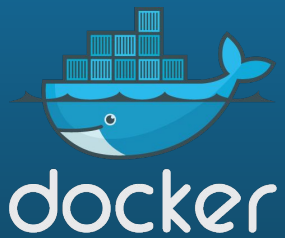
Docker Accredited Consultant MTA Enablement Workshop

October 2017
v17.06



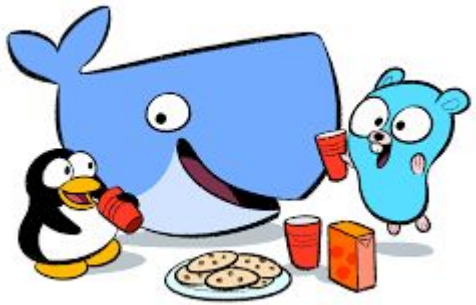
DAC Enablement Workshop

Format:

- Interactive
- Very hands-on, Tech heavy
- Focus on Design Best Practices and Architecture
- 4 Labs (Team)
- Discussion and questions encouraged!

Goals!

- Understand the MTA program
- Become enabled to deliver MTA POCs
- Go deeper into Docker Enterprise Edition(EE)
- Understand EE design and architecture best practices
- Have fun doing all the above :)



docker

Additional Resources

- training.play-with-docker.com
- github.com/docker/labs
- success.docker.com

Agenda

Day 1

- About this Workshop
- MTA Introduction
- MTA POC
  - Foundations
  - Roles & Responsibilities
  - Methodology & Tooling
- Hands-on Lab
- Wrap-Up

Agenda

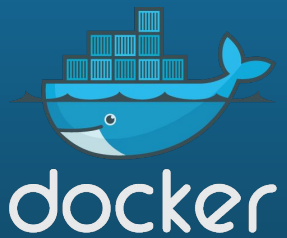
Day 2

- Introductions and Setup (9:00 - 9:15)
- Docker EE Basic Deep Dive(9:15-11)
  - Orchestration (30 mins)
  - Networking (30 mins)
  - Break (5 mins)
  - Security (30 mins)
  - Logging (10 mins)
- Swarm Lab (11:00- 12:00)
- Lunch (12:00-1:00)
- UCP Deep Dive (UCP) (1:00-2:00)
- UCP Lab (2:00-3:00)
- Break (3:00-3:15)
- DTR Deep Dive (3:15-4:15)
- DTR Lab (4:15-5:00)

Day 3

- Application Deployment Deep Dive (9:00-9:45)
- Application Deployment Lab (9:45-11:00)

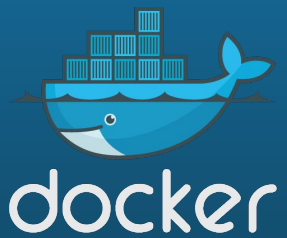
Docker Enterprise Edition Basics



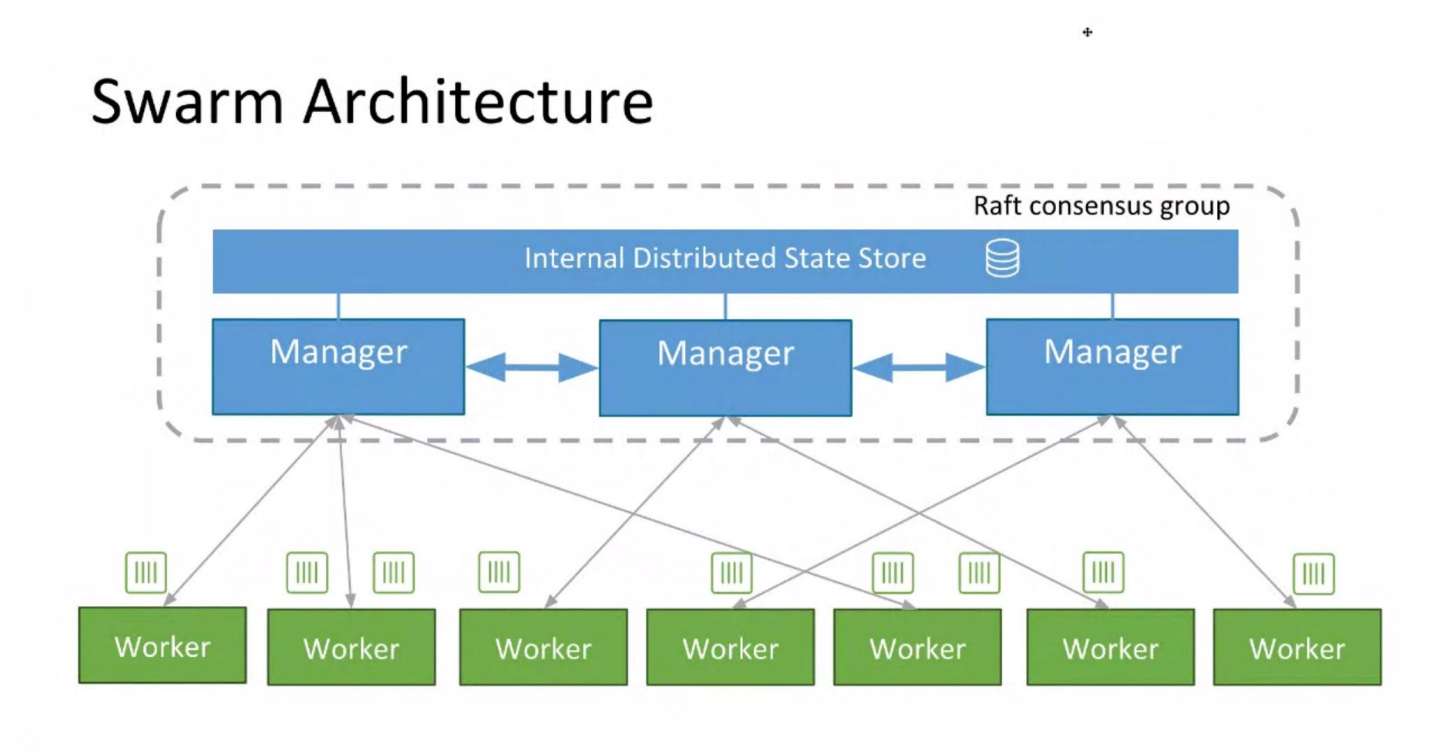
Docker EE Basic Deep Dives

- **Orchestration (30 mins)**
- **Networking (30 mins)**
- **Security(30 mins)**
- **Logging (15 mins)**

Orchestration



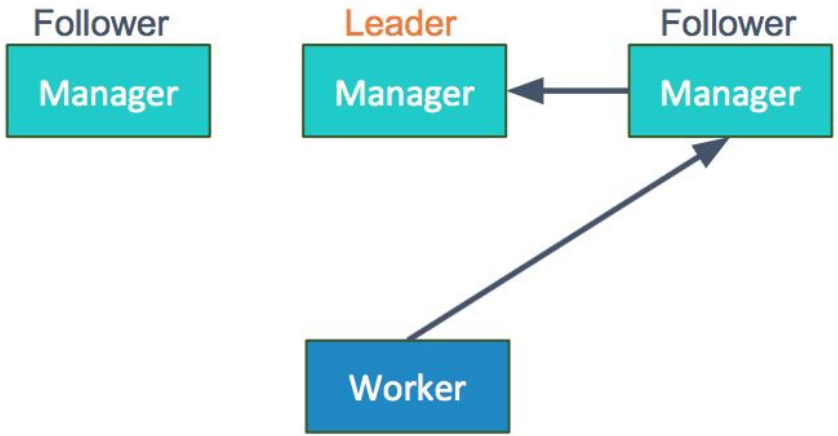
Swarm Architecture



Swarm High Availability

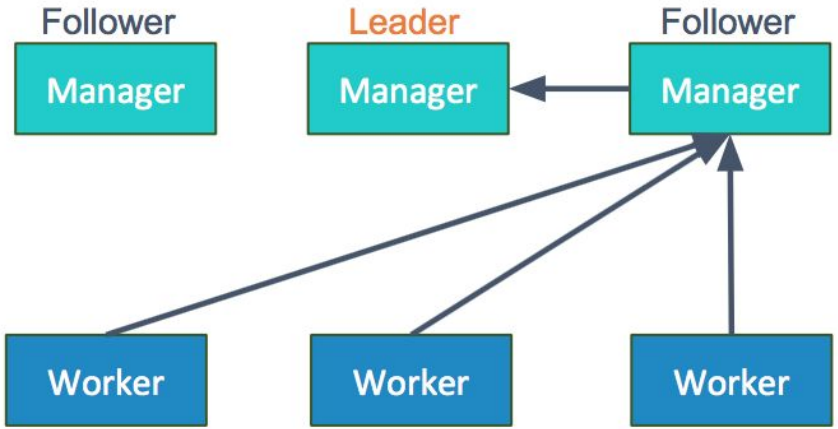
Controller and replicas	Failures tolerated
1	0
3	1
5	2
7	3

Swarm Workers and Managers



- **Worker** can connect to any **Manager**
- **Followers** will forward traffic to the **Leader**

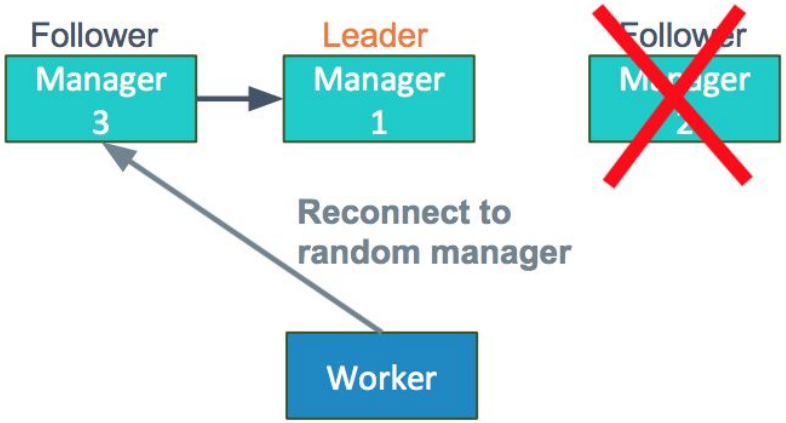
Swarm Workers and Managers



- **Followers** multiplex all **workers** to the **Leader** using a single connection
- Backed by **gRPC** channels (HTTP/2 streams)
- Reduces **Leader** networking load by spreading the connections evenly

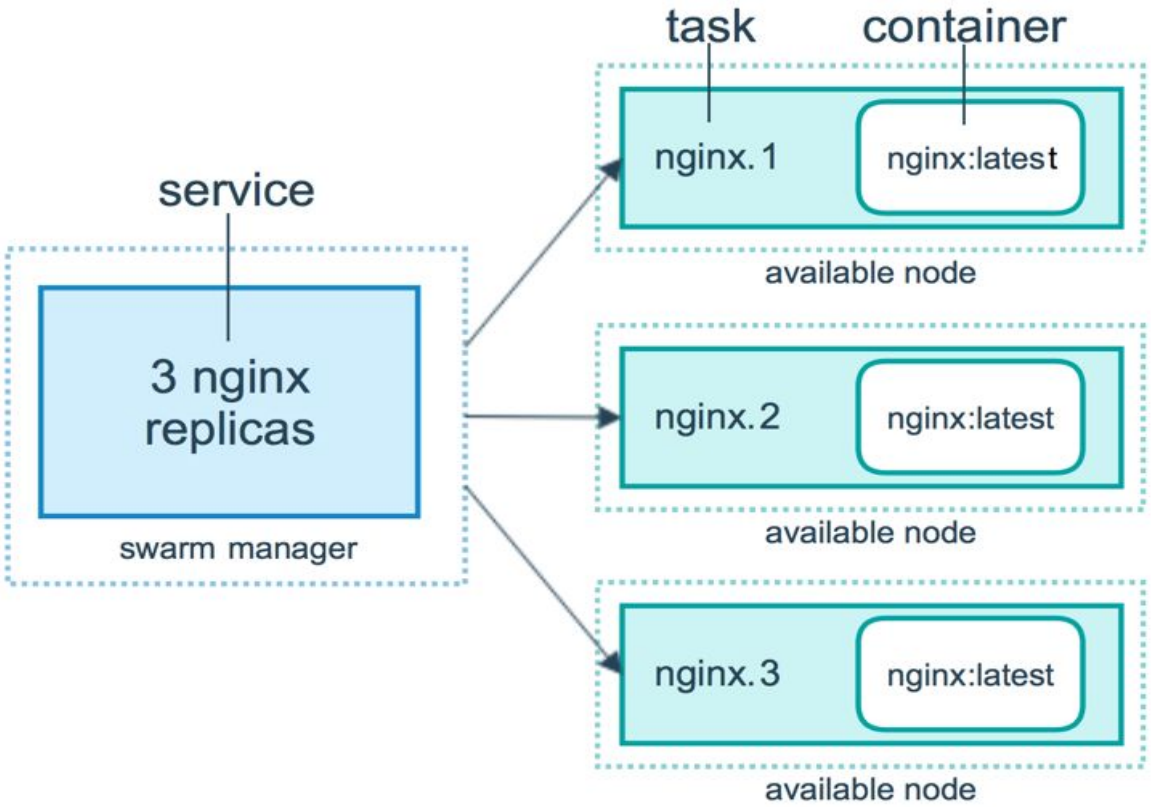
Example: On a cluster with 10,000 workers and 5 managers, each will only have to handle about 2,000 connections. Each follower will forward its 2,000 workers using a single socket to the leader.

Swarm Workers and Managers



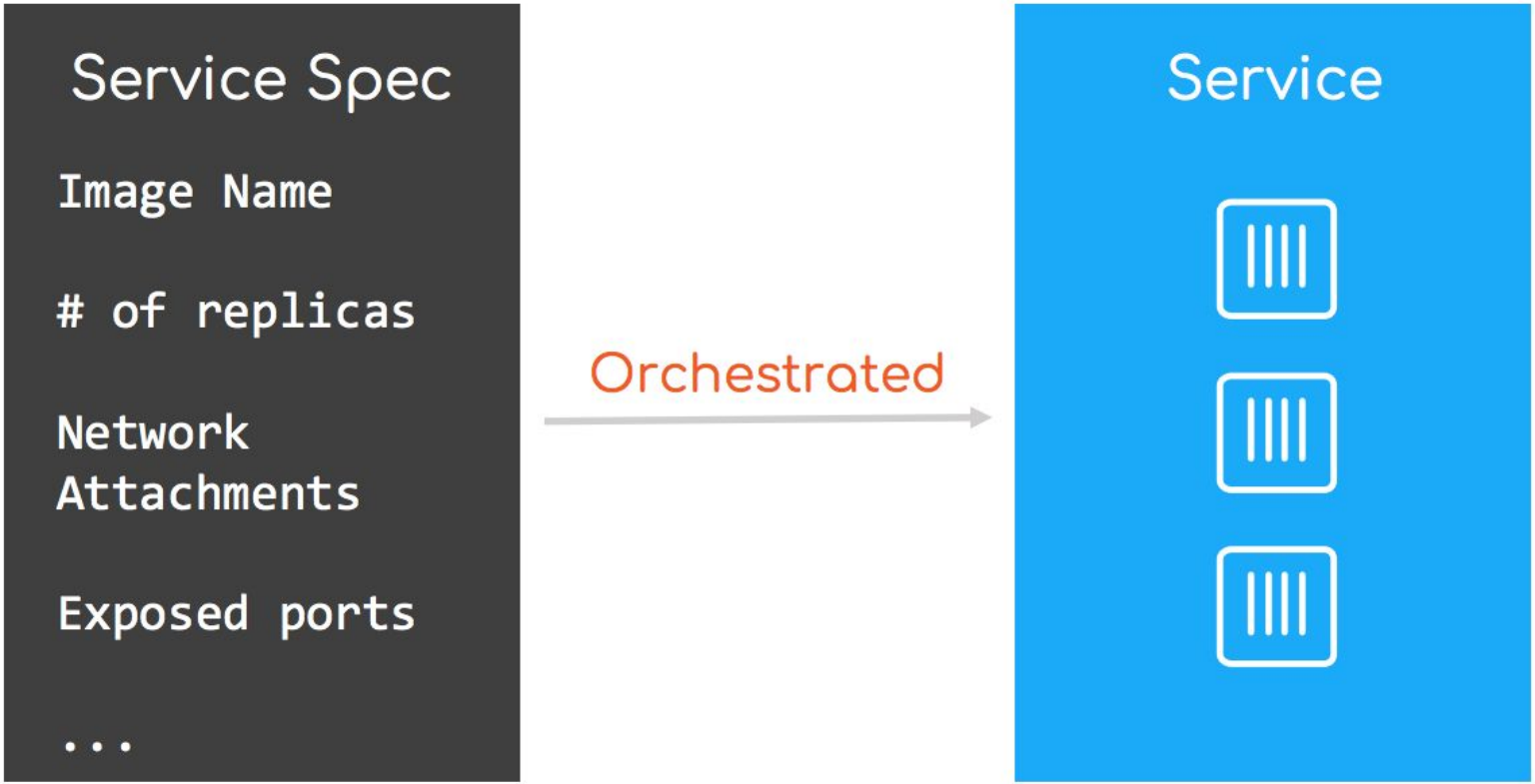
- **Manager** sends list of all managers' addresses to Workers
- When a new manager joins, all workers are notified
- Upon manager failure, workers will reconnect to a different manager

Docker Tasks: Atomic Unit of Orchestration

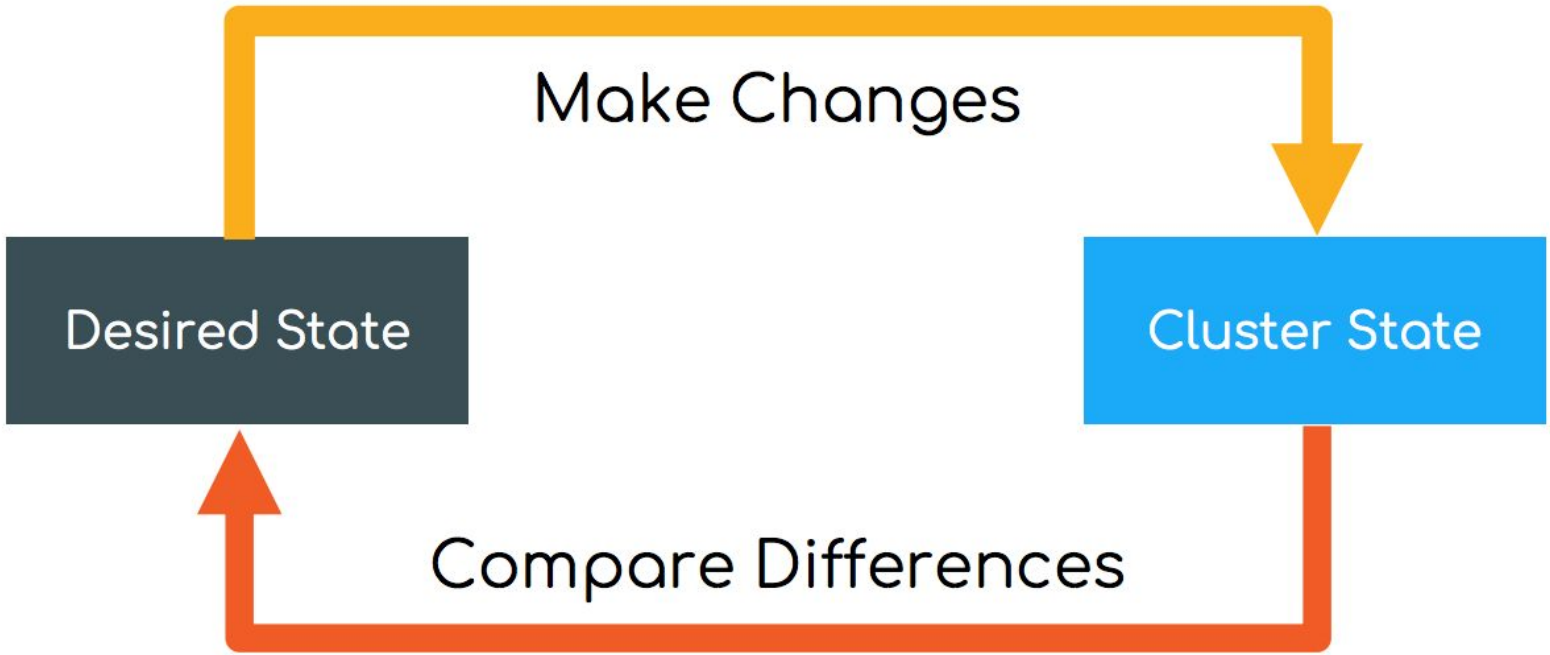


docker

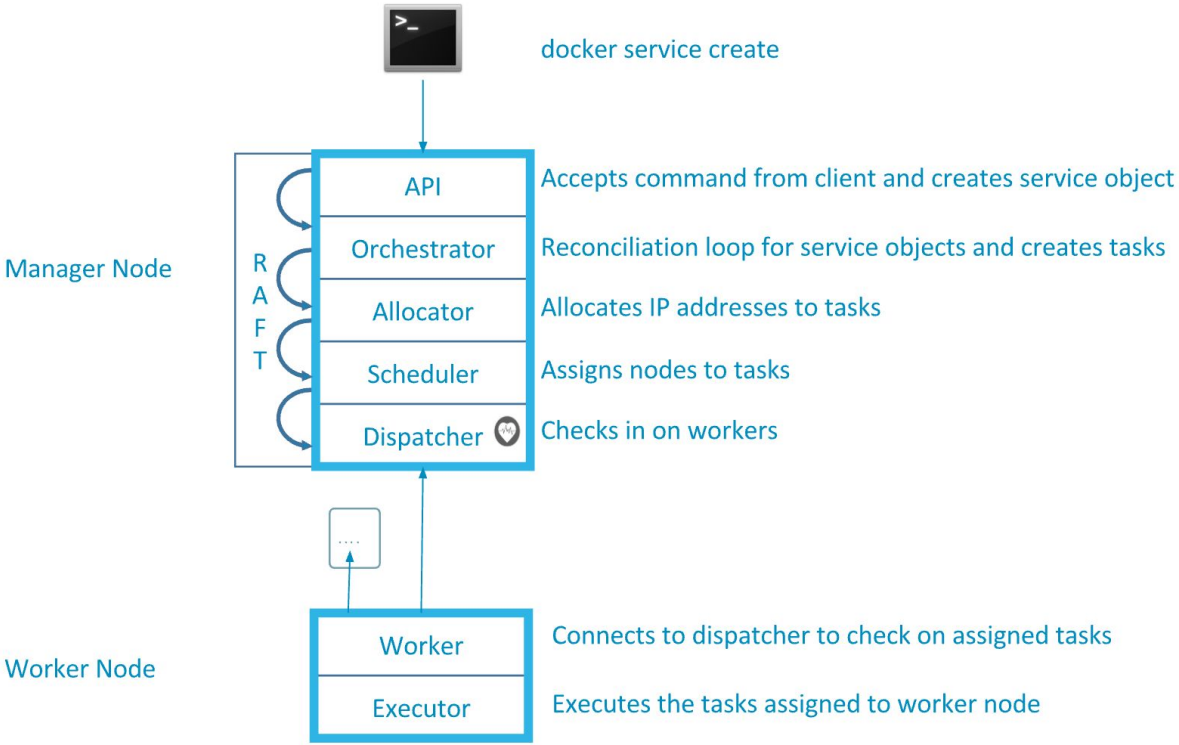
Docker Services



Task Lifecycle Management



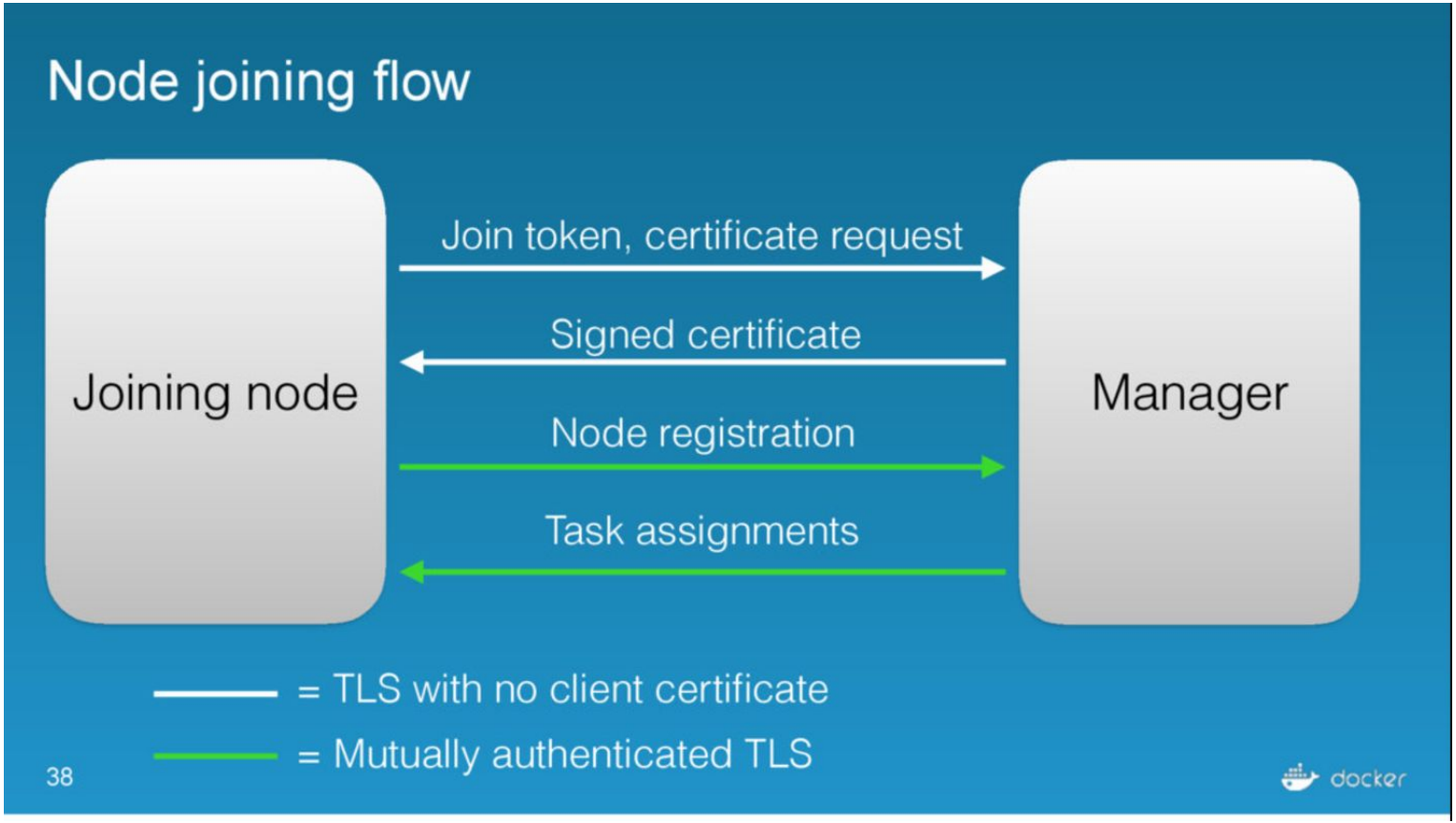
Task State - (docker service ps <service>)



