    image: prem/thr_master_docker:latest
    ports:
      - "3000:3000"
    links:
      - elasticsearch
    entrypoint: sh /usr/src/app/entrypoint.sh
    volumes:
      - /usr/src/app/thregistry
      - ./thregistry/entrypoint.sh:/usr/src/app/entrypoint.sh
      - ./thregistry/registry.conf:/trackhub-registry/src/Registry/registry.conf
      - ./thregistry/registry_testing.conf:/trackhub-registry/src/Registry/registry_testing.conf
  elasticsearch:
    image: elasticsearch:1.7.6
    command: elasticsearch -Des.network.host=0.0.0.0
    ports:
      - "9200:9200"
      - "9300:9300"
    volumes:
      - ./elasticsearch_1_7/data:/usr/share/elasticsearch/data
    container_name: es_thr_17
```

entrypoint.sh
./src/Registry/script/registry_server.pl


DEMO

Development to Production

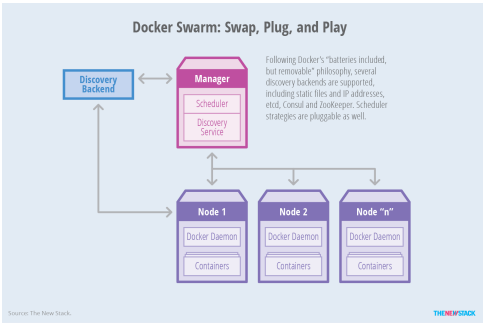
Requirements

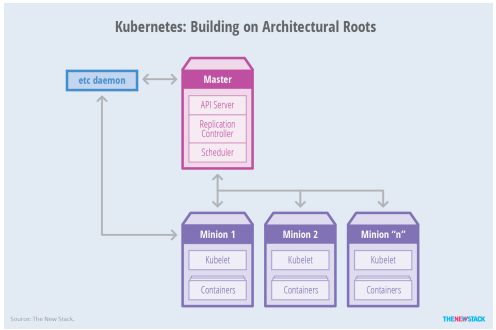
- Developer set up as identically to production as possible.
- A complete flow from developer laptop to staging and production.

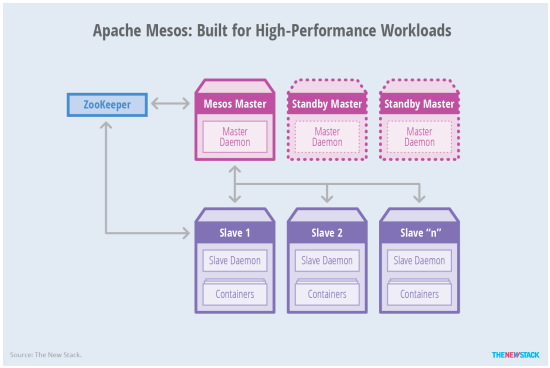
Challenges:

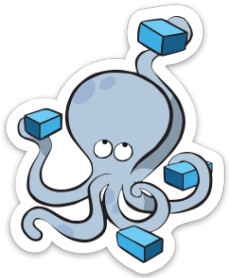
- Image management : Continuous deployment pipeline – code commit to Docker image to Docker compose
- Container's root user and Docker host's root user
- Cluster provisioning
- Service Discovery
- Network Access and Security
- Load Balancing across containers and hosts
- Managing differences in volume bindings, port binding, logs etc.,
- Container monitoring

Orchestration

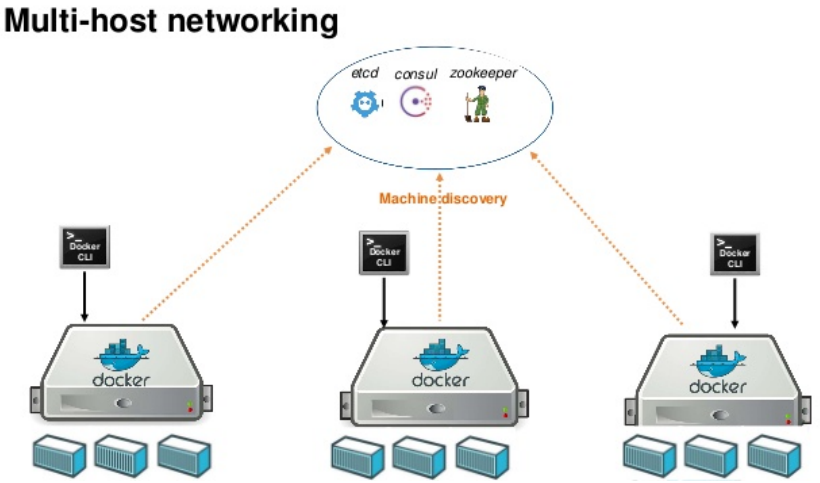








Service Discovery



Conclusion

Challenges:

Deployment into production requires some effort initially

Container management, networking, security etc.,

Other tools are needed for large workflow automation.

Benefits:

Better deployment strategy

Breakdown monolithic application to tiny single-minded applications

Portable – Multi-cloud platform deployment

Reusable components

Continuous Deployment and Testing

Public registry for sharing containers

Rapidly growing Docker container ecosystem


Thank
You