Security Model

- All Swarm connections are encrypted with TLS by default (no way to disable it!)
- Each node is identified by its certificate (CN = node ID)
- By default, each manager acts as a CA with same key
- Join token used to authenticate to obtain cert
- Join token includes digest of root cert to secure against MITM
- Can rotate join tokens to revoke older ones
- Automatically renew certificates (every 90 days)

Node Join Operation



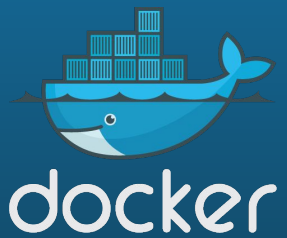
Swarm Certificates

```
## Swarm Manager Node


$ openssl x509 -noout -text -in swarm-node.crt | grep 'Subject\|Issuer'
        Issuer: CN=swarm-ca
        Subject: O=jbwjyw1e8p2g97g4szuoi5q1j, OU=swarm-manager, CN=unctml1t6jsrnd7v2b9cnohsm
        Subject Public Key Info:
            X509v3 Subject Key Identifier:
            X509v3 Subject Alternative Name:

## Swarm Worker Node

$ openssl x509 -noout -text -in swarm-node.crt | grep 'Subject\|Issuer'
        Issuer: CN=swarm-ca
        Subject: O=jbwjyw1e8p2g97g4szuoi5q1j, OU=swarm-worker, CN=ttj80hvbbjo1ny5g1kye3g5le
        Subject Public Key Info:
            X509v3 Subject Key Identifier:
            X509v3 Subject Alternative Name:
```

Managing Swarm Nodes

```
$ docker swarm init
$ docker swarm join-token worker|manager
$ docker swarm join
$ docker node ls
$ docker node inspect
$ docker swarm leave
$ docker node remove
```

Docker Networking



Docker Networking Design Philosophy

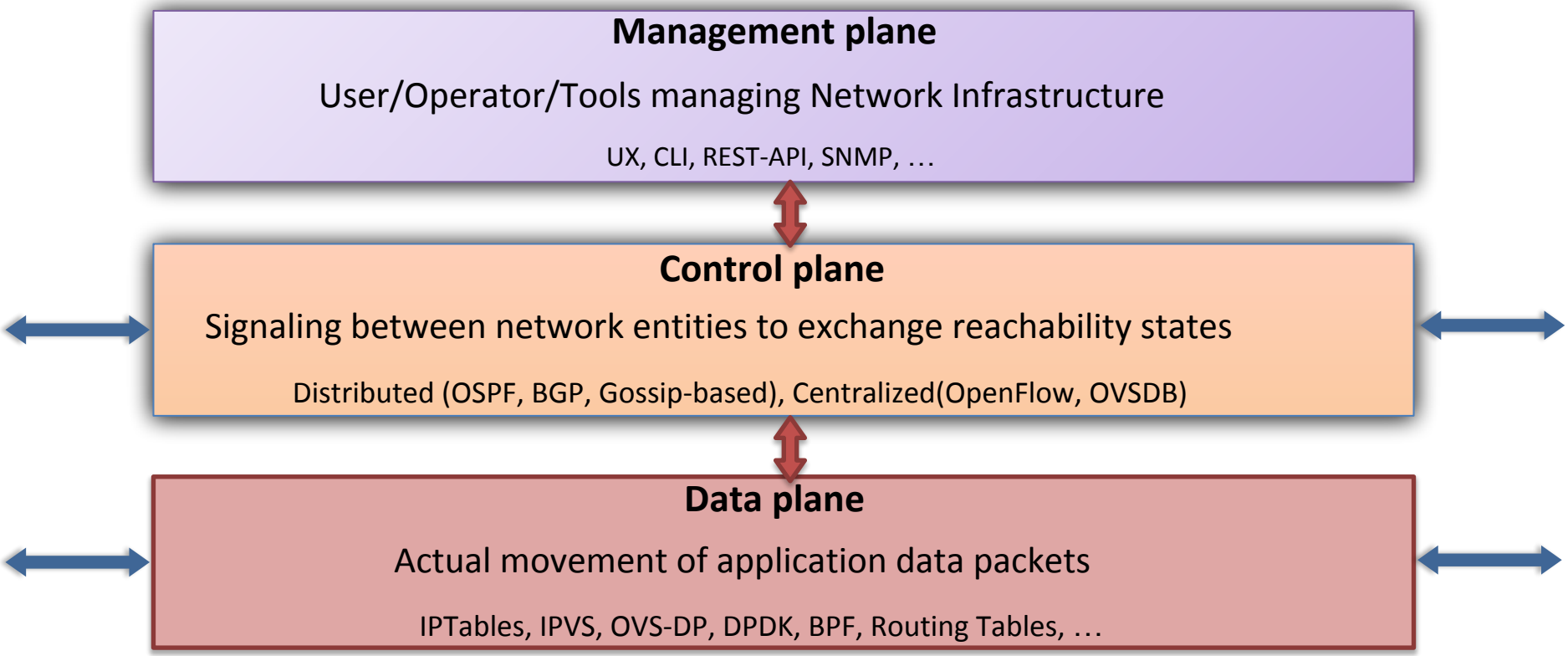
Portability

Consistent behavior of applications in different networking environments.

Extensibility

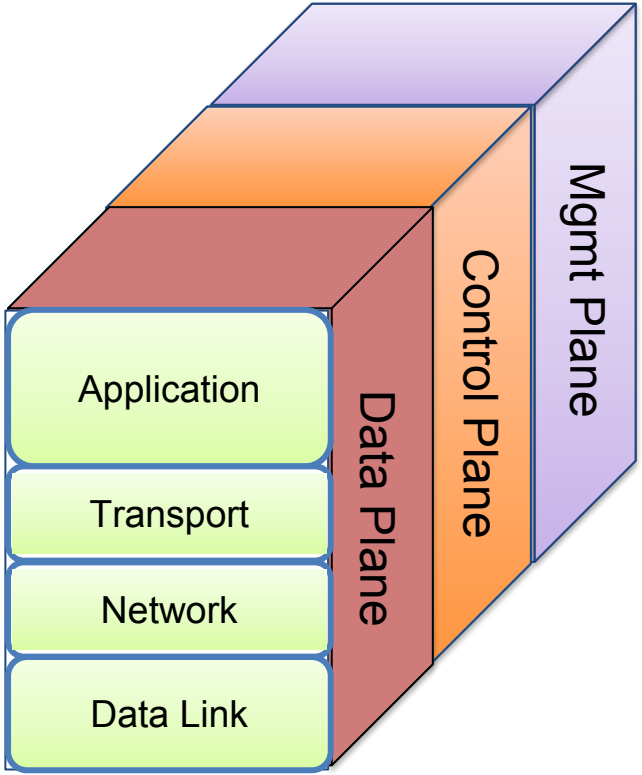
Batteries included but swappable with Plugin API Design

Networking Planes

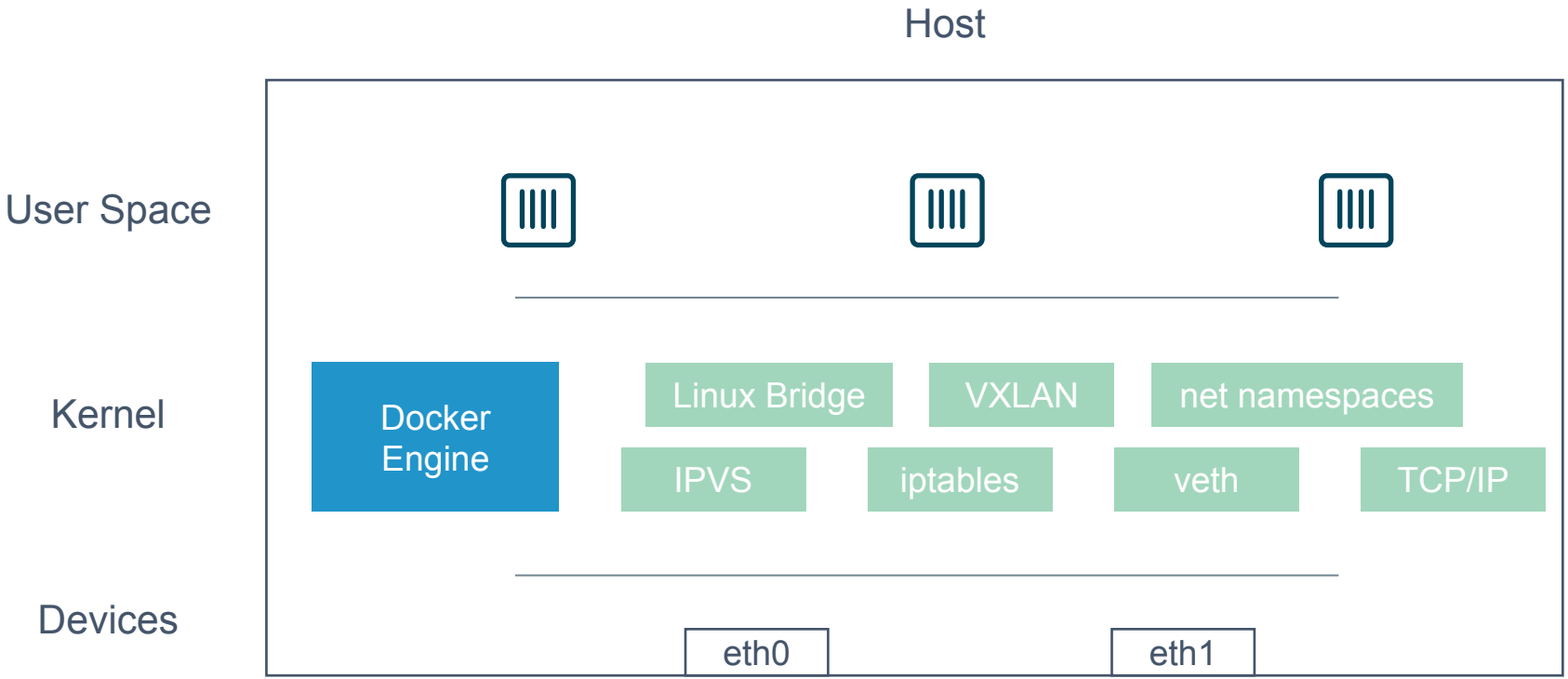


Docker networking

- Provides portable application services
  - Service-Discovery
  - Load-Balancing
- Built-in and pluggable network drivers
  - Overlay, macvlan, bridge
  - Remote Drivers / Plugins
- Built-in Management plane
  - API, CLI
  - Docker Stack / Compose
- Built-in distributed control plane
  - Gossip based
- Encrypted Control & Data plane



Docker Networking *is* Linux (and Windows) Networking



Docker Networking on Linux and Windows

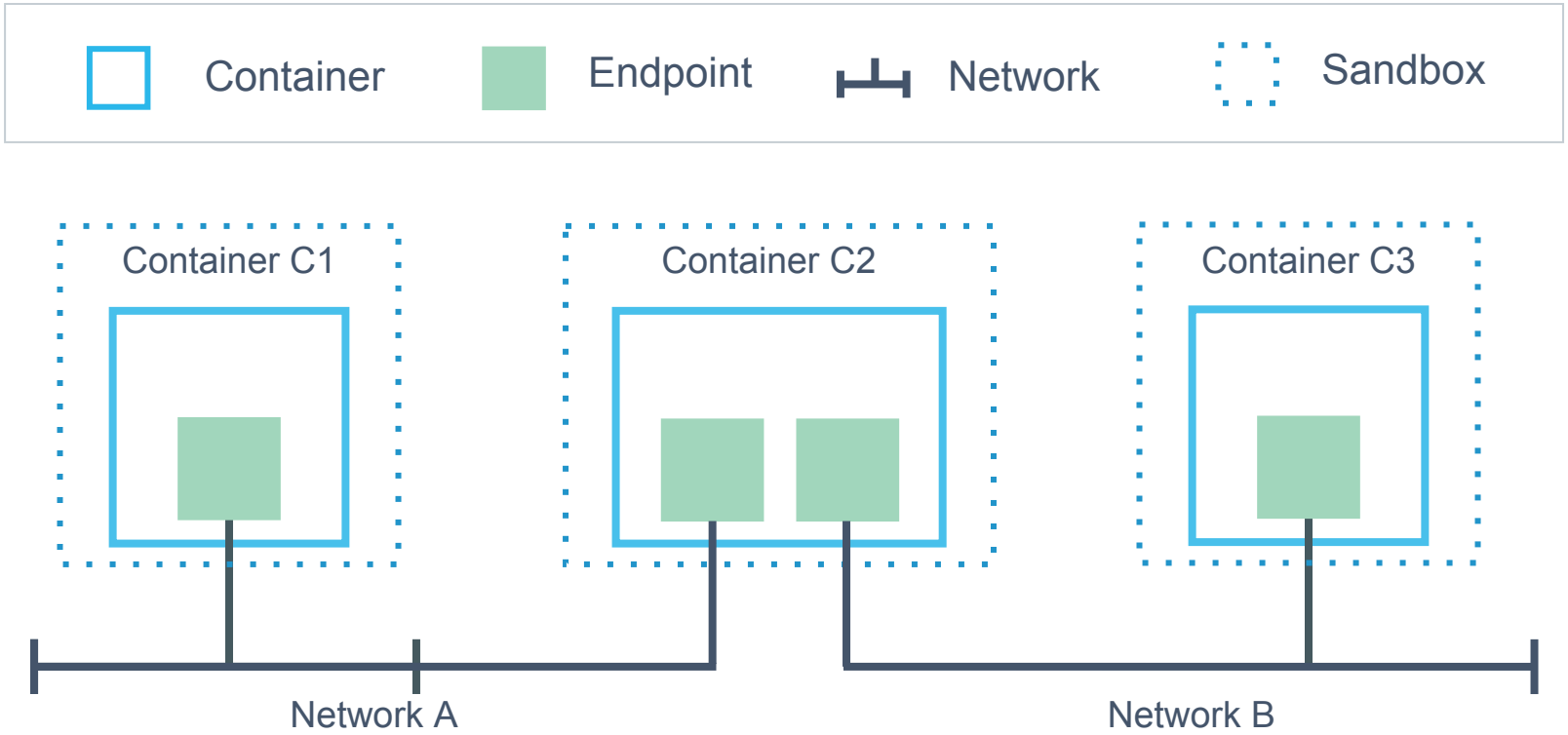
Linux

- Network Namespace
- Linux Bridge
- Virtual Ethernet Devices
- IP Tables

Windows

- Network Compartments
- VSwitch
- Virtual nics
- Firewall & VFP Rules

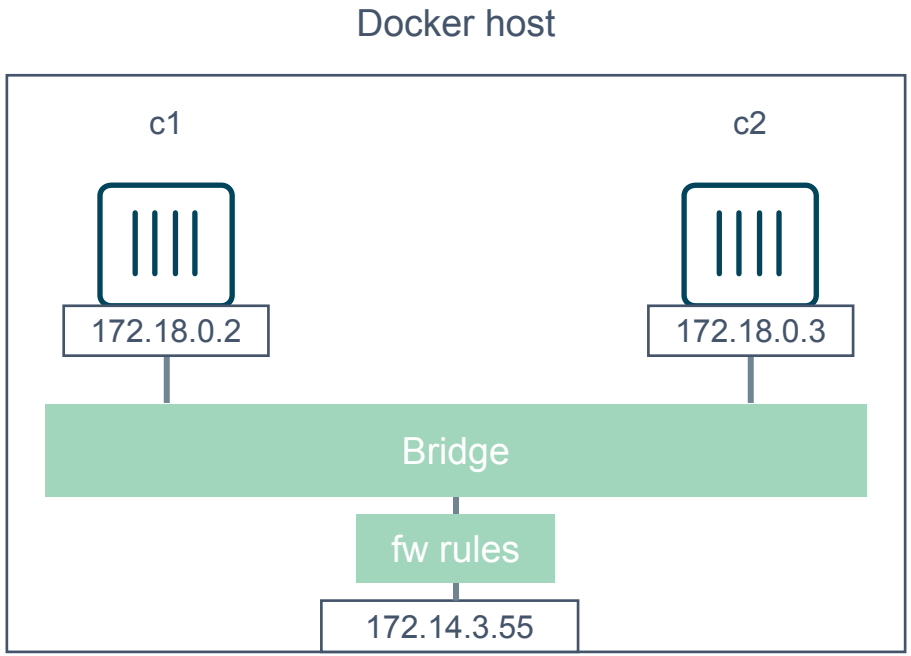
Containers and the CNM



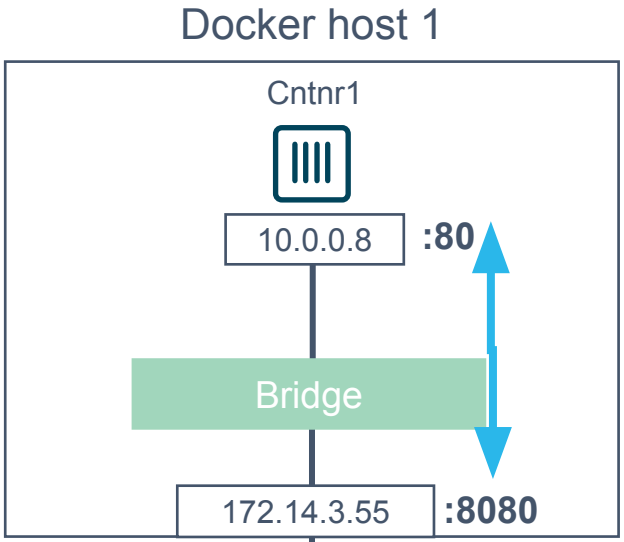
Native Docker Networking Drivers

```
$ docker info

…

Plugins:
 Volume: local
 Network: bridge host ipvlan macvlan null overlay

…
```

Using Docker Networks



Docker Bridge Networking and Port Mapping



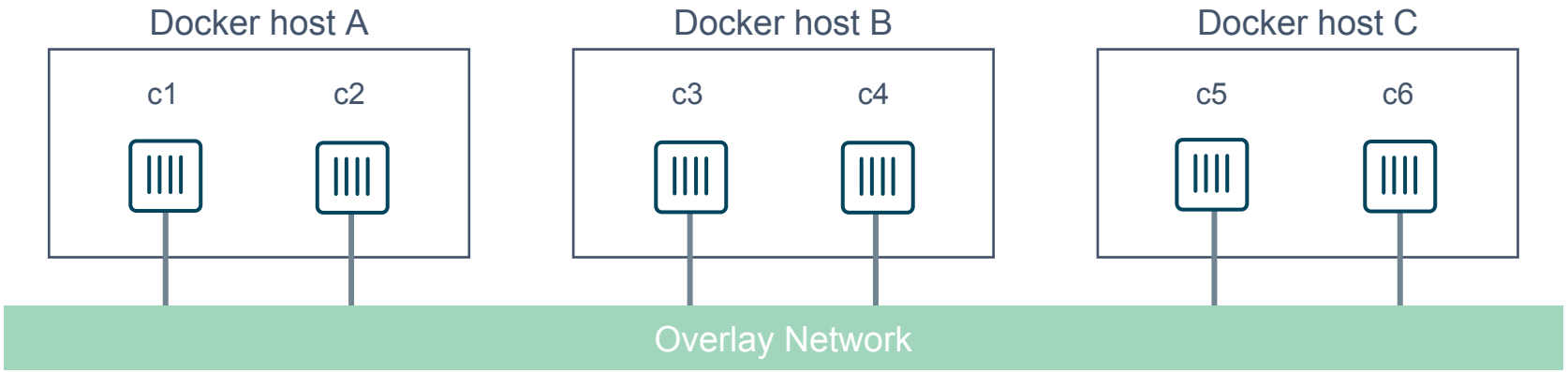
Host port

Container port

```
$ docker run -p 8080:80 ...
```

What is Docker Overlay Networking?

The **overlay** driver enables simple and secure **multi-host** networking

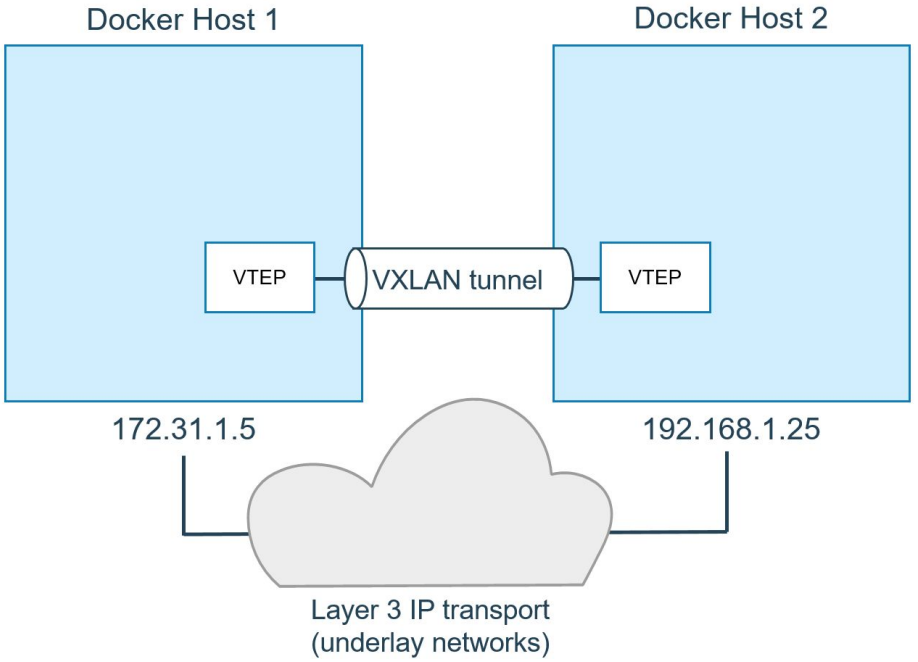


All containers on the **overlay** network can communicate!

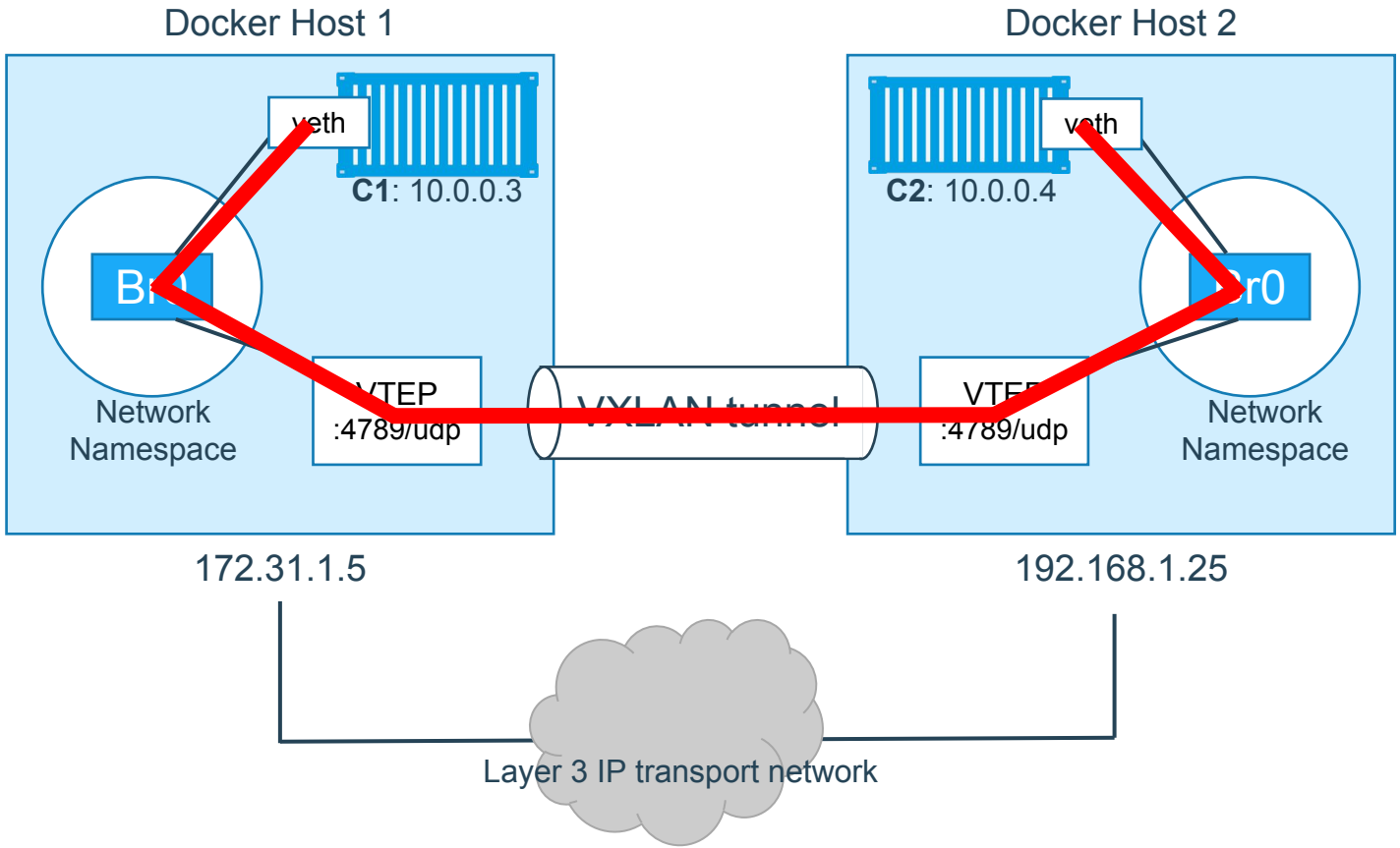
VXLAN

- The **overlay** driver uses VXLAN technology
- A **VXLAN tunnel** is created on top of **underlay network(s)**
- At each end of the tunnel is a VXLAN tunnel end point (**VTEP**)
- The **VTEP** performs encapsulation and de-encapsulation
- The **VTEP** exists in the Docker Host's network namespace

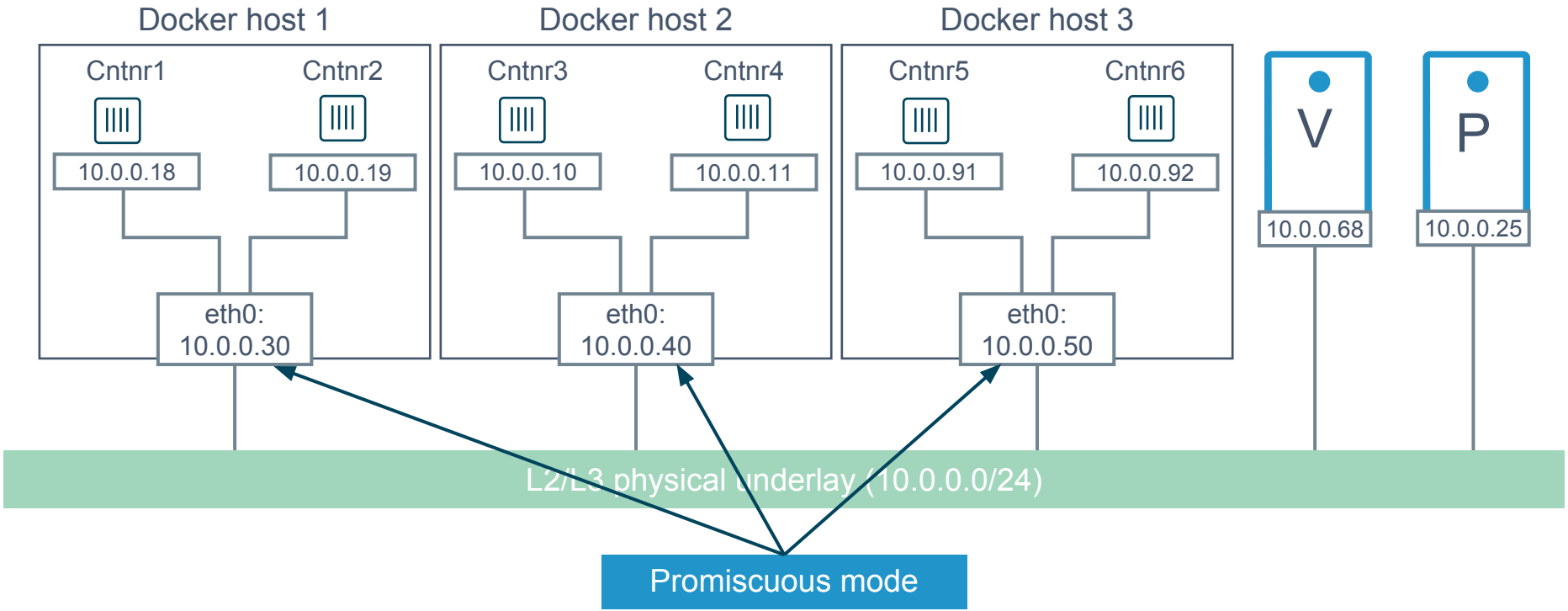
Docker Overlay Driver



Docker Overlay in Detail



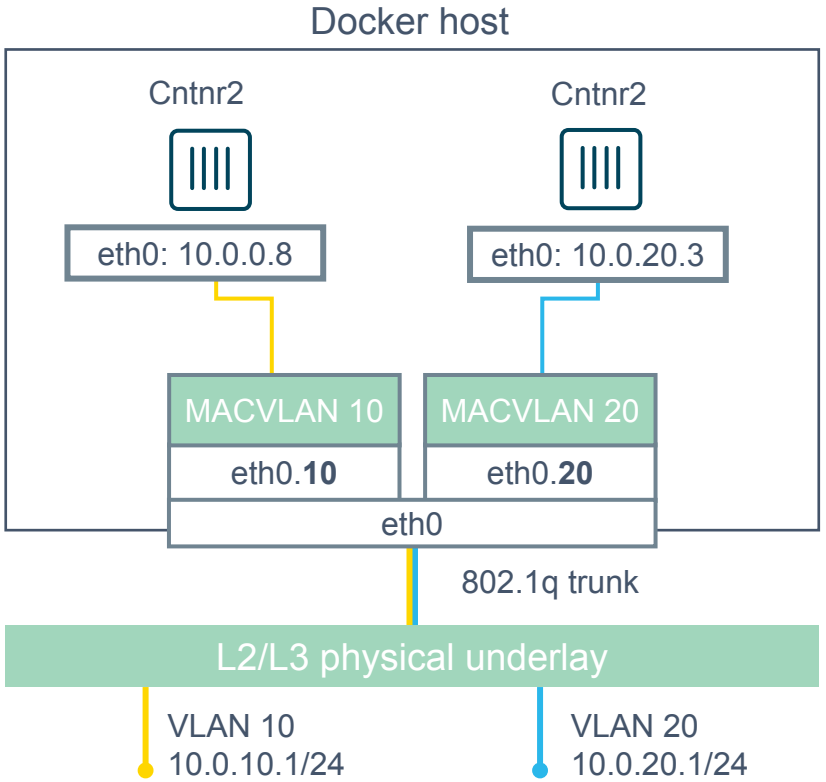
MACVLAN Driver (single VLAN, no subinterface)



NOTE: Many cloud providers don't currently support promiscuous mode

MACVLAN Driver (sub-interfaces, VLAN Trunks)

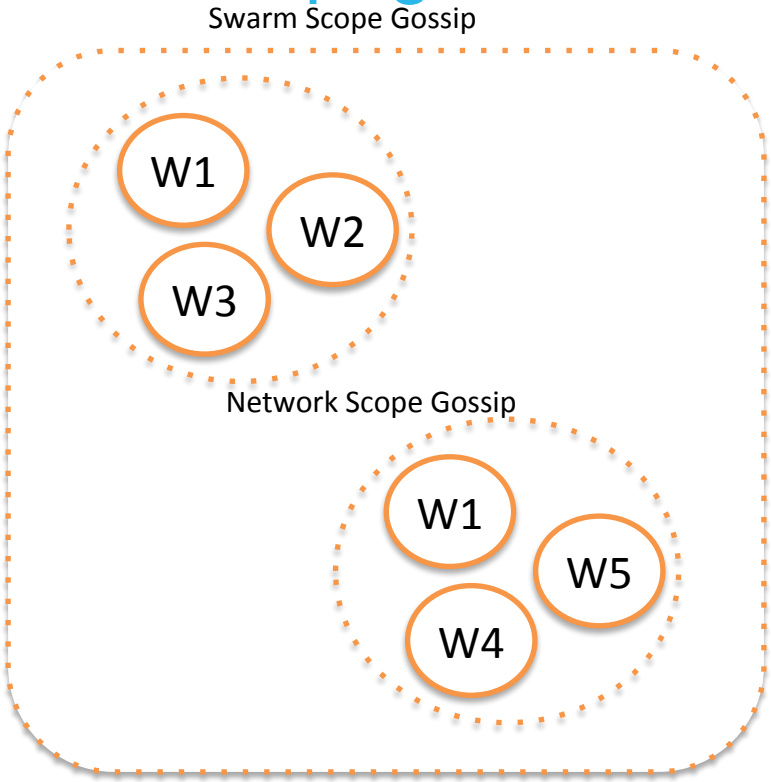
- MACVLAN uses **sub-interfaces** to process 802.1Q VLAN tags.
- In this example, two sub-interfaces are used to enable two separate VLANs
- Yellow lines represent VLAN 10
- Blue lines represent VLAN 20



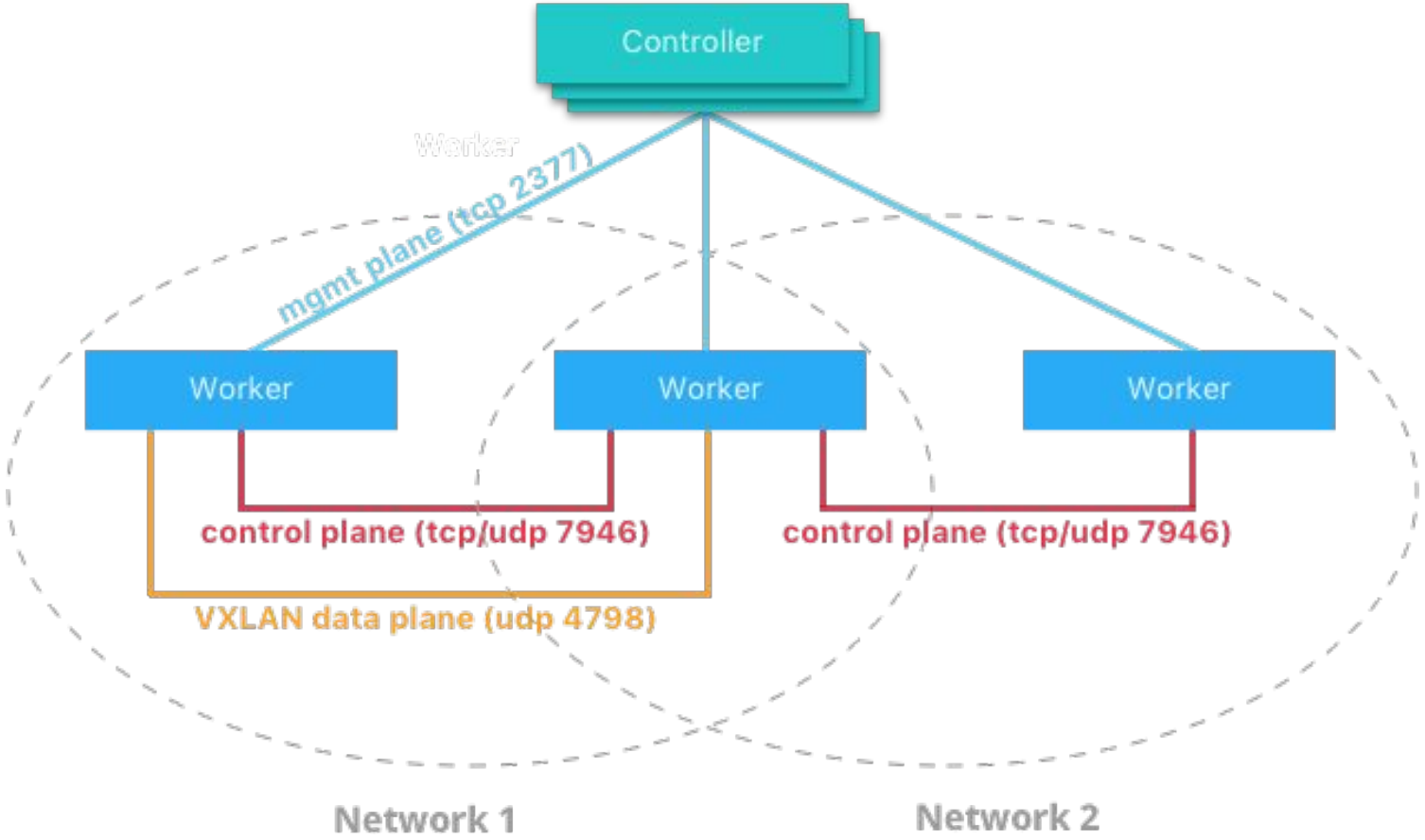
Gossip

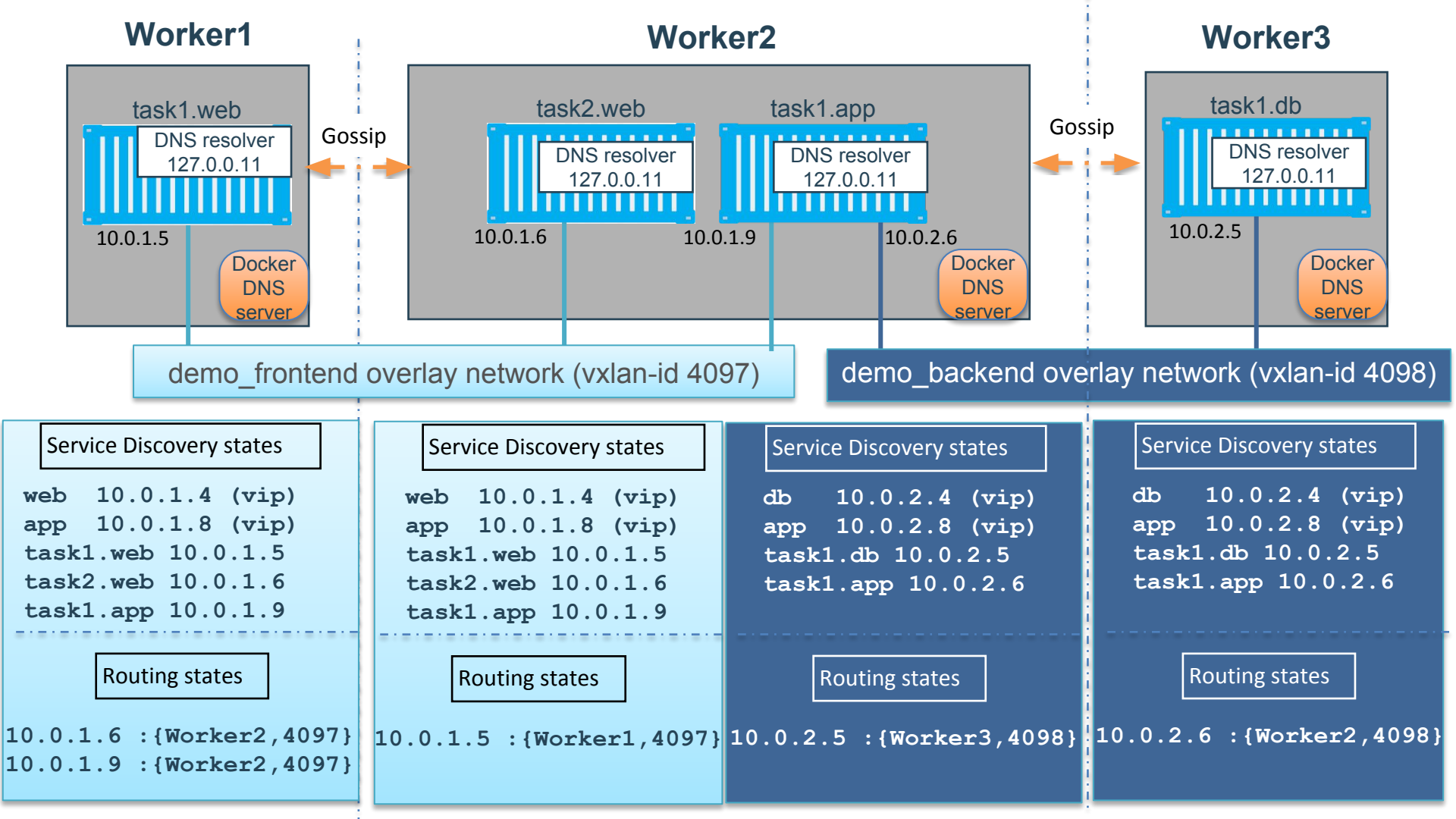
- **Eventually consistent**
- **State dissemination through de-centralized events**
  - Service Registration
  - Load-Balancer configs
  - Routing states
- **Fast convergence**
  - ~ O(logn)
- **Highly scalable**
- **Continues to function even if all managers are Down**

Decentralized Event Propogation



Mgmt, Control, and Data Plane in Practice




Worker1
Worker2
Worker3
task1.web
DNS resolver
127.0.0.11
10.0.1.5
Docker DNS server
Gossip
task2.web
DNS resolver
127.0.0.11
10.0.1.6
task1.app
DNS resolver
127.0.0.11
10.0.1.9
10.0.2.6
Docker DNS server
Gossip
task1.db
DNS resolver
127.0.0.11
10.0.2.5
Docker DNS server
demo_frontend overlay network (vxlan-id 4097)
demo_backend overlay network (vxlan-id 4098)
Service Discovery states
web 10.0.1.4 (vip)
app 10.0.1.8 (vip)
task1.web 10.0.1.5
task2.web 10.0.1.6
task1.app 10.0.1.9
Routing states
10.0.1.6 :{Worker2,4097}
10.0.1.9 :{Worker2,4097}
Service Discovery states
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task1.web 10.0.1.5
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task1.app 10.0.1.9
Routing states
10.0.1.5 :{Worker1,4097}
Service Discovery states
db 10.0.2.4 (vip)
app 10.0.2.8 (vip)
task1.db 10.0.2.5
task1.app 10.0.2.6
Routing states
10.0.2.5 :{Worker3,4098}
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app 10.0.2.8 (vip)
task1.db 10.0.2.5
task1.app 10.0.2.6
Routing states
10.0.2.6 :{Worker2,4098}

Docker Stack Deploy

```
$ docker stack deploy -c d.yml demo
Creating network demo_frontend
Creating network demo_backend
Creating service demo_web
Creating service demo_app
Creating service demo_db
```

- Swarm scope - network resources that are owned and managed centrally by the controllers
- Local scope - network resources that are owned and managed by the worker node

Local scope - bridge, macvlan, host

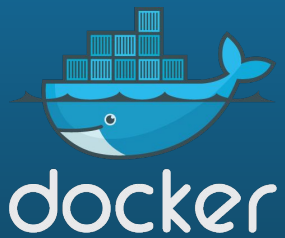
Swarm scope - Overlay, Contiv

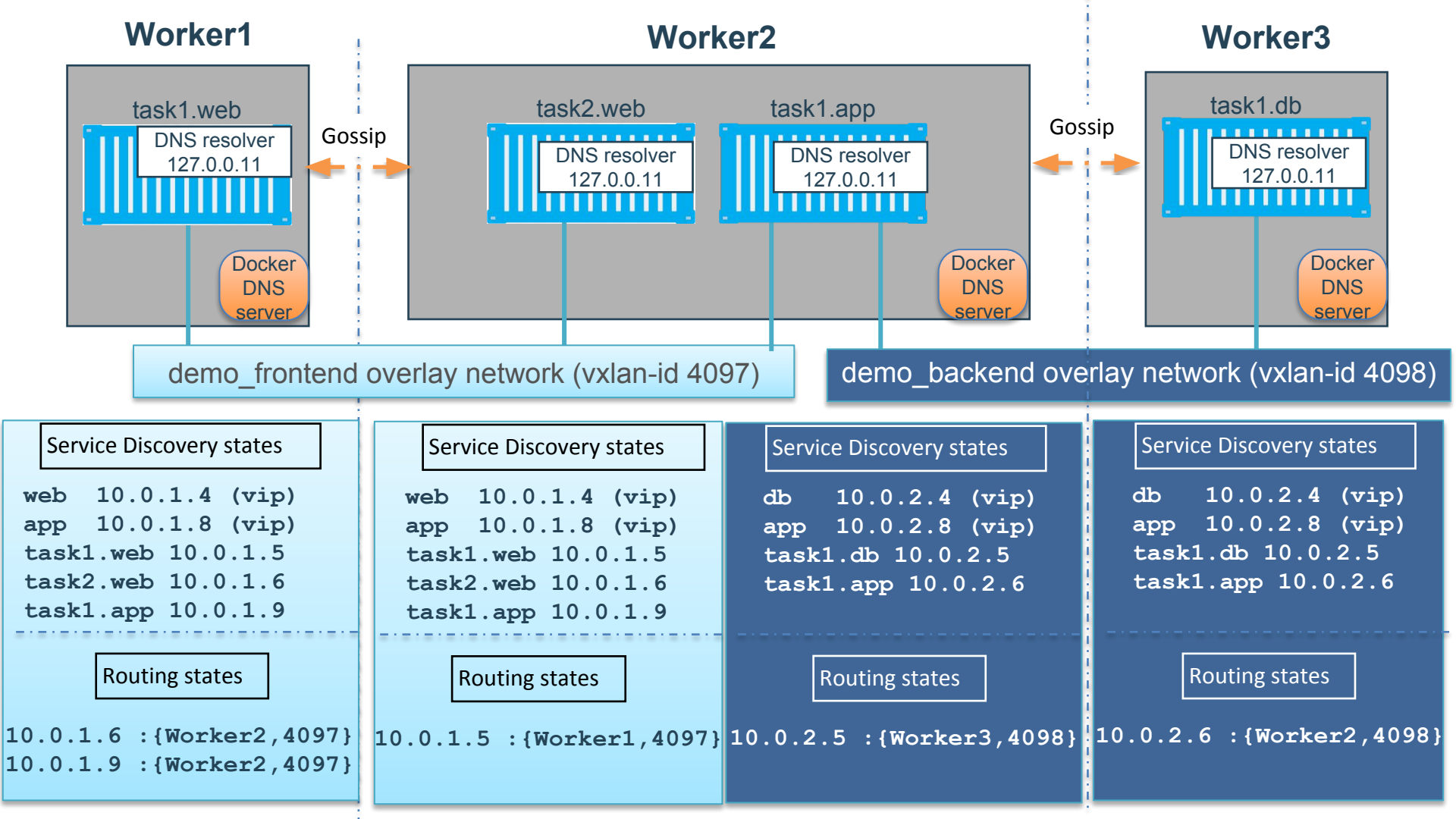
- Manager only operation
- Reserves network resources at mgmt plane such as subnet and vxlan-id. No impact to the data-plane yet.

- Manager reserves service and task resources : Service VIP and Task IPs
- Tasks Scheduled to swarm workers
- Network scoped Service Registration on Docker DNS server
  - Service name -> VIP
  - Task name -> Task IP
  - task.Service-Name -> All Task IPs
- Exchange SD & LB states via Gossip
- **Prepare Data-plane***
- Call Driver APIs and exchange driver states via Gossip

Docker Networking

Service Discovery

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Worker2
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DNS resolver
127.0.0.11
Docker
DNS
server
Gossip
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task1.app
Gossip
task1.db
demo_frontend overlay network (vxlan-id 4097)
demo_backend overlay network (vxlan-id 4098)
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app 10.0.1.8 (vip)
task1.web 10.0.1.5
task2.web 10.0.1.6
task1.app 10.0.1.9
Routing states
10.0.1.6 :{Worker2,4097}
10.0.1.9 :{Worker2,4097}
Service Discovery states
web 10.0.1.4 (vip)
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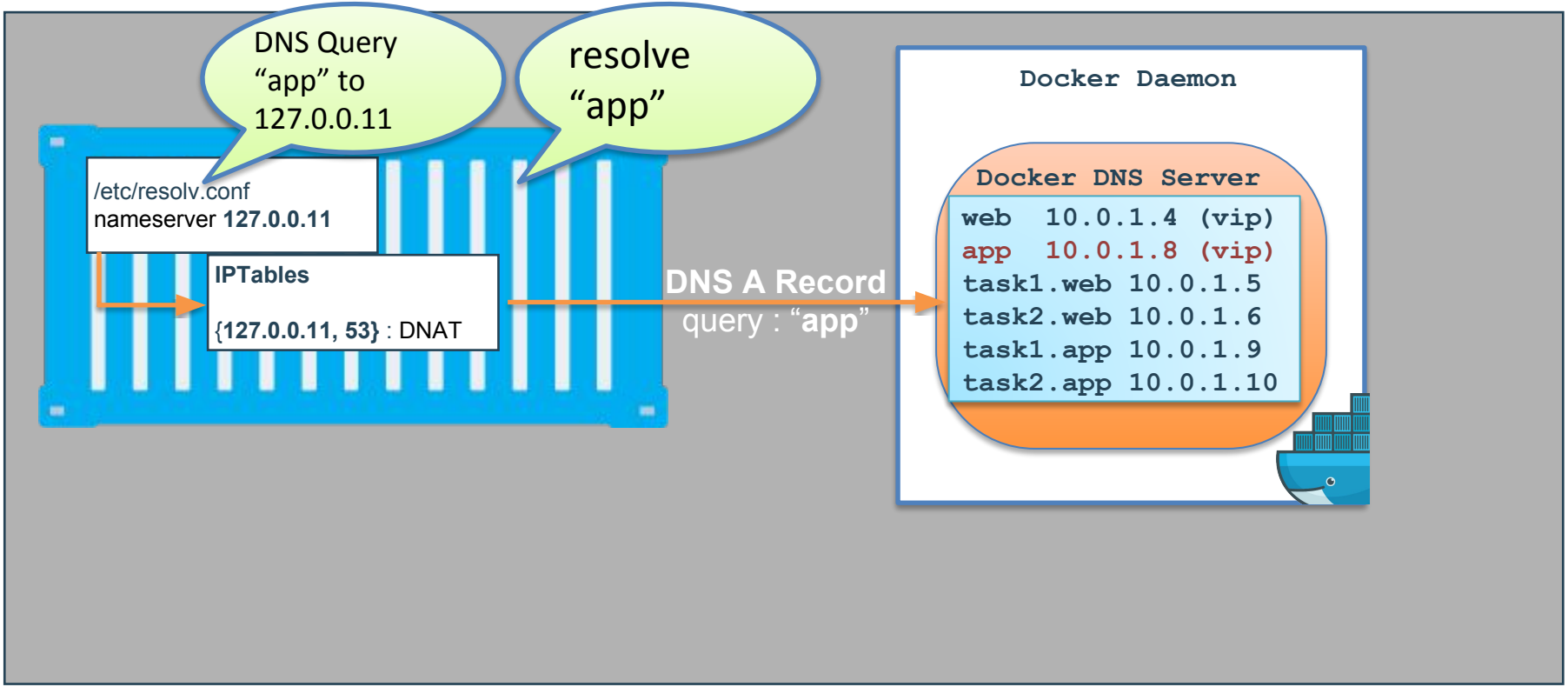
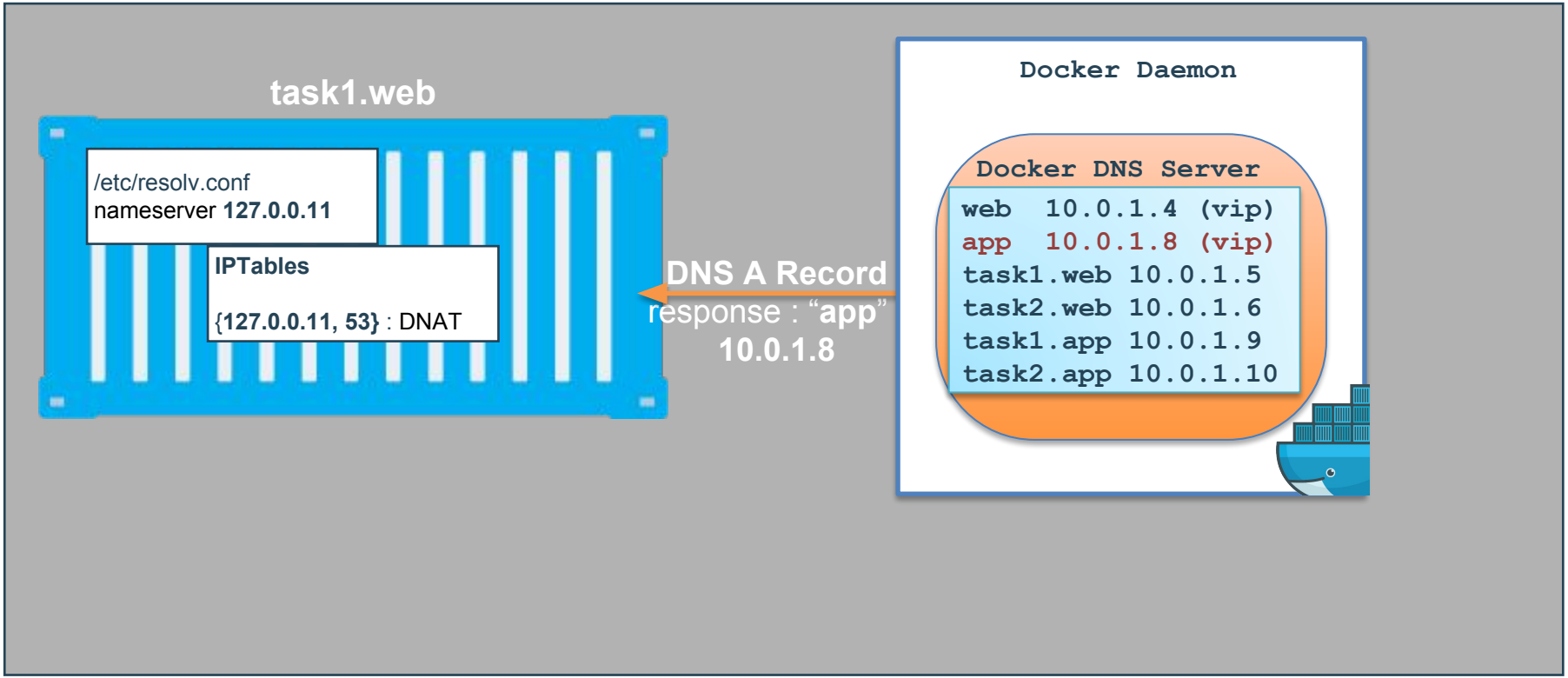
task1.web 10.0.1.5
task2.web 10.0.1.6
task1.app 10.0.1.9
Routing states
10.0.1.5 :{Worker1,4097}
Service Discovery states
db 10.0.2.4 (vip)
app 10.0.2.8 (vip)
task1.db 10.0.2.5
task1.app 10.0.2.6
Routing states
10.0.2.5 :{Worker3,4098}
Service Discovery states
db 10.0.2.4 (vip)
app 10.0.2.8 (vip)
task1.db 10.0.2.5
task1.app 10.0.2.6
Routing states
10.0.2.6 :{Worker2,4098}

Dissecting DNS Lookups

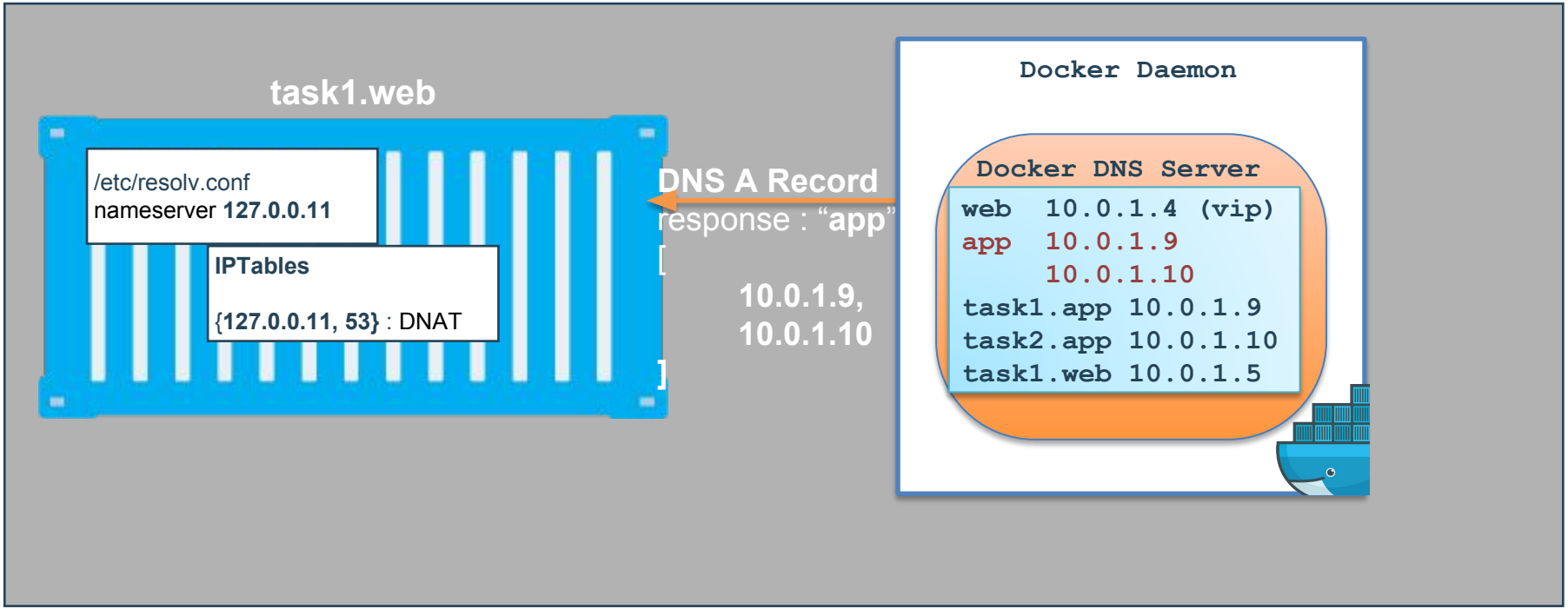


Dissecting DNS Lookups



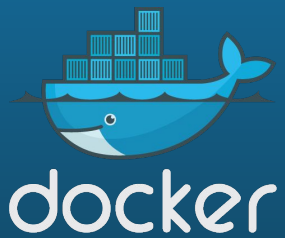
DNS Round Robin Mode

docker service create —name=app **—endpoint-mode=dns-rr** demo/my-app



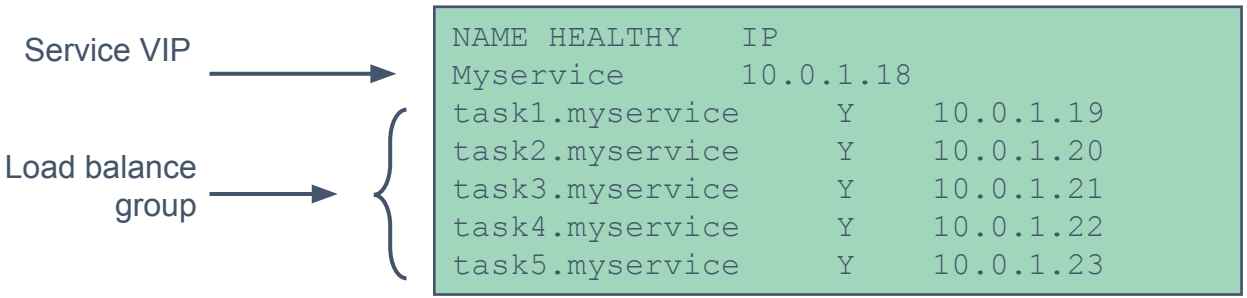
Docker Networking

Load Balancing



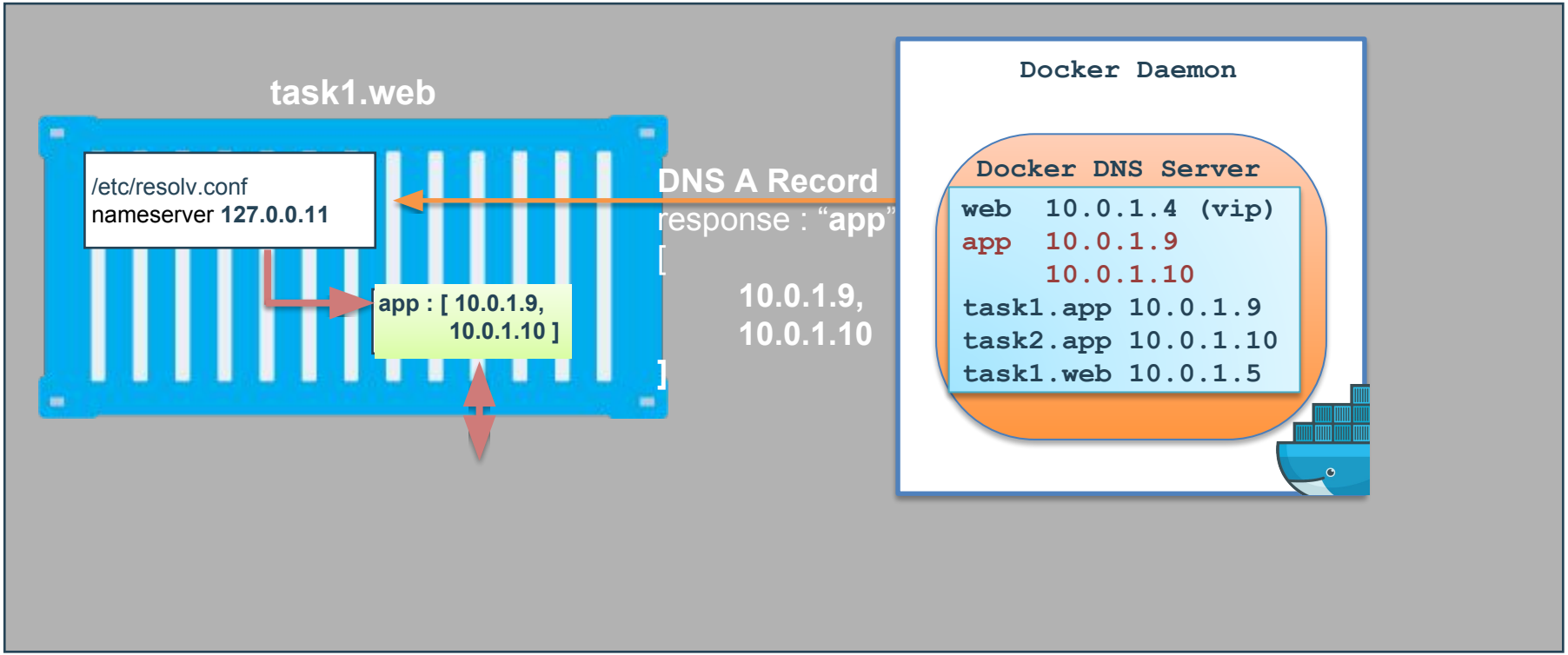
Internal LB: Service Virtual IP (VIP) Load Balancing

- Every **service** gets a **VIP** when it's created
  - This stays with the service for its entire life
- Lookups against the VIP get load-balanced across all **healthy tasks** in the service
- Behind the scenes it uses Linux kernel **IPVS** to perform transport layer load balancing
- docker service create —name=app **—endpoint-mode=vip** demo/my-app
- `docker inspect <service>` (shows the service VIP)

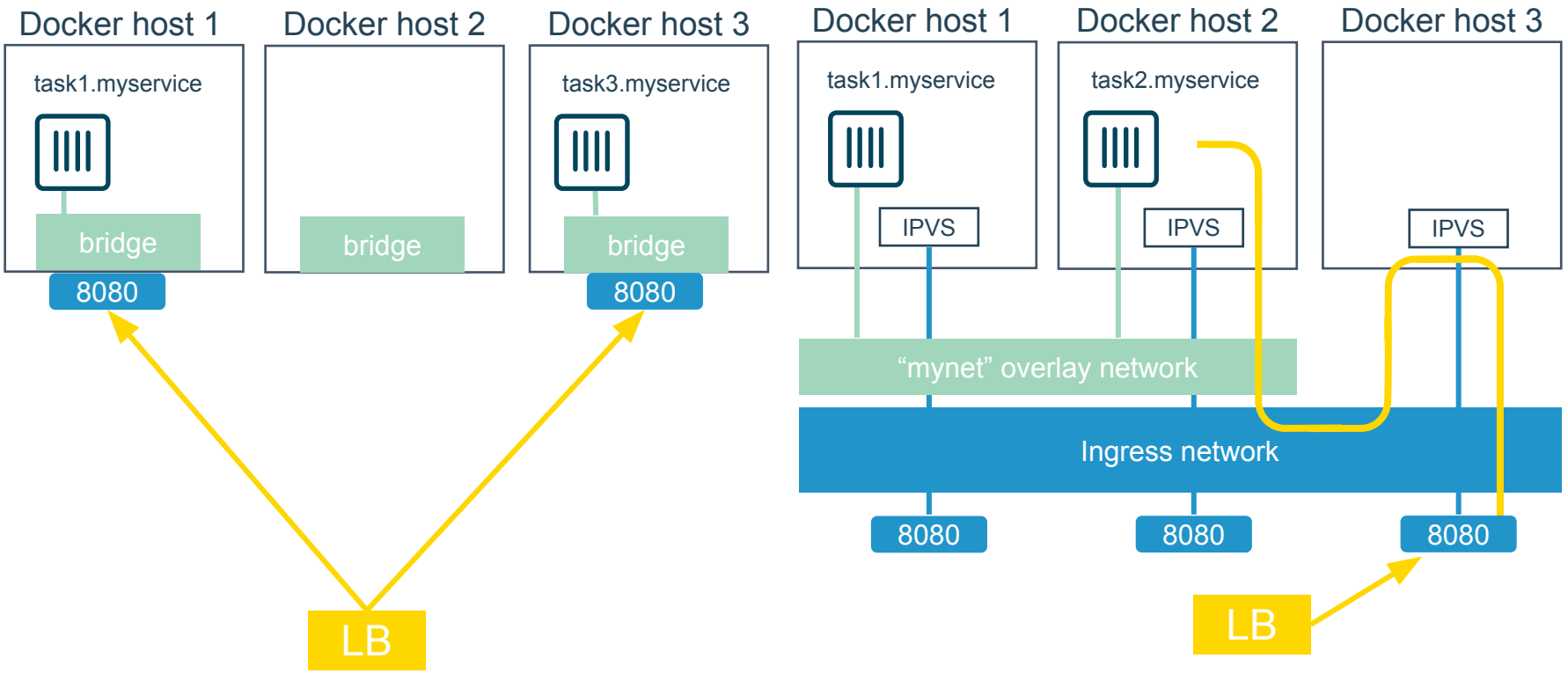


Internal LB: DNS RR Load Balancing

docker service create —name=app **—endpoint-mode=dns-rr** demo/my-app



Publish Mode: Host vs Ingress

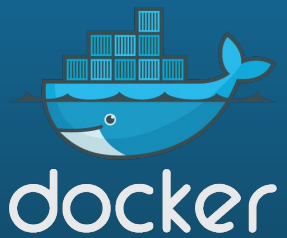


--publish-mode=host

--publish-mode=ingress

docker

Docker Security



Docker secures your software supply chain

Secure Platform

Strong isolation and secure by default

+

Secure Content

Content integrity and trust

+

Secure Access

Authentication, authorization and access control

For Developers

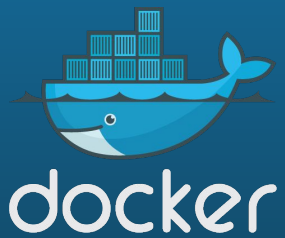
- Does not hinder speed or creativity
- Accelerate secure development

For IT ops

- Flexible and granular controls
- Proactive risk management

Docker Security

Secure Platform



“Gartner asserts that applications deployed in containers are more secure than applications deployed on the bare OS.”

http://blogs.gartner.com/joerg-fritsch/can-you-operationalize-docker-containers/

Secure platform

All Linux isolation capabilities

- pid namespace
- mnt namespace
- net namespace
- uts namespace
- user namespace
- pivot_root
- uid/gid drop
- cap drop
- all cgroups
- selinux
- apparmor
- seccomp

+

1. Out of the box default settings and profiles

2. Granular controls to customize settings

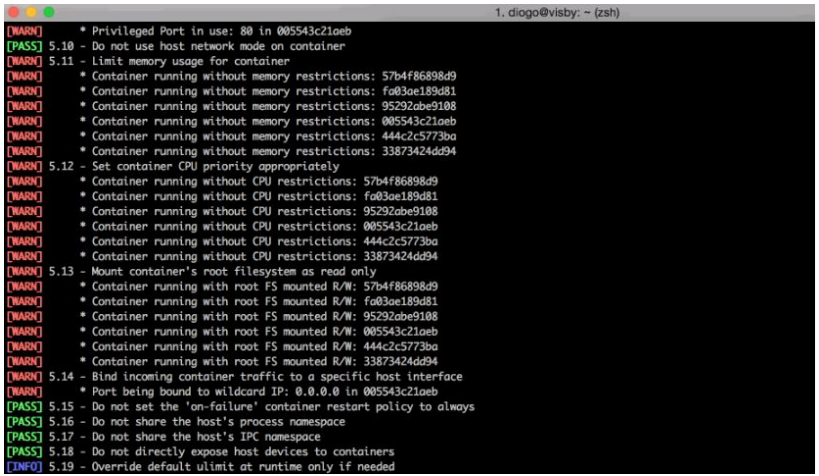
=

Secure by default

Available Container Security Features, Requirements and Defaults			
Security Feature	**LXC 2.0**	**Docker 1.11**	**CoreOS Rkt 1.3**
User Namespaces	Default	Optional	Experimental
Root Capability Dropping	Weak Defaults	Strong Defaults	Weak Defaults
Procfs and Sysfs Limits	Default	Default	Weak Defaults
Cgroup Defaults	Default	Default	Weak Defaults
Seccomp Filtering	Weak Defaults	Strong Defaults	Optional
Custom Seccomp Filters	Optional	Optional	Optional
Bridge Networking	Default	Default	Default
Hypervisor Isolation	Coming Soon	Coming Soon	Optional
MAC: AppArmor	Strong Defaults	Strong Defaults	Not Possible
MAC: SELinux	Optional	Optional	Optional
No New Privileges	Not Possible	Optional	Not Possible
Container Image Signing	Default	Strong Defaults	Default
Root Interation Optional	True	False	Mostly False

Source: source: "Understanding and Hardening Linux Containers", page 96

Docker Bench



Ensure secure host configurations

- Aligned to recommendations in Center for Internet Security's Benchmark for Docker Engine 1.11
- Automates checking your host configs against the benchmark recommendations

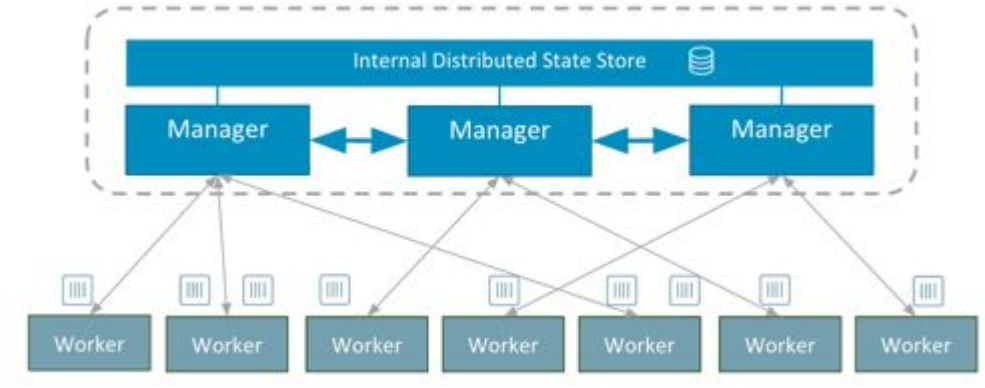
Easy to use

- Available to run as a container or using a Compose file

www.dockerbench.com

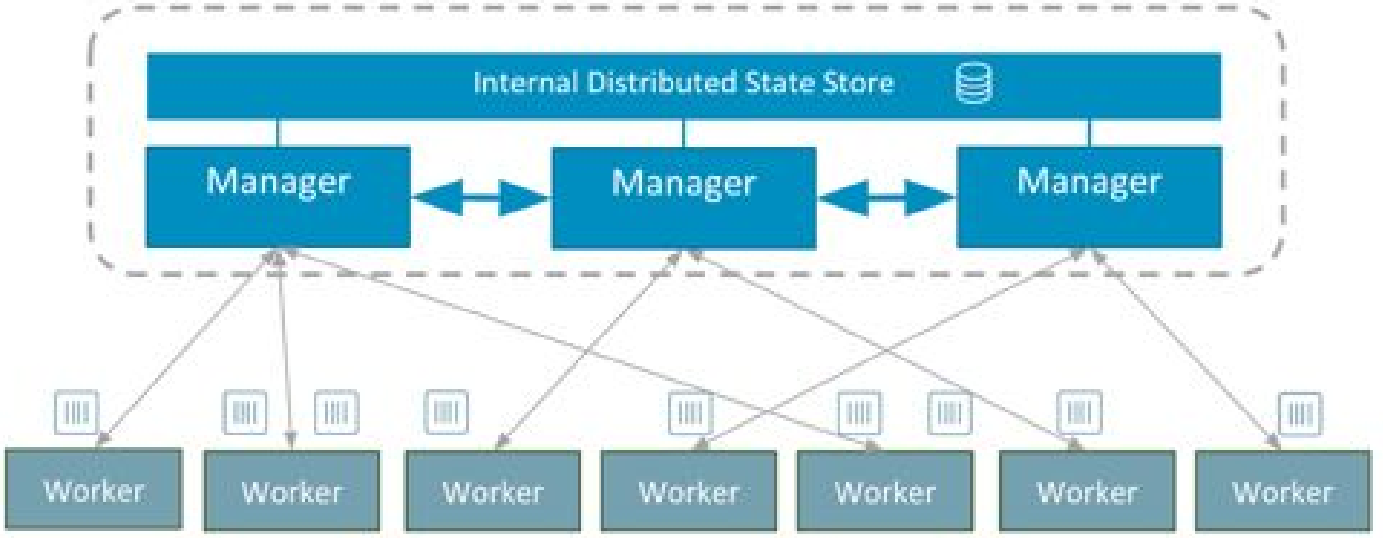
Secure Cluster Management

- Docker 1.12 integrates swarm.
- Strong default swarm security.
- Strict privilege separation between managers and workers.



Orchestration Privilege Separation - What's the goal?

Privileged ->

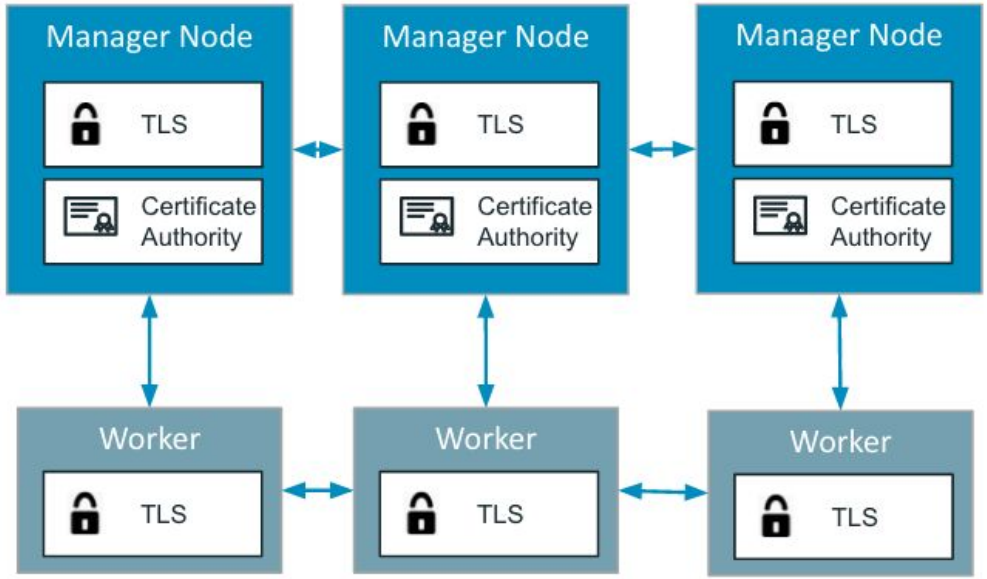


Unprivileged ->

- **<u>Worker nodes must only have access to resources (e.g. networks, secrets, volumes) that are explicitly needed for their function</u>**

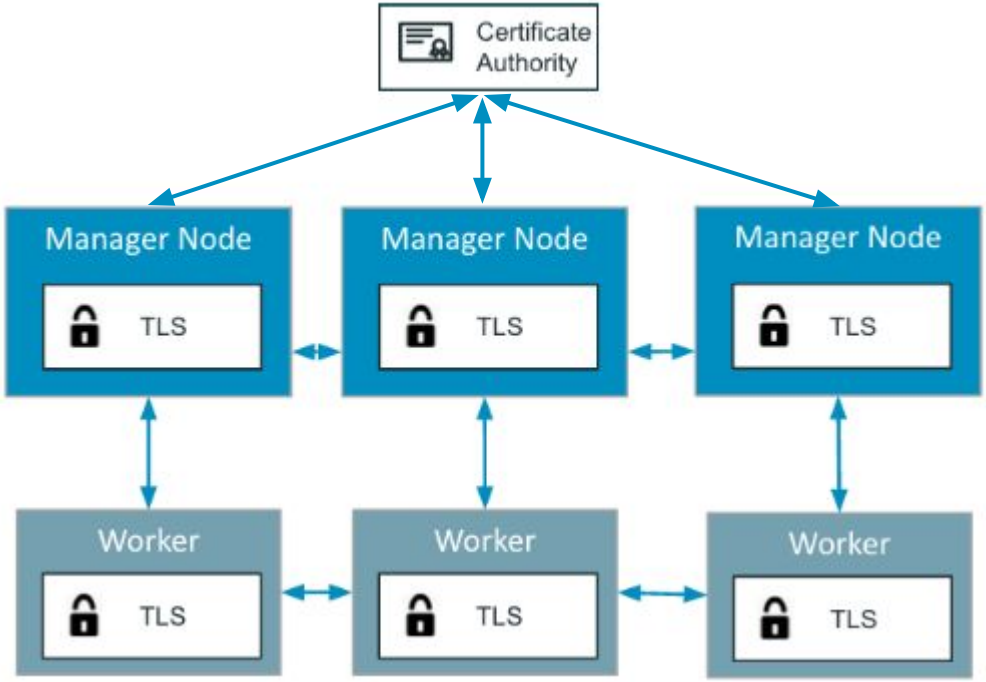
Mutual TLS by default

- Leader acts as CA.
- Any Manager can be promoted to leader.
- Workers and managers identified by their certificate.
- Communications secured with Mutual TLS.



Support for External CAs

- Managers support BYO CA.
- Forwards CSRs to external CA.

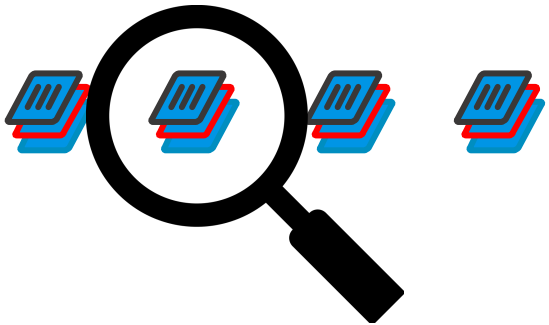


Automatic Certificate Rotation

- Customizable certificate rotation periods.
  - Minimum window of 30 minutes.
- Occurs automatically.
- Ensures potentially compromised or leaked certificates are rotated out of use.
- Whitelist of currently valid certificates.

Image Scanning for Windows and Linux Images

CONTINUOUSLY SCAN FOR VULNERABILITIES IN ALL IMAGES



KEY FEATURES

- Binary-level scans of both Windows and Linux images against a CVE database of known vulnerabilities
- Continuous monitoring after initial scan to alert when new vulnerabilities are found

BENEFITS

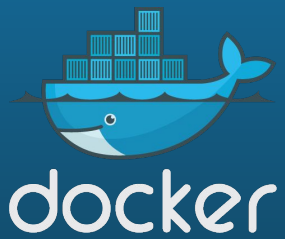
- Improve application security by scanning for known vulnerabilities prior to deploying and continuous checks thereafter
- Ensure compliance with alerts to new vulnerabilities

Secure Addition of Nodes

Only one way to approve addition of a node to the cluster:

Secure token

Docker Secrets Management



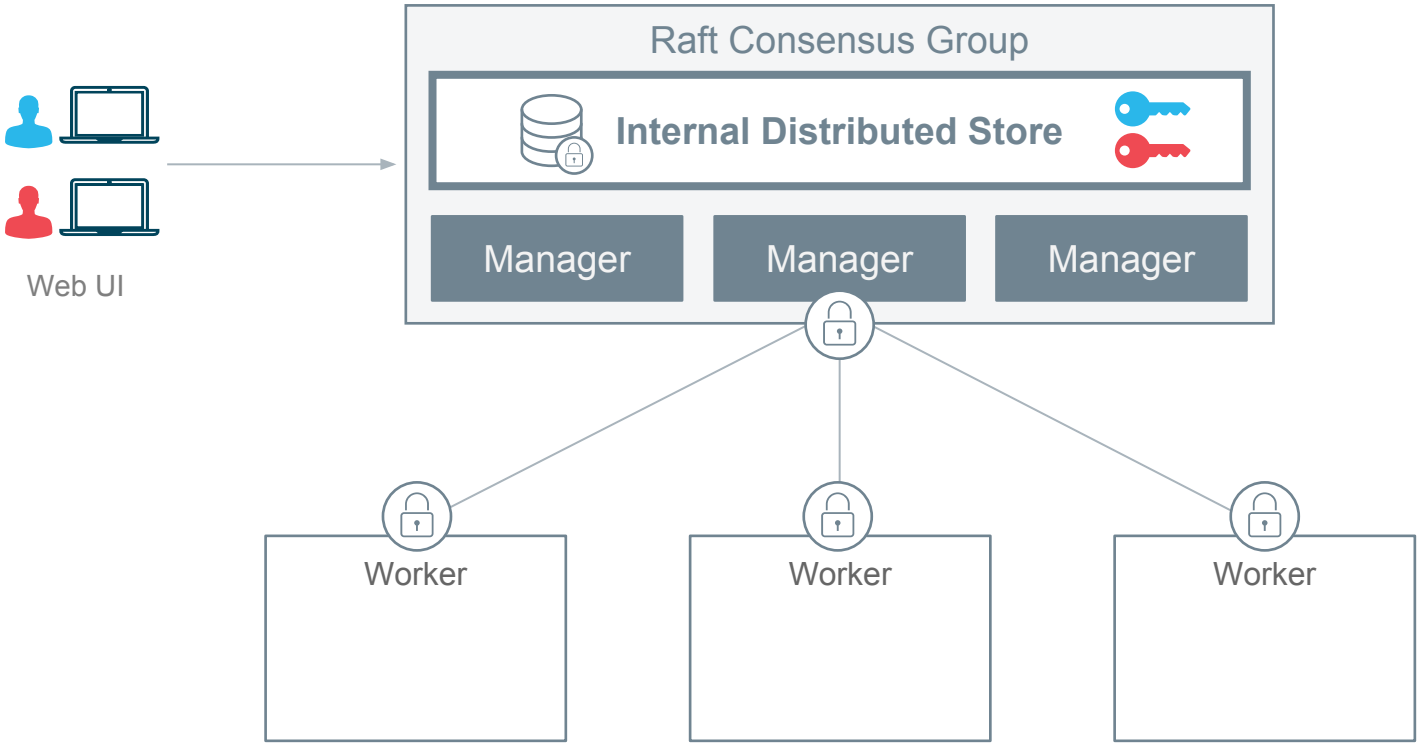
Safer Apps with Docker Secrets Management

- Apps are safer when there is a standardized interface for accessing secrets
  - Works for legacy/microservices, dev/ops and Linux/Windows
- Apps are safer when secrets are not stored in the app itself

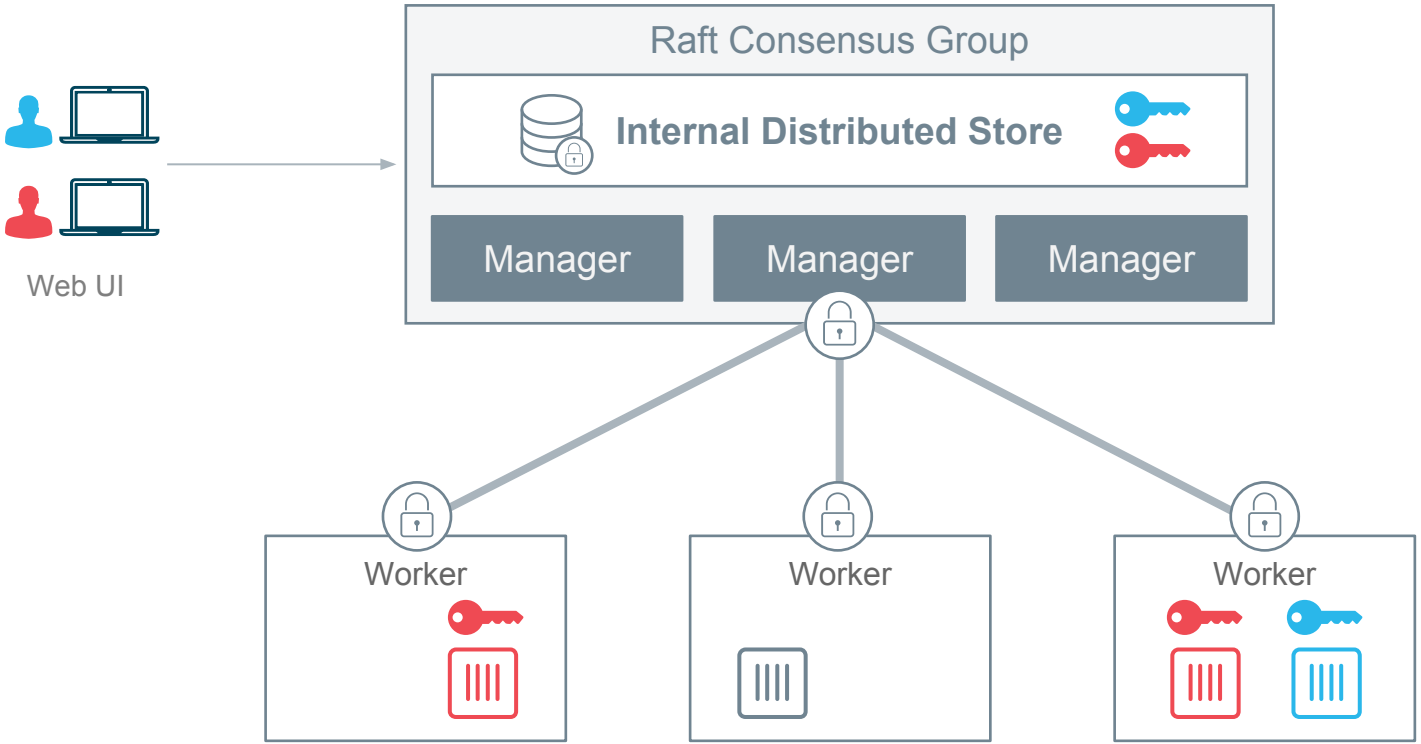
Trusted Delivery with Docker Secrets Management

- Encrypted at rest in the cluster store
- Encrypted while in motion on the network
- Delivered only to the specific authorized app
- Available to containers only in memory, never saved to disk

Docker Datacenter Secrets Architecture

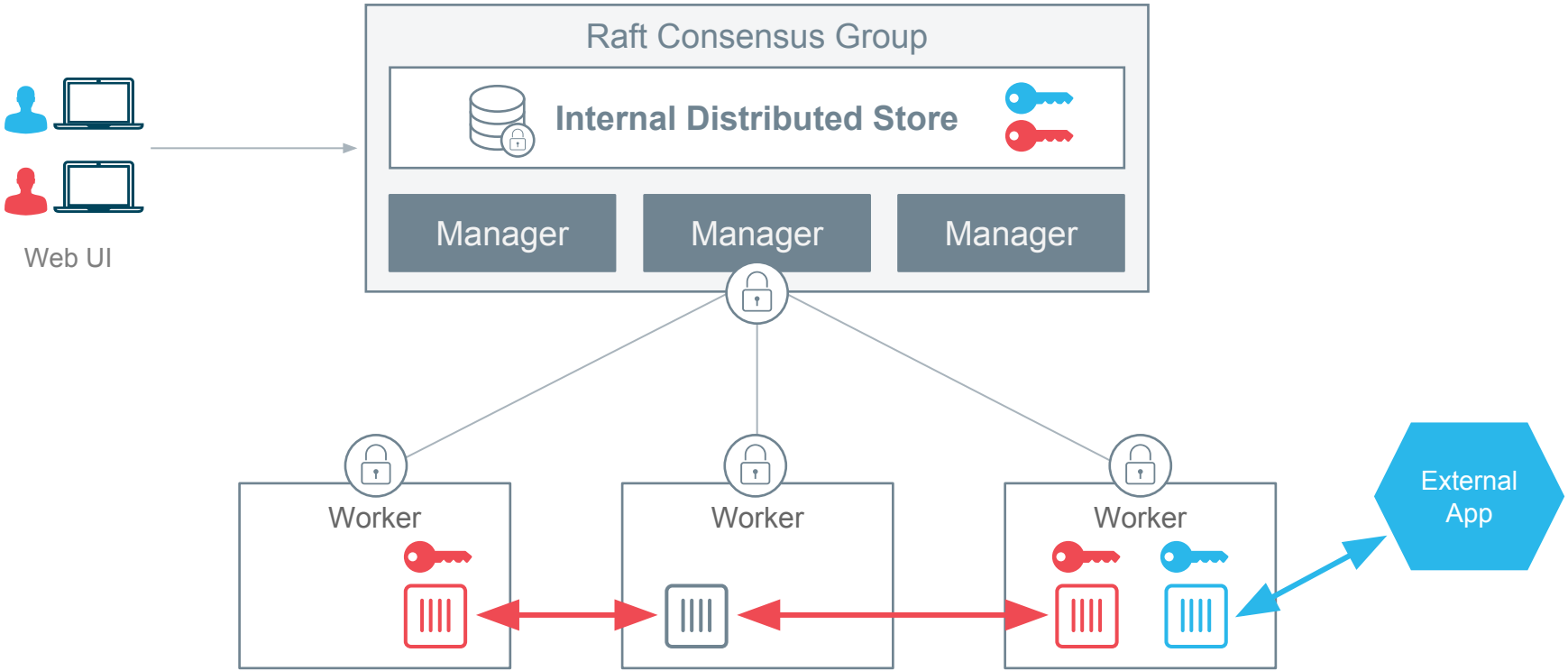


Docker Datacenter Secrets Architecture



docker

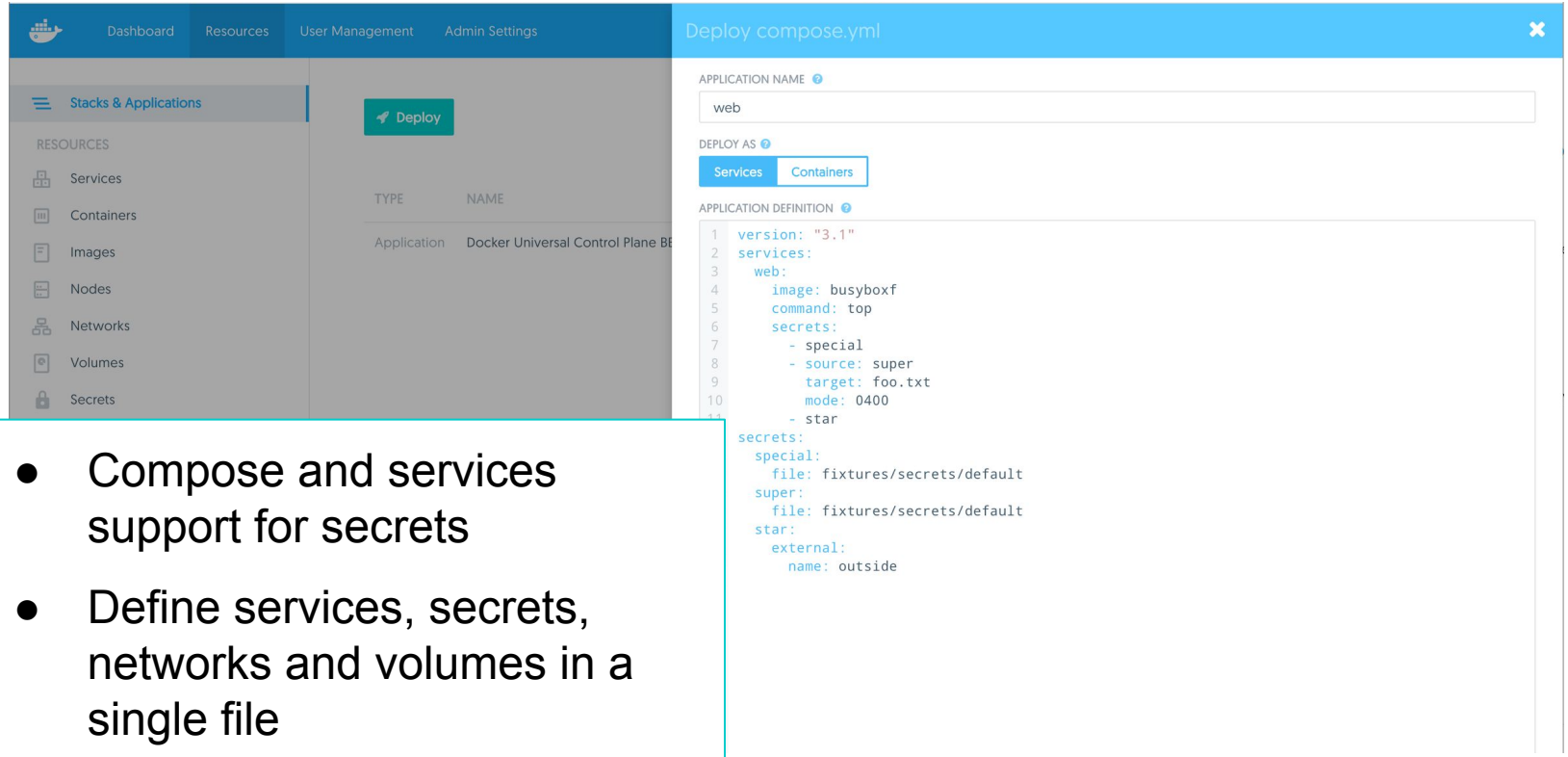
Docker Datacenter Secrets Architecture



Usable Security with Secrets Management

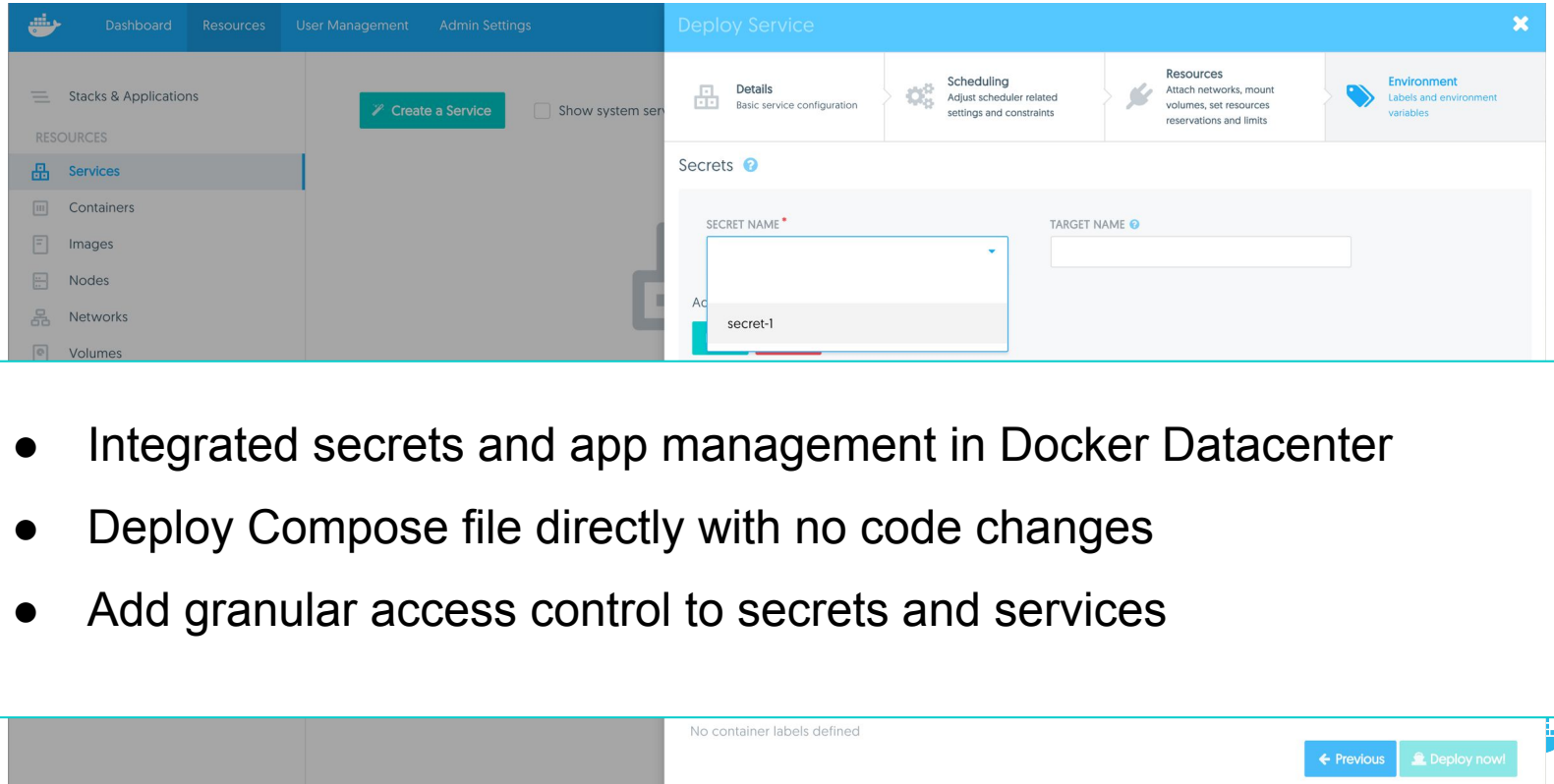
- Standardized interface for developers and IT ops
- Developers have a simple interface
- IT ops gains secure policy management
- Same security guarantees travel with the app across different infrastructures

For Dev: Simple Developer Workflow



- Compose and services support for secrets
- Define services, secrets, networks and volumes in a single file

For Ops: Docker Datacenter Delivers Integrated Management and Controls

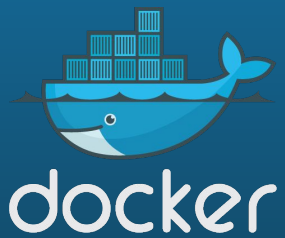


- Integrated secrets and app management in Docker Datacenter
- Deploy Compose file directly with no code changes
- Add granular access control to secrets and services

Docker Security

Secure Content

Securing the Image Pipeline



Common questions on content security

- What is inside my container?
- How do I know where this code came from?
- How do I keep our team safe from bad components?
- How do I stay on top of patches for compliance and governance?
- How do I NOT make this a giant pain for everyone? (including myself)

Securing the software supply chain with Docker

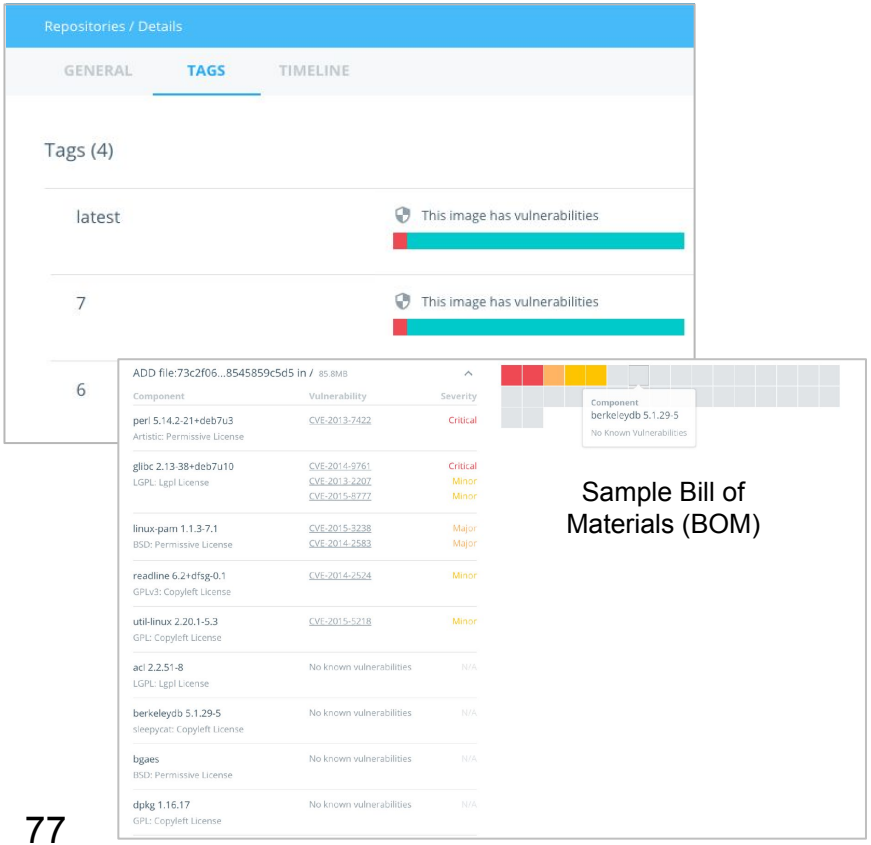
Before Docker

- Cumbersome tools with high failure rates of patches
- Reactive and slow process
- Software and dependency matrix with patches create more dependencies and clashes
- Security is a silo from dev and app ops

After Docker

- Faster, more successful software updates
- Simplify software compliance process
- Trusted delivery with self contained, secure and signed containers
- Unified workflow enabling both dev and ops

Secure Content: Image scanning and vulnerability detection



Sample Bill of Materials (BOM)

Deep visibility with binary level scanning

- Detailed BOM of included components and vulnerability profile
- Checks packages against CVE database AND the code inside to protect against tampering
- Covers wide range of languages, binaries, OS

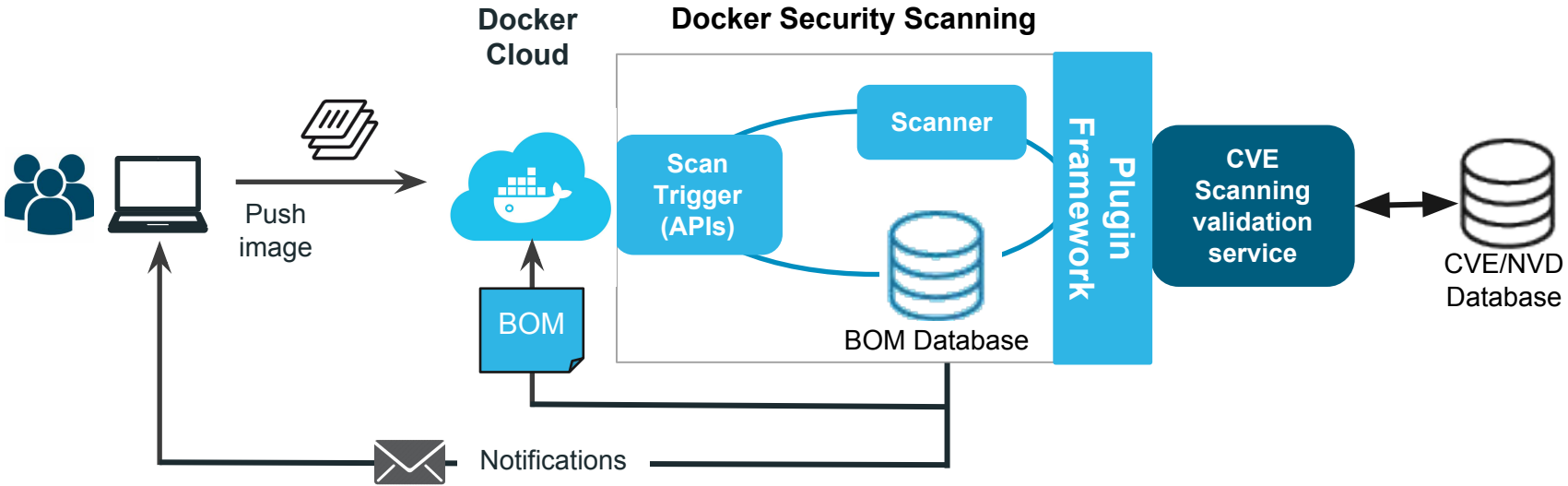
Proactive risk management

- Continuous monitoring of CVE/NVD databases with notifications pointing to repos and tags that contain new vulnerabilities

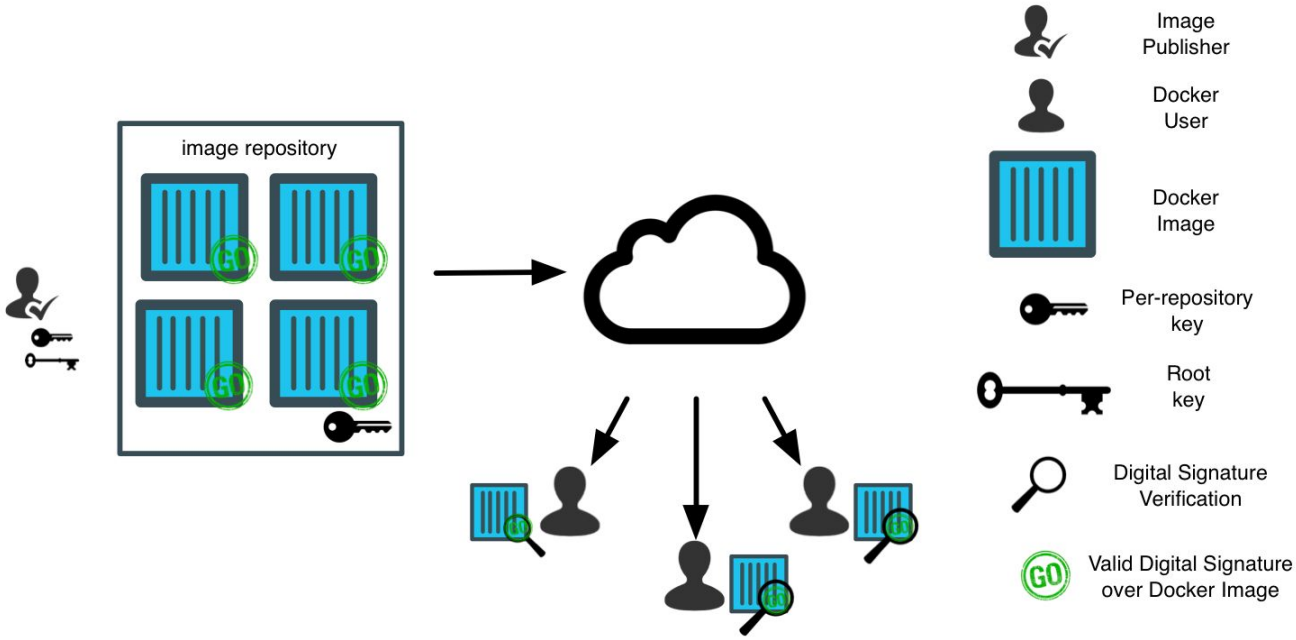
Secure the software supply chain

- Integrated workflow with Docker Content Trust
- Available for Official Repos since Nov 2015

Secure Content: Image scanning and vulnerability detection

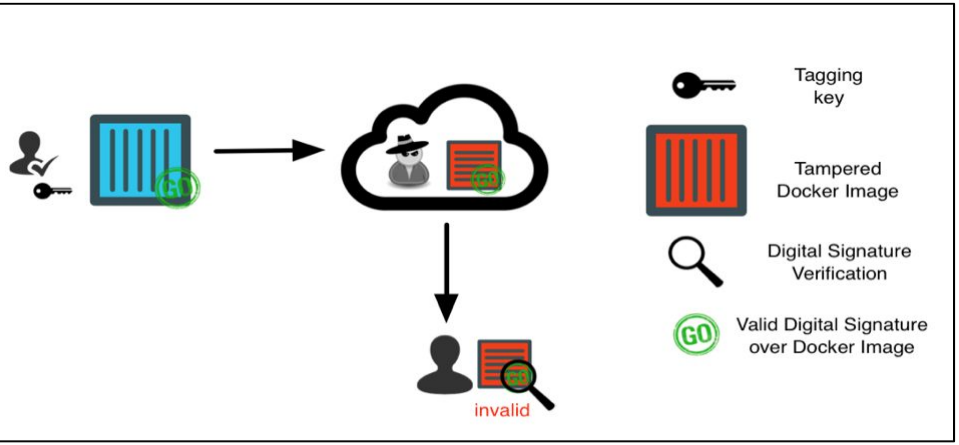


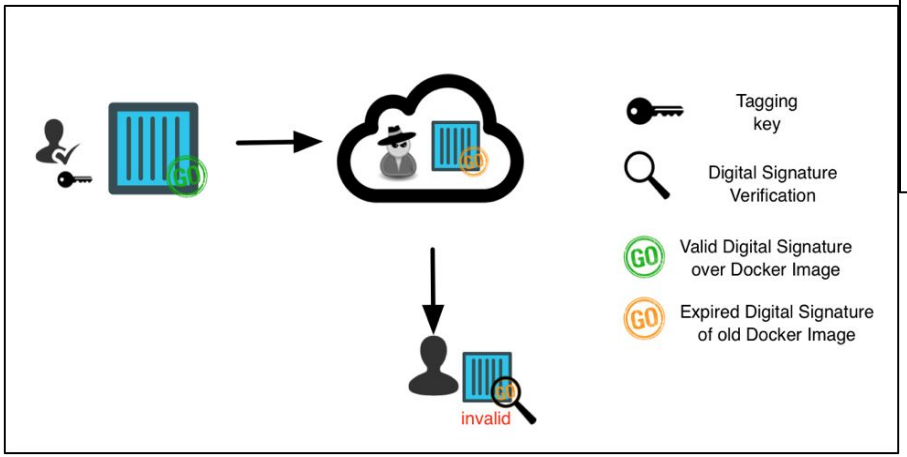
Content: Docker Content Trust



- Publisher digitally signs the Docker images before sending them to the cloud
- Any user can independently verify the digital signatures on the images

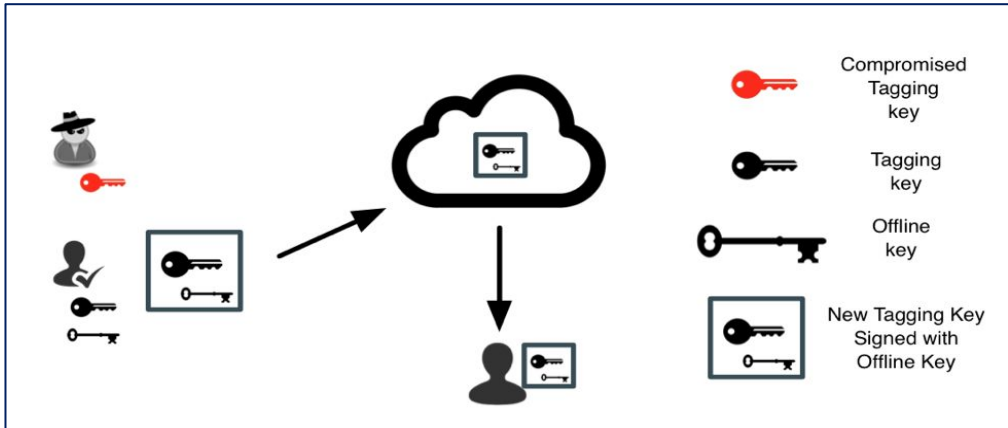
Use Case: Image Forgery —>

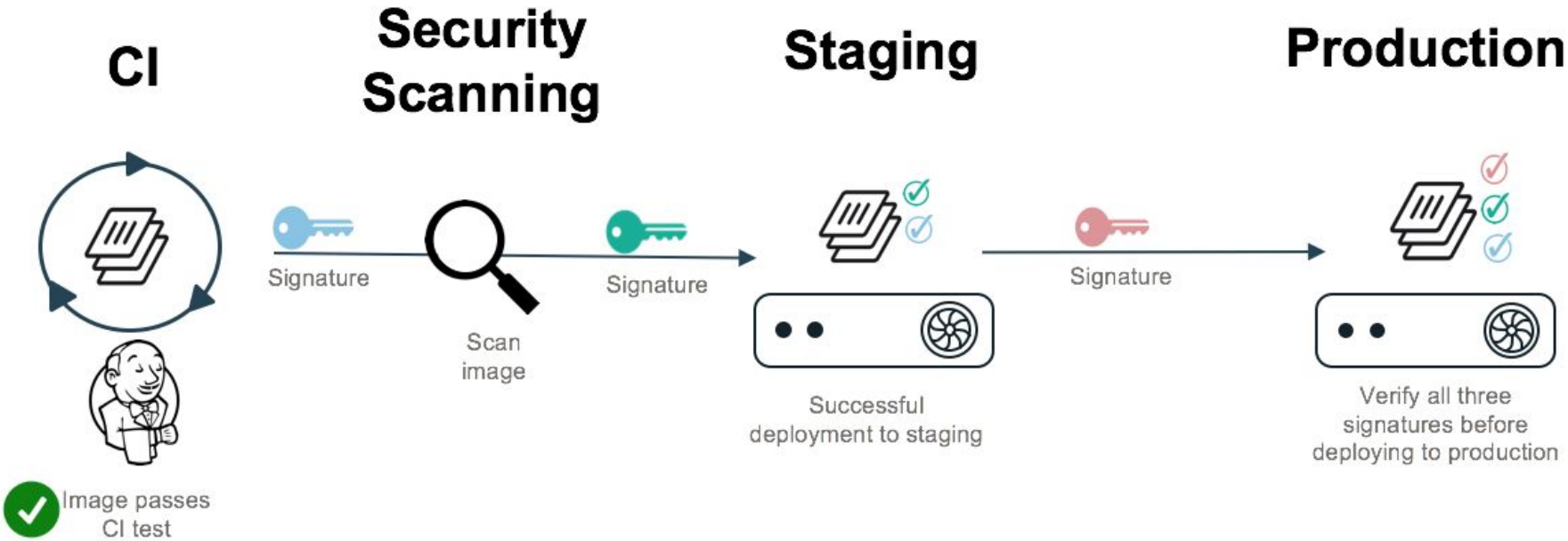




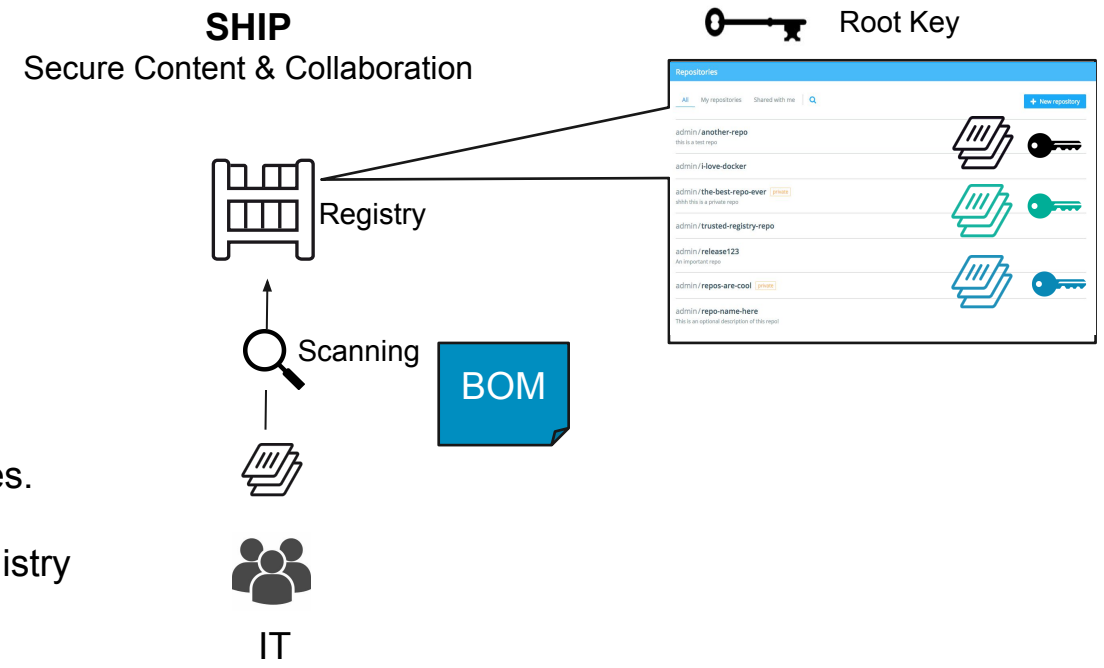
<— Use Case: Replay attacks

Use Case: Compromised keys —>




CI
Security Scanning
Staging
Production
Signature
Scan image
Signature
Signature
Image passes CI test
Successful deployment to staging
Verify all three signatures before deploying to production

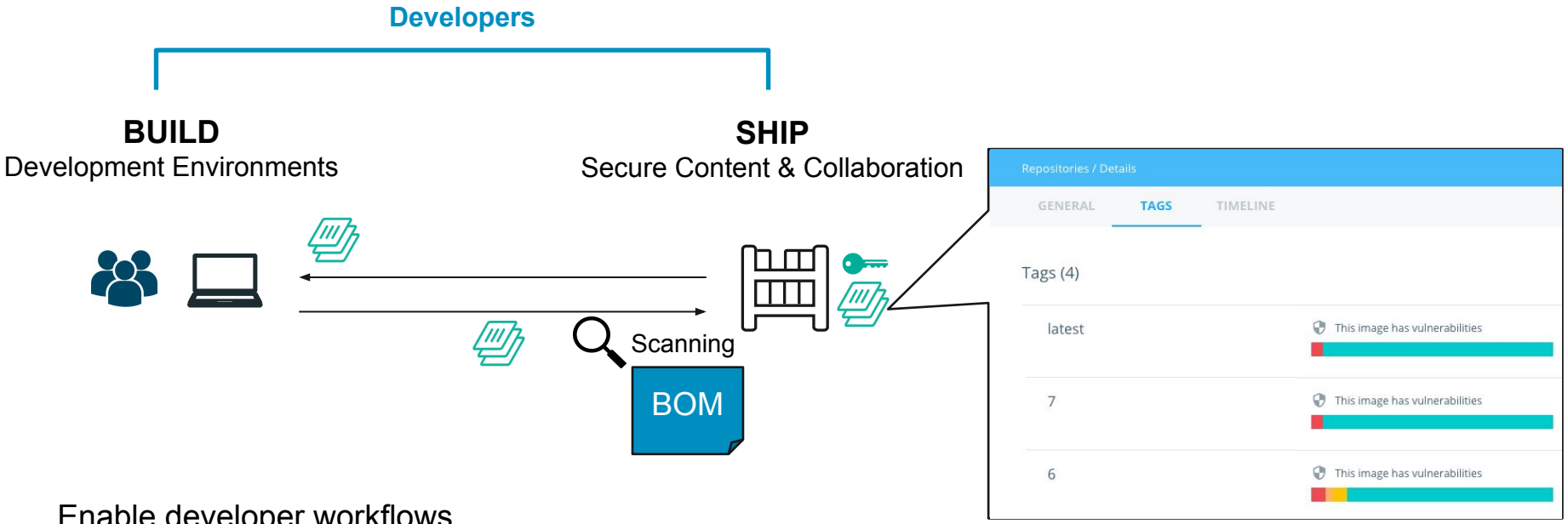
1. Start with a secure base



Set up a central repository

- IT creates and scans base images.
- Images are digitally signed
- Images are pushed to central registry

2. Build secure apps

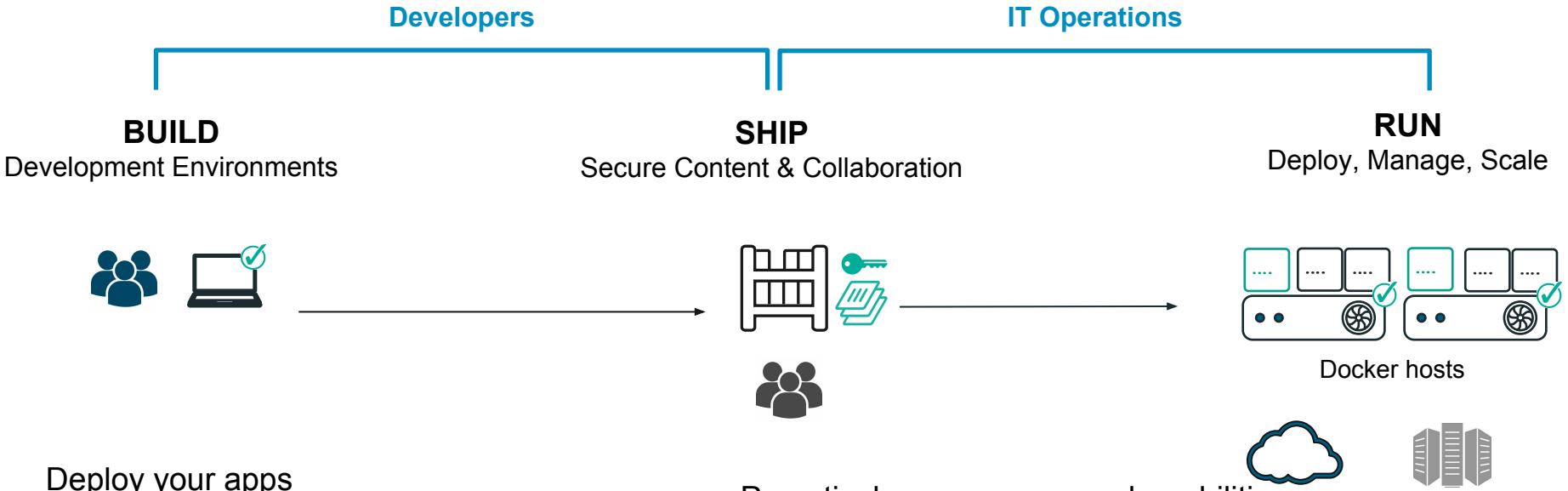


Enable developer workflows

- Pull from library of secure images
- Local Docker host establishes trust with repo and registry
- Build apps, add image layers and CI test
- Scan updated image and generate new BOM
- Remediate issues or deploy

View history of BOMs for all scanned tags per repo

3. Deploy apps



Deploy your apps

- Deploy apps to next environment
- Secure host configurations with Docker Bench
- Hosts establish trust with repo

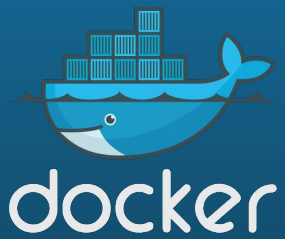
Proactively manage new vulnerabilities

- New VULN added to database regarding a package
- Docker checks all BOMs that have this package
- Notification is sent re: affected repos and tags

Docker Security

Secure Access

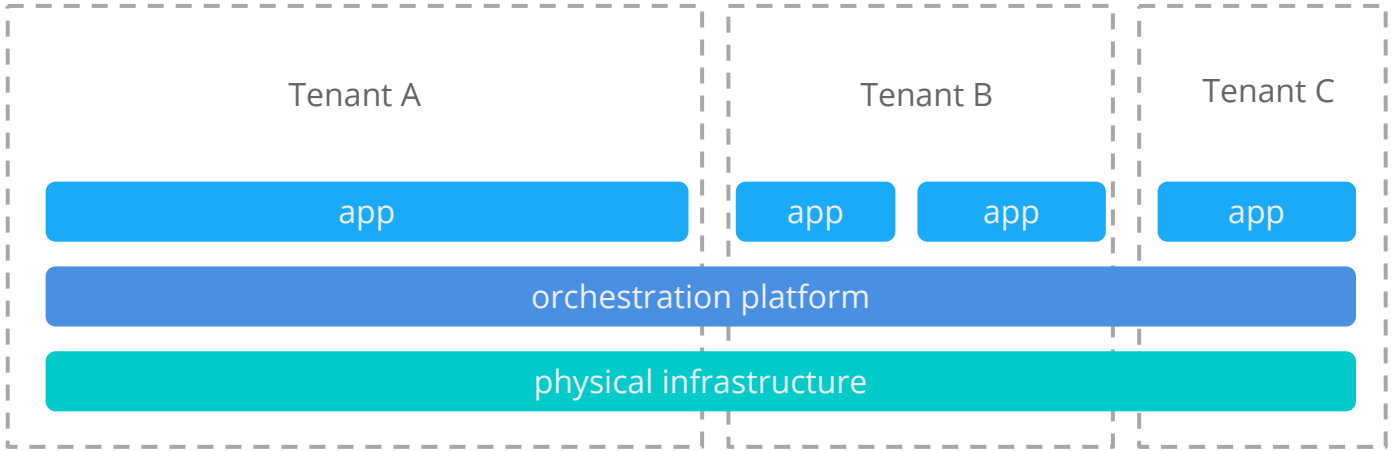
Docker Enterprise Access Control

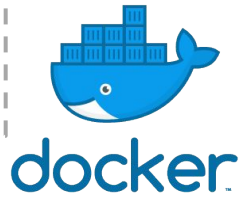


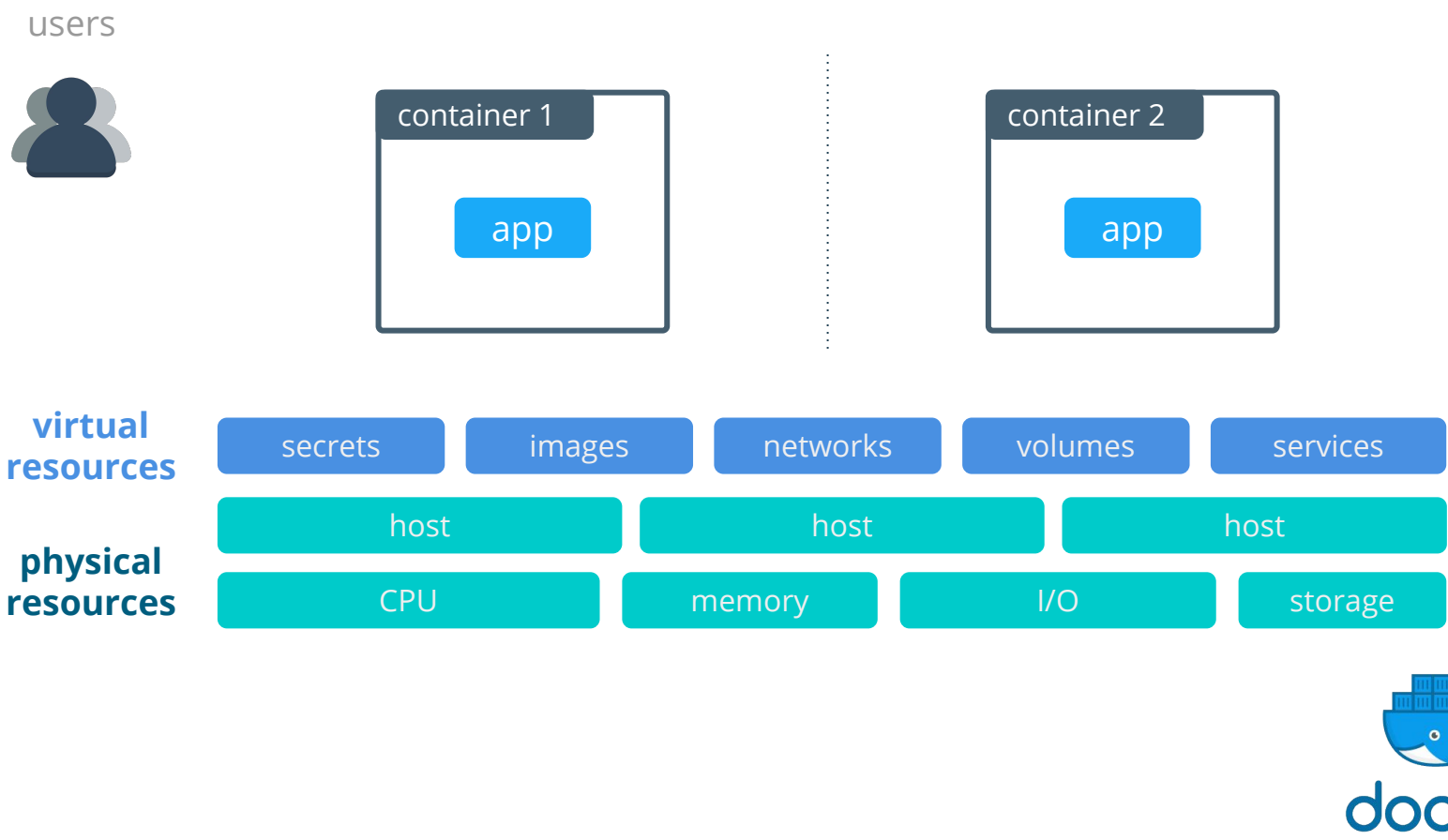
Resource Sharing

Why we don’t give every team their own cluster

- Higher resource utilization
- Specialization of skillsets for discrete layers of IT stack
- Separation of responsibilities for more resilient and manageable architectures

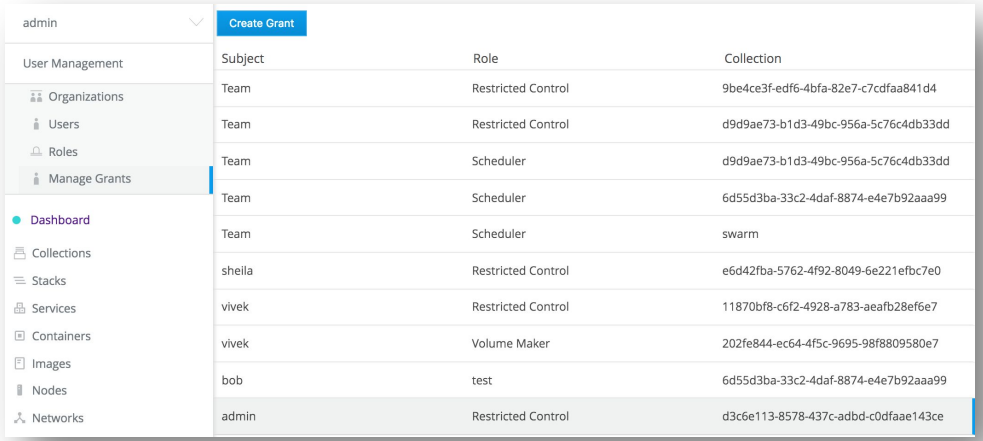





users
container 1
app
container 2
app
virtual resources
secrets
images
networks
volumes
services
physical resources
host
host
host
CPU
memory
I/O
storage
docker

Highly Customizable Roles

CUSTOMIZE ROLES AND IMPROVE ACCESS GRANULARITY AND CONTROL



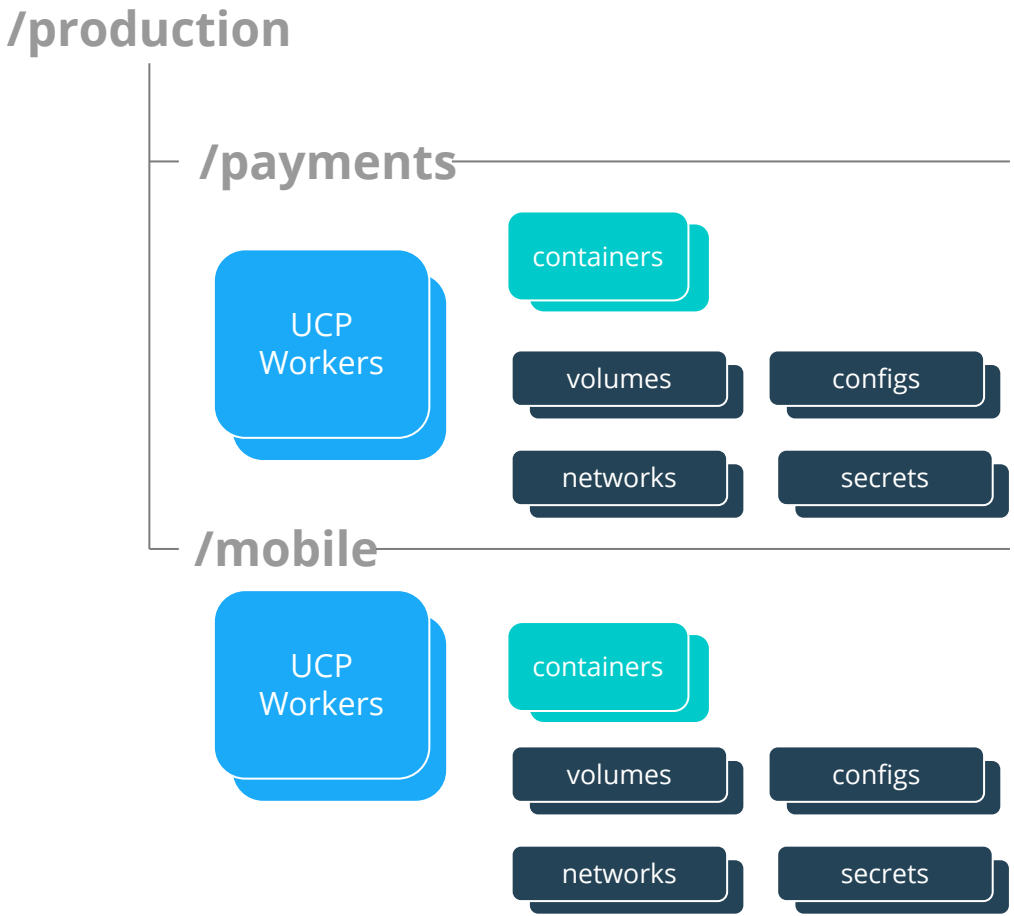
KEY FEATURES

- Create custom roles with granular action permissions or leverage pre-defined default roles
- Define resource collections to more easily visualize and assign users to specific cluster resources
- Define Organizations of one or more Teams

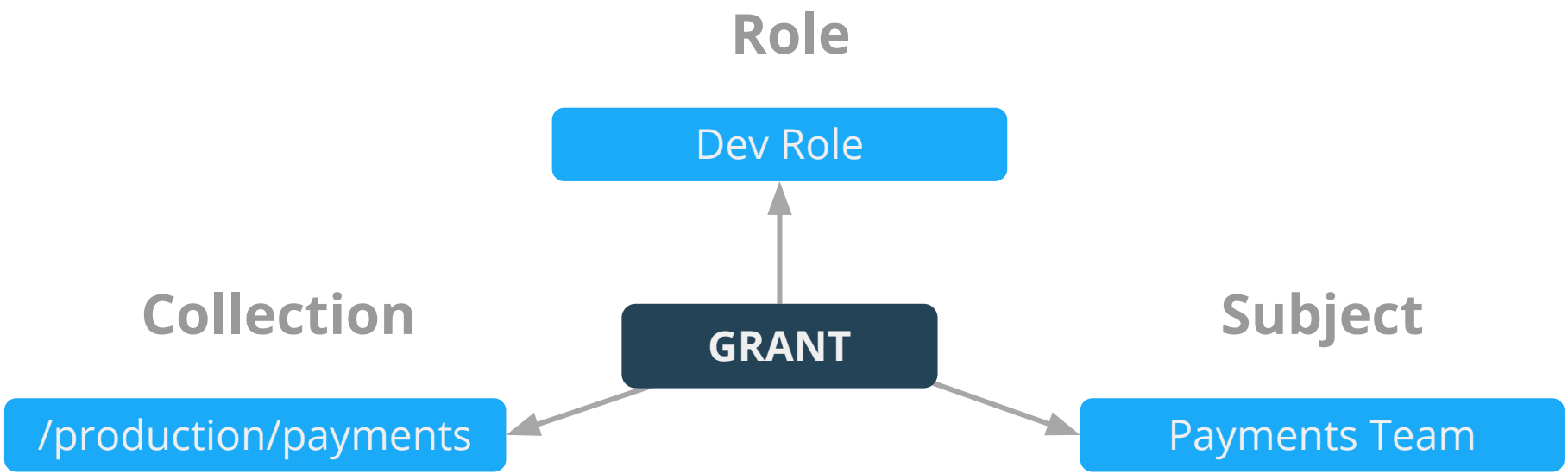
BENEFITS

- Easily manage complex organizations by defining permissions across user groups and resource collections
- Improve security by setting permissions that align to your organization’s requirements and practices
- Meet compliance and regulatory requirements through tight access control and separation of roles and responsibilities

collections

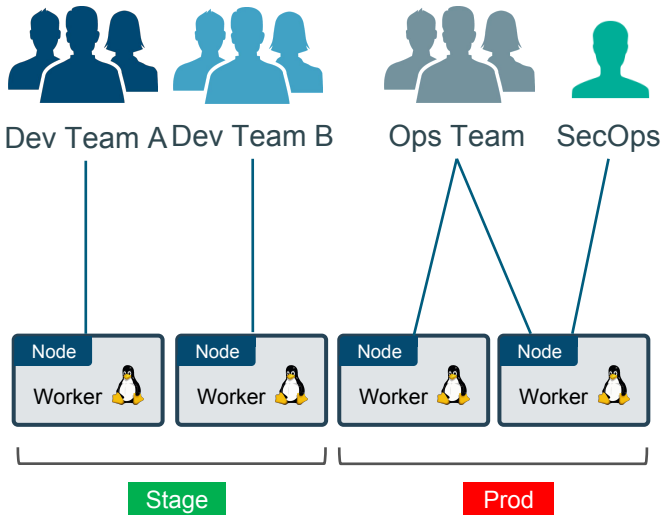


grants


Role
Dev Role
Collection
GRANT
Subject
/production/payments
Payments Team

Node Access Control

SUPPORT SECURE MULTI-TENANCY ACROSS MULTIPLE TEAMS THROUGH NODE-BASED ISOLATION AND SEGREGATION



KEY FEATURES

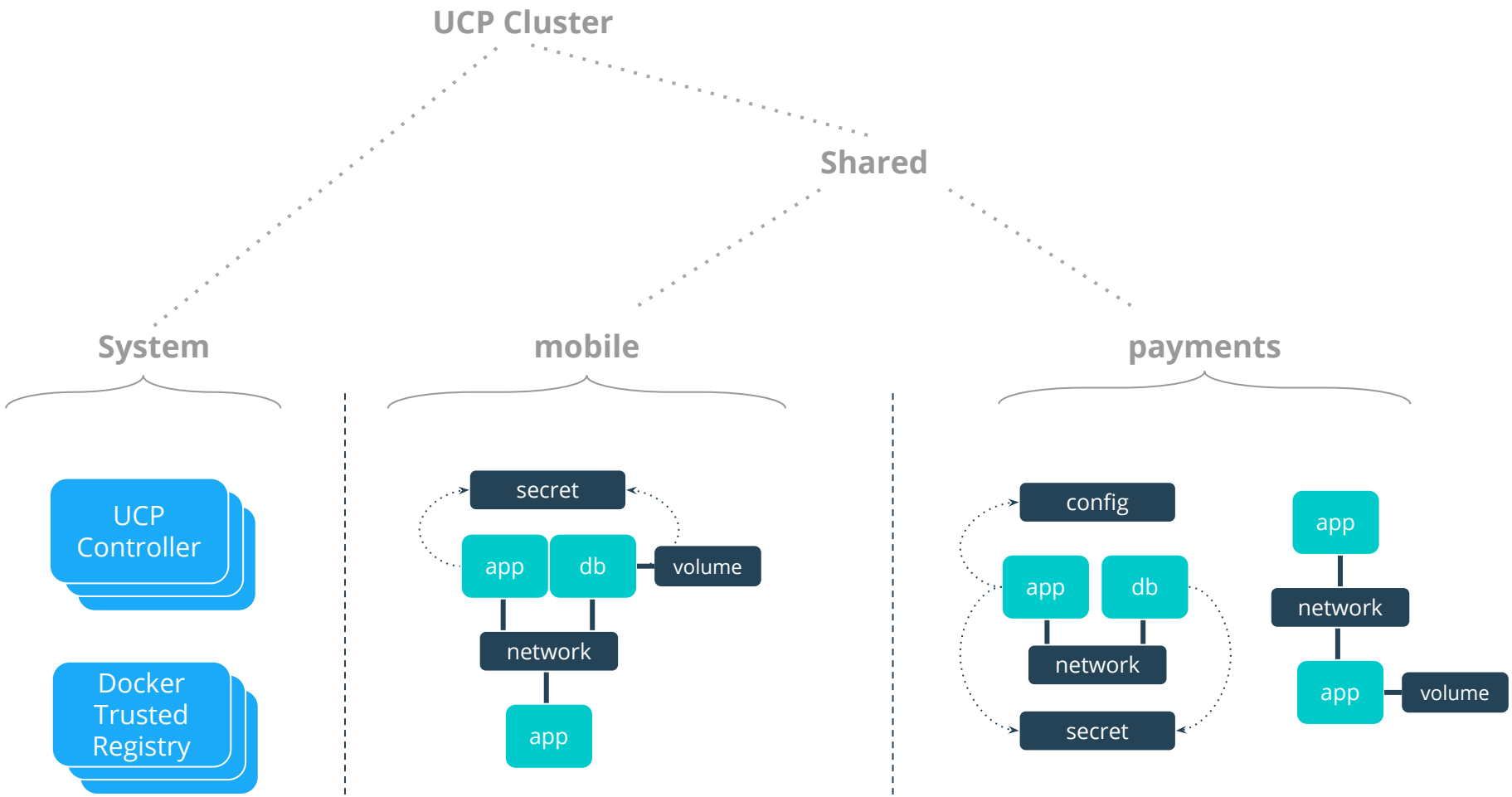
- Enforce node affinity and node anti-affinity rules to allow certain users/teams/orgs to deploy within a subset of nodes or outside certain nodes (eg. Production nodes)
- Set up different security zones within the same cluster to isolate and segregate access of protected information

BENEFITS

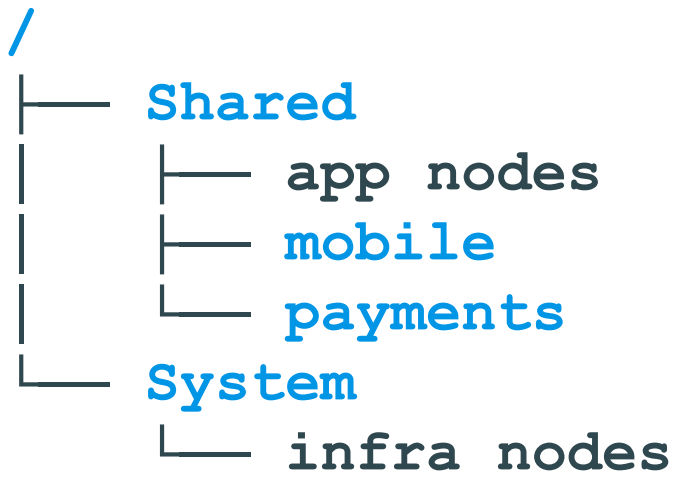
- Support multiple teams within the same cluster while providing physical separation and isolation
- Prevent “noisy neighbors” by limiting a team’s resources to approved nodes
- Meet compliance and regulatory requirements by isolating sensitive workloads to certain nodes and limiting access to those nodes

Access Control at OrcaBank

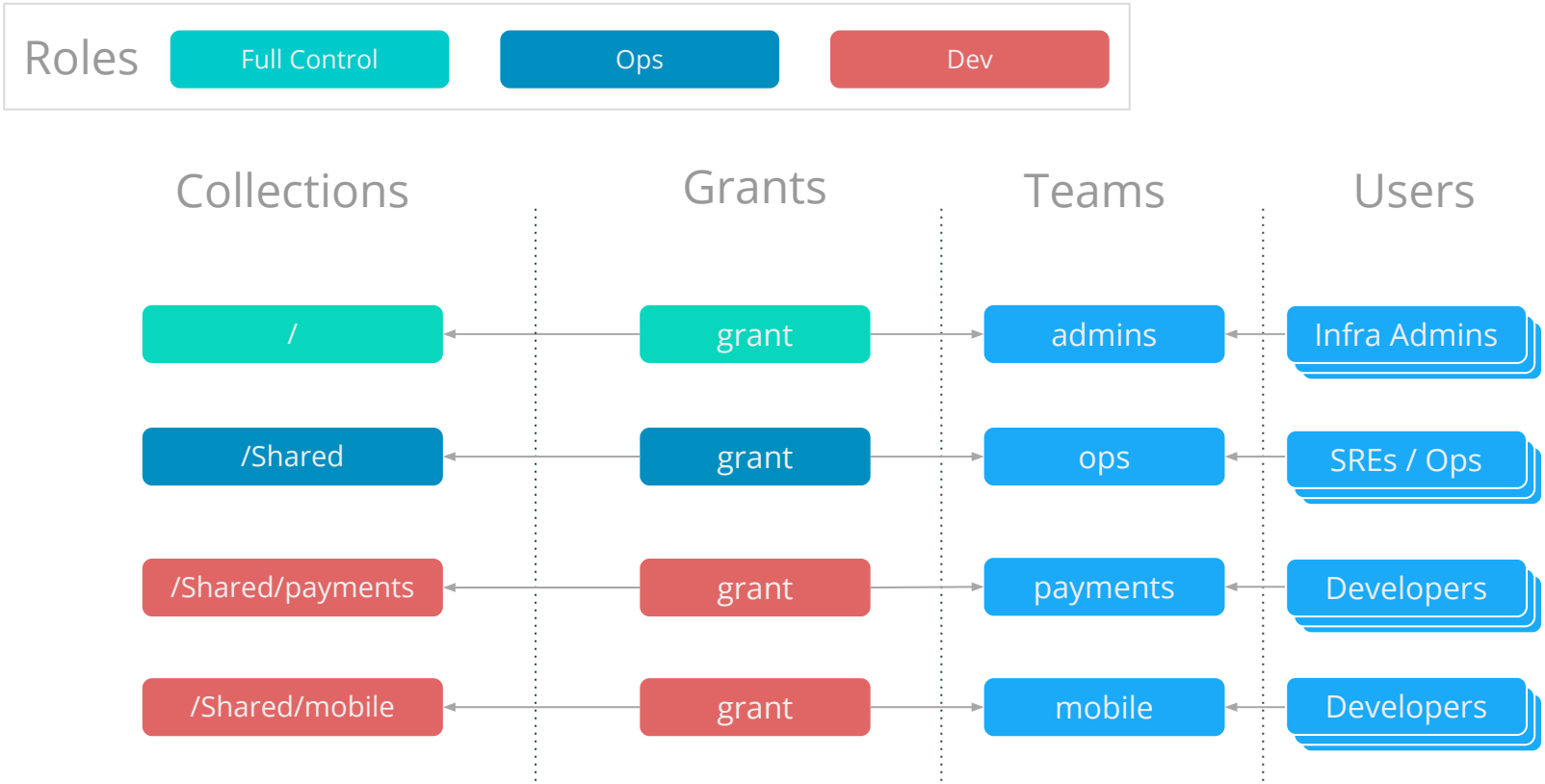
- **Admins** - Full capabilities, full stack
- **Ops team** Full capabilities against application nodes
- **Payments team** can view their containers only
- **Mobile team** can view their containers only


UCP Cluster
Shared
System
mobile
payments
UCP Controller
Docker Trusted Registry
secret
app
db
volume
network
app
config
app
db
network
secret
app
network
app
volume

OrcaBank collection architecture



grant composition



/System

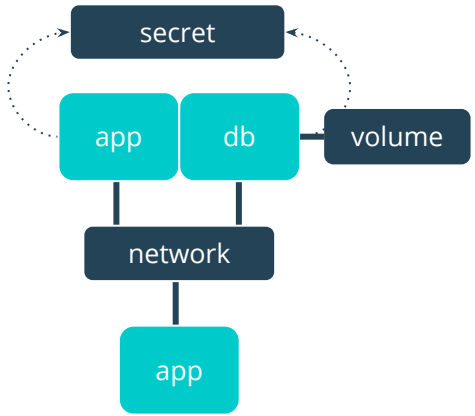
/Shared

Worker Nodes

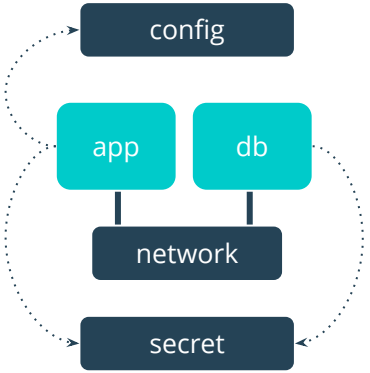
UCP Controller

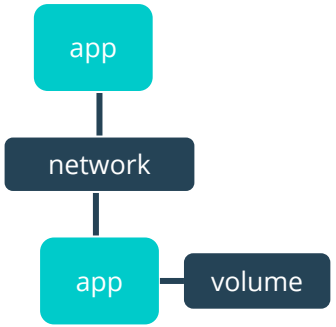
Docker Trusted Registry

/mobile



/payments





/System

/Shared

UCP Controller

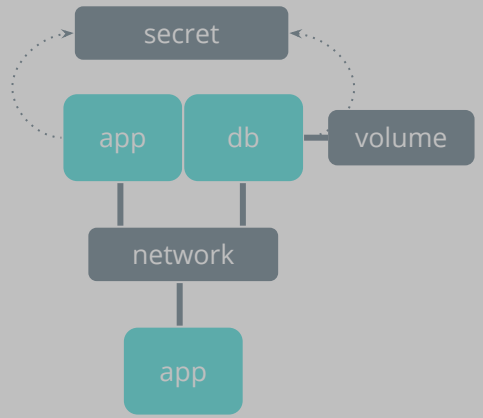
UCP Workers

No Access

Mobile Team

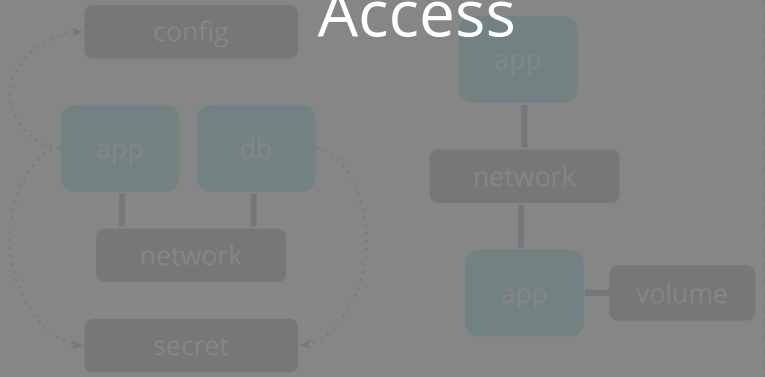
- View containers
- View services
- View logs
- Container Inspect

/mobile



/payments

Docker Trusted Registry



No Access

/System

/Shared

UCP Controller

No Access

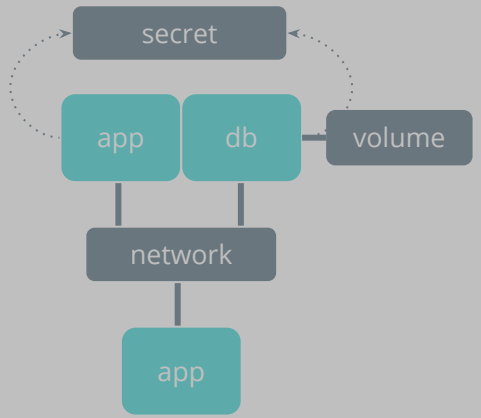
Docker Trusted Registry

UCP Workers

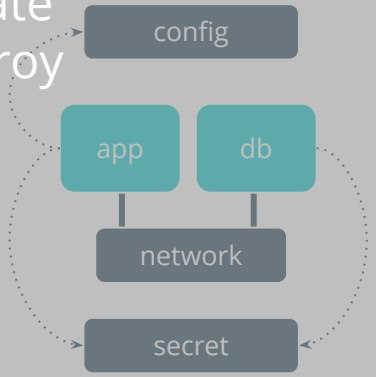
Ops Team

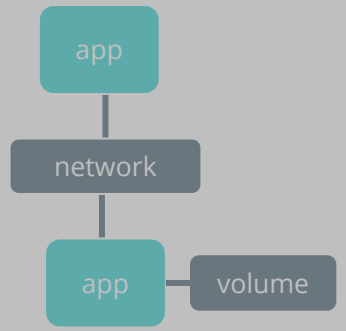
- All Resources
  - Deploy
  - View
  - Update
  - Destroy

/mobile



/payments





Docker secures your software supply chain

Secure Platform

All available isolation and containment

Default security settings and profiles

Docker Bench

Swarm Node Identity

+

Secure Content

Docker Content Trust

Security Scanning

+

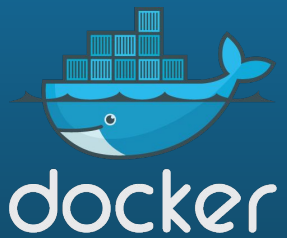
Secure Access

Role based access control (RBAC)

AD/LDAP integration

Auth plugins

Logging



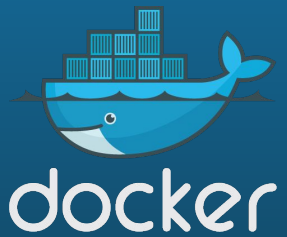
Docker Logging

- Two Types of Logs
- Container vs Engine Logs
- Engine
  - System Logging (e.g journald)
  - Most modern OSs use Journald
- Container
  - Configured at Daemon Level (/etc/docker/daemon.json) applies to ALL containers

OR

  - Configured Container/Service Level (--log-opt) at container runtime. Overrides ^
- Supported Drivers: json, splunk, syslog, gelf, journald, awslogs, fluentd

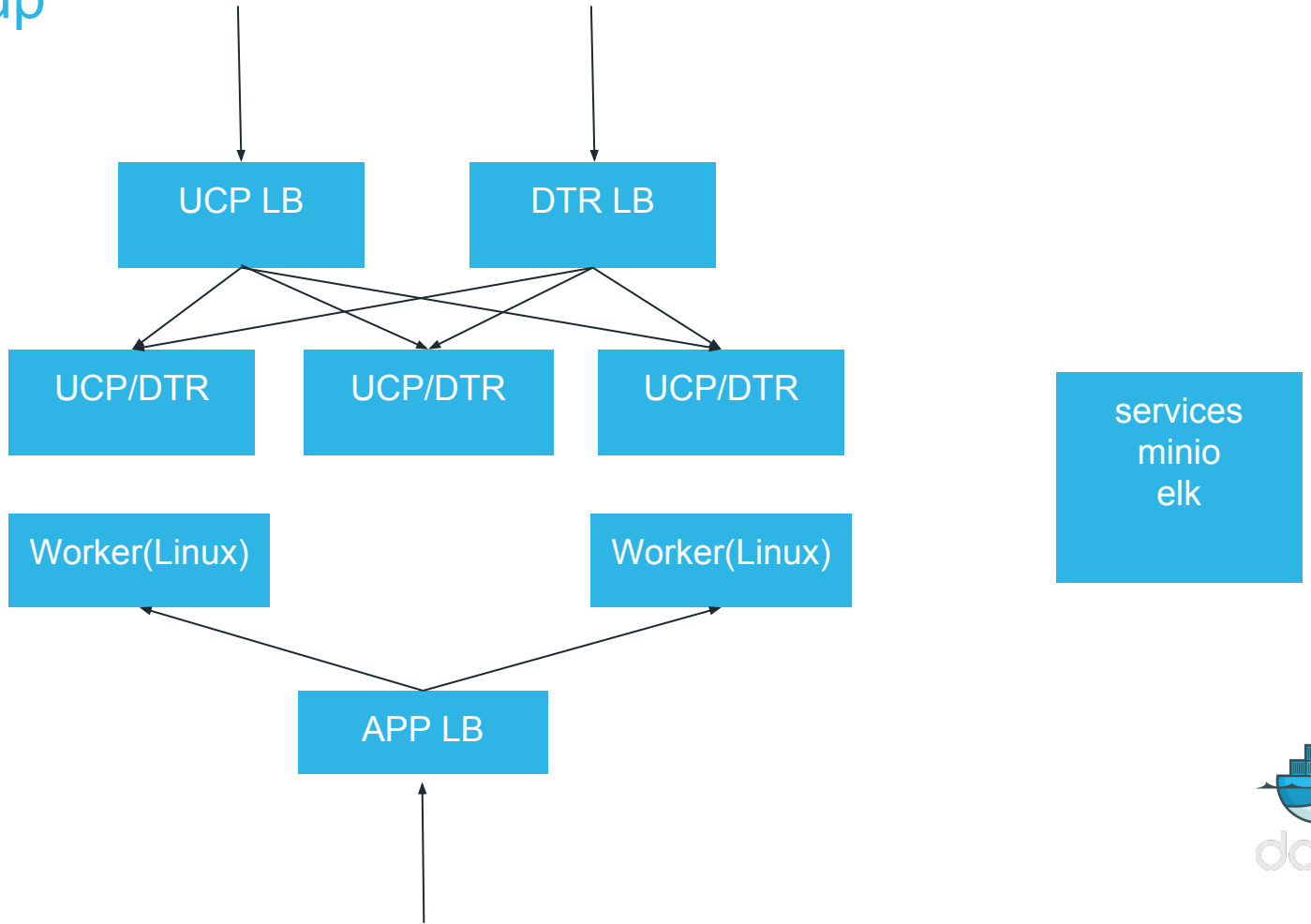
Swarm Lab



Lab Setup

- 1 Setup per Team to include:
  - 3x lb (UCP, DTR, APP)
  - 3x Manager Nodes (UCP and DTR)
  - 1x Infrastructure Services
    - Minio
    - ELK Stack
  - 2x UCP worker nodes
  - CNAMEs DNS entries for UCP, DTR, and application

Lab Setup

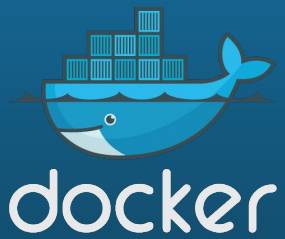

UCP LB
DTR LB
UCP/DTR
UCP/DTR
UCP/DTR
Worker(Linux)
Worker(Linux)
APP LB
services
minio
elk

Swarm Lab Summary

- ❑ Installed Docker EE on the two worker Nodes
- ❑ Created a Swarm (3 managers, 2 worker nodes)
- ❑ Launched a logging service to stream all logs to ELK

Docker Enterprise Edition Standard

Universal Control Plane

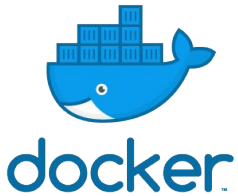


UCP Overview

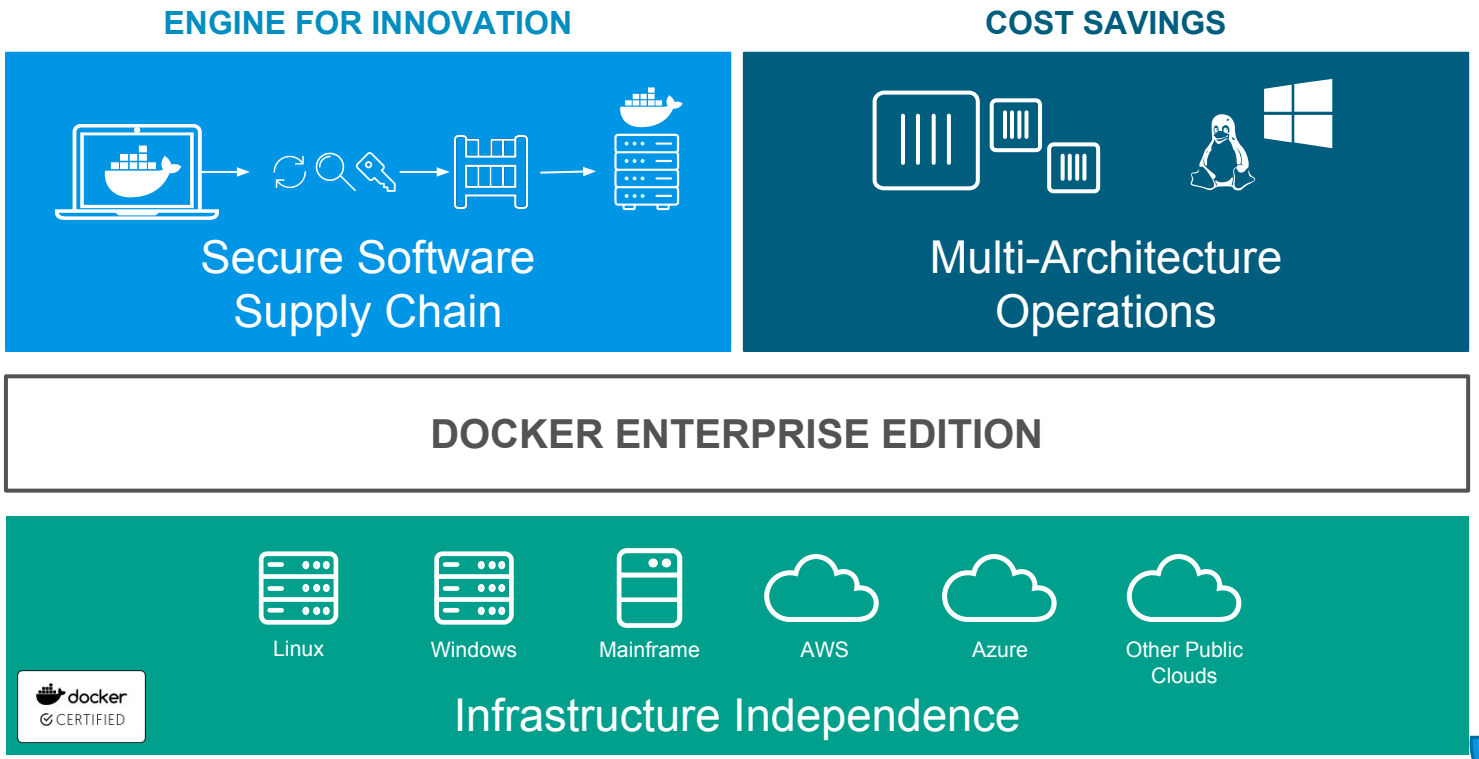
- What's new in 17.06
- Architecture
- Deep Dives
  - Client Bundle
  - Secure Deployment
  - HRM
  - Backup and Recovery
  - Healthchecks
- UCP In Practice: Installation and Ongoing Operations

Docker Enterprise Edition 17.06

What's New Technical Overview
August 2017



Docker is the only Containers-as-a-Service platform for IT that manages and secures diverse applications across disparate infrastructure, both on-premises and in the cloud



Highlights of Docker EE 17.06

Multi-Architecture Operations

- Mixed Windows and Linux cluster support
- Linux on IBM z Systems support
- RBAC for nodes

Secure Software Supply Chain

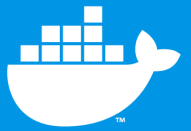
- Automated image promotions
- Immutable repositories
- Multi-stage builds
- Cluster configuration and security APIs

Infrastructure Independence

- Resource collections
- Custom roles
- Enhanced UI
- Docker service logs

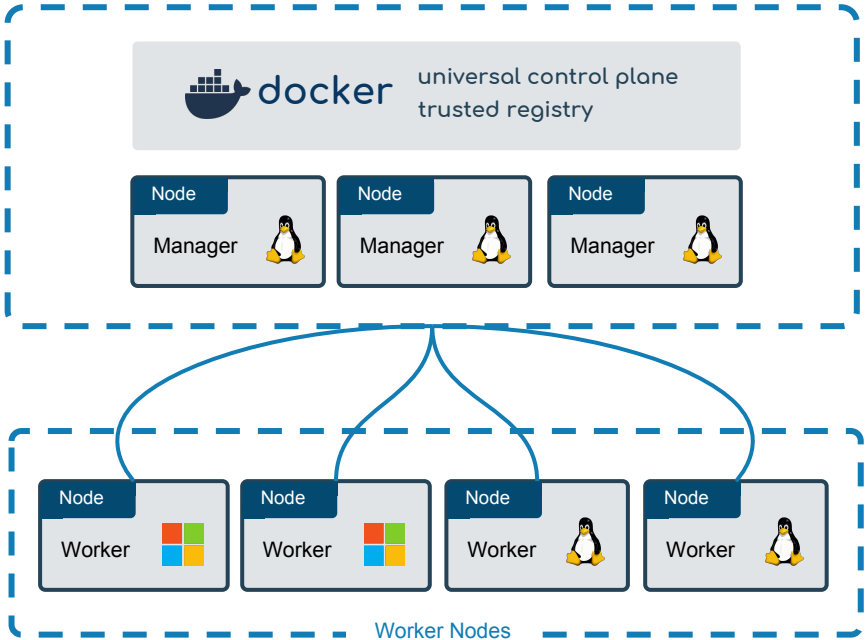
New Feature Details

What’s New in Docker EE 17.06



Mixed Windows and Linux Clusters

UNIFORMLY OPERATE, MANAGE, AND SECURE WINDOWS AND LINUX CONTAINERS



KEY FEATURES

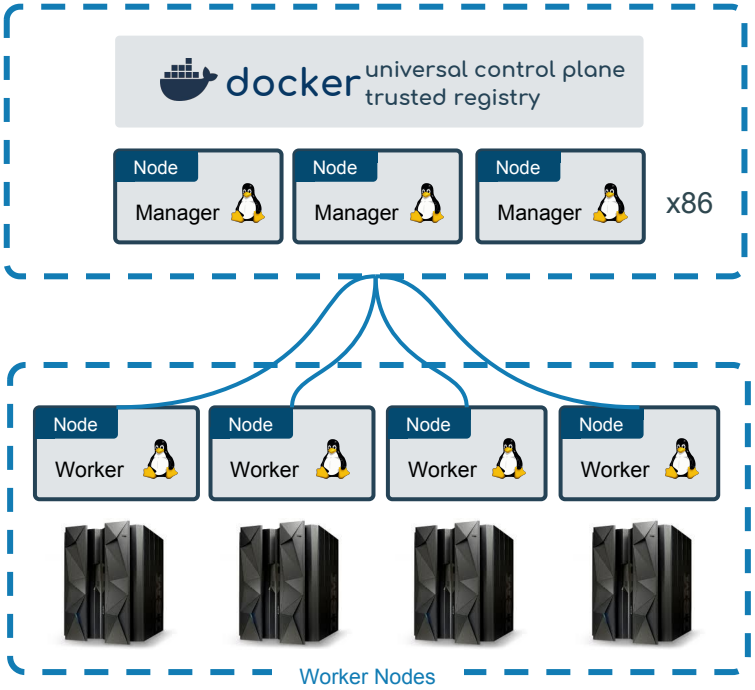
- Extend enterprise security features like image signing, image scanning, and secrets management to both Windows and Linux worker nodes
- Leverage the same LDAP/AD integration and RBAC rules across Windows and Linux nodes
- Visualize all apps in the same environment

BENEFITS

- Improve resource utilization and incur less management overhead with centralized management across Windows and Linux apps
- Reduce risk with enforced processes and policies that are consistent across Windows & Linux apps

Run Docker on IBM Z

GET THE BENEFITS OF CONTAINERS FOR APPS ON MAINFRAME



KEY FEATURES

- Support Docker on SLES, Ubuntu, and RHEL hosted on IBM Z mainframes
- Extend enterprise security features like image signing, image scanning, and secrets management to mainframe Linux apps
- Leverage the same LDAP/AD integration and RBAC rules across all nodes
- Visualize all apps in the same environment

BENEFITS

- Incur less management overhead with centralized management across x86 and IBM Z apps
- Improve maintenance and patching and reduce downtime with containerized mainframe applications
- Improve resource utilization on IBM Z while standardizing the software supply chain

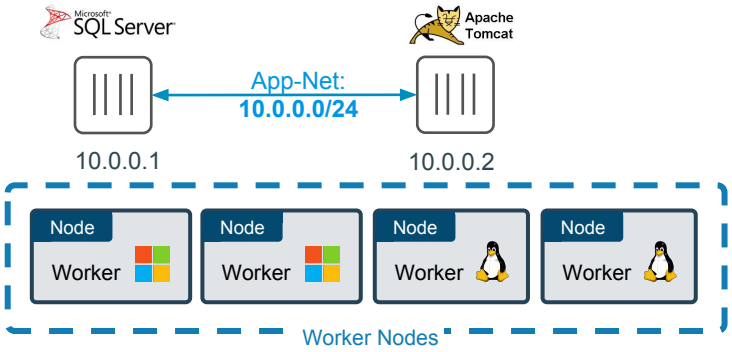
Preparing Windows Nodes

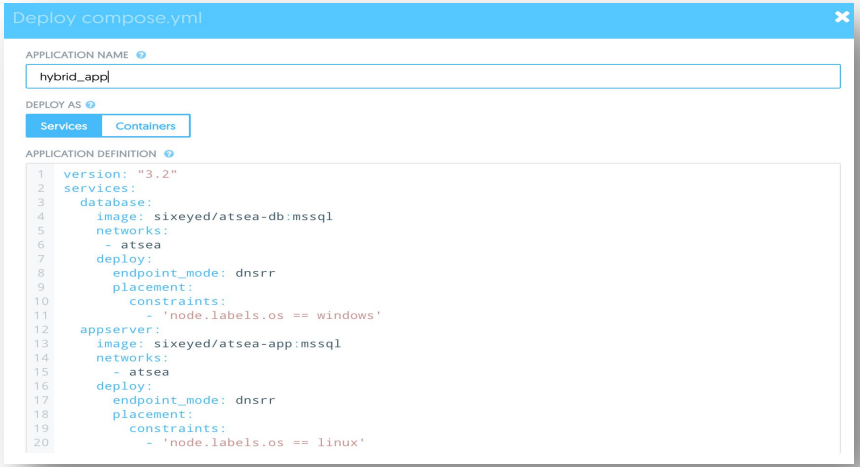
Windows nodes need to complete prerequisite steps before joining a cluster:

- Ensure latest patches have been applied to Windows Server 2016
- Pre-pull UCP Windows agent image
- The actual `swarm join` command is the same for Linux and Windows

Hybrid Applications

CONNECT WINDOWS AND LINUX CONTAINERS





- Leverage best-in-class technologies across Windows and Linux
- Connect Windows and Linux containers in the same cluster through a common overlay network
- Build Compose files for hybrid applications
- Leverage labels and constraints for intelligent placement and scheduling

Closer Look: Hybrid OS App Docker Compose File

```
services:
  database:
    image: sixeyed/atsea-db:mssql
    ports:
      - mode: host
        target: 1433
    networks:
     - atsea
    deploy:
      endpoint_mode: dnsrr
      placement:
        constraints:
          - 'node.platform.os == windows'
  appserver:
    image: sixeyed/atsea-app:mssql
    ports:
      - target: 8080
        published: 8080
    networks:
      - atsea
    deploy:
      placement:
        constraints:
          - 'node.platform.os == linux'
networks:
  atsea:
```

Windows currently only supports host-mode for publishing ports

Windows nodes should be set to use DNS round robin service discovery

Windows and Linux nodes can share a common overlay network

`node.platform.os` is a built in label that can be used for workload placement

Windows Limitations and Alternate Approaches

- Networking
  - No ingress routing mesh
    - Use host mode and the HTTP routing mesh
  - No encrypted networks
    - Encrypt communications at the app level using HTTPs, TLS, etc.
- Secrets
  - Temporary secret files are stored on disk.
    - Use BitLocker to encrypt the secret data at rest.
  - Specify UID, GID, and mode are not supported for secrets on Windows services.
    - However secrets are currently only accessible by administrators and and users with system access within the container.
- Mounts
  - On Windows Docker can’t listen on a Unix socket.
    - Use TCP or a named pipe instead.

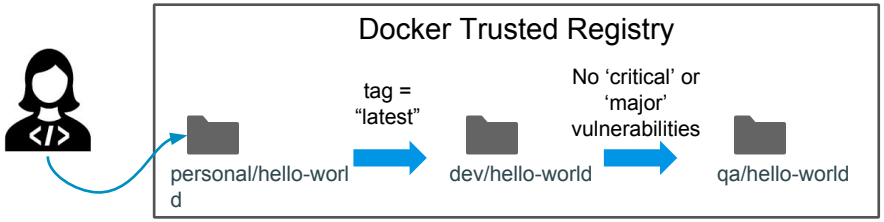
Scanning Windows Images: Additional Steps

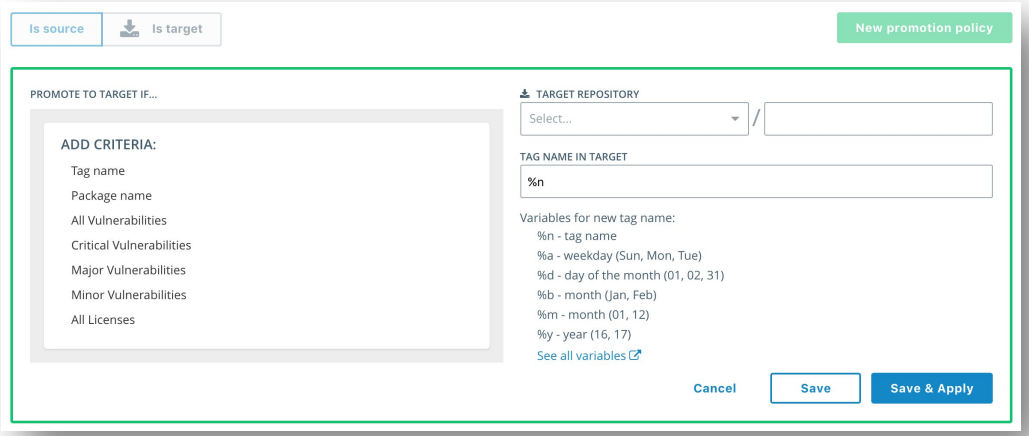
- By default image layers based on official Microsoft images are not pushed to DTR
  - Only the manifest and layers not based on MSFT images are sent
  - DTR cannot scan these foreign layers because they are not present on the system
  - Microsoft Image layers are actually pulled from a Microsoft registry

- Need to modify `C:\ProgramData\docker\config\daemon.json`
  - Add: `"allow-nondistributable-artifacts": ["<dtr-domain>:<dtr-port>"]`

Automatic Image Promotion

SCALE WITH AUTOMATED POLICIES FOR IMAGE MANAGEMENT





KEY FEATURES

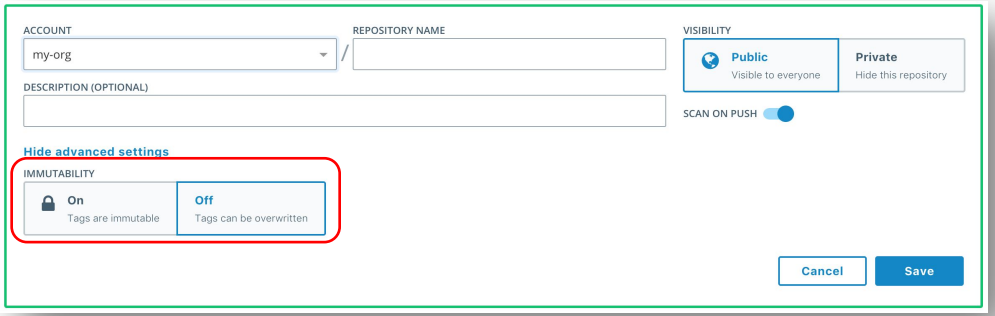
- Define policies to automatically promote images from one repository to another repository within Docker Trusted Registry
  - Each repository can have multiple policies
  - Criteria can include tags, package names, vulnerabilities, or license review
  - Images can be automatically re-tagged when promoted
- Promote images manually as well

BENEFITS

- Automate image management for improved agility, removing manual bottlenecks
- Ensure images are not promoted unless they meet certain criteria for improved consistency

Immutable Repositories

PREVENT INADVERTENT CHANGES TO TAGS



KEY FEATURES

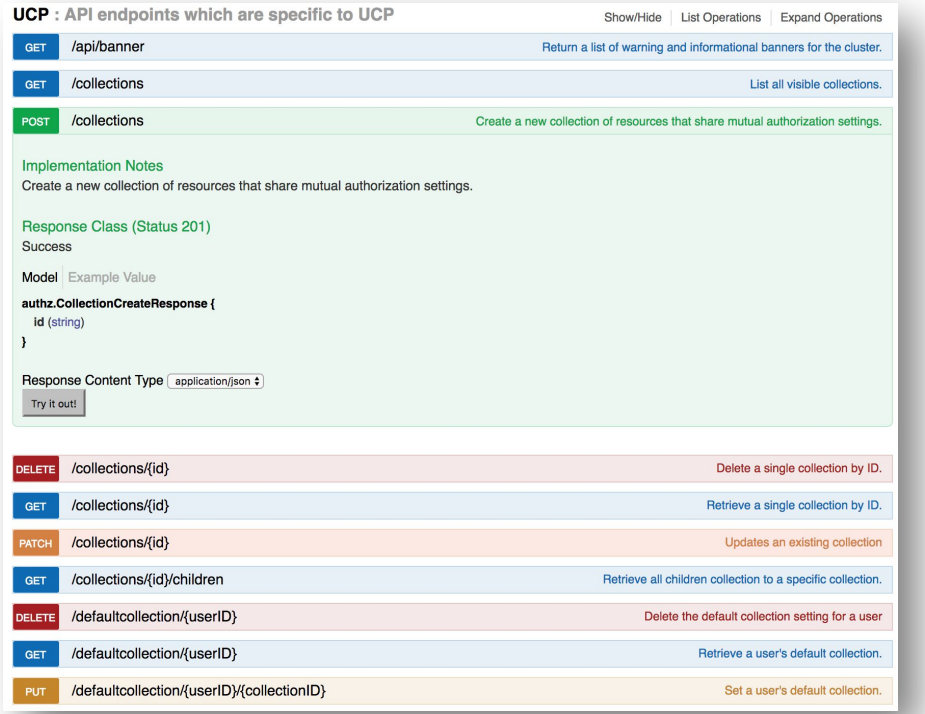
- Prevent users from altering existing tags on repositories that are marked for immutability
  - New tags can be added but pushing tags to existing tags is blocked

BENEFITS

- Improve transparency in repositories by preventing tags from being overwritten – either accidentally or maliciously

New APIs for Configuration and Management

AUTOMATE AND ORCHESTRATE DAY-TO-DAY TASKS



KEY FEATURES

- Automate and orchestrate the management of your CaaS platform with new APIs:
  - Access Control permissions
  - User / Team / Org management
  - Cluster configuration
- Interact with the API directly from the UI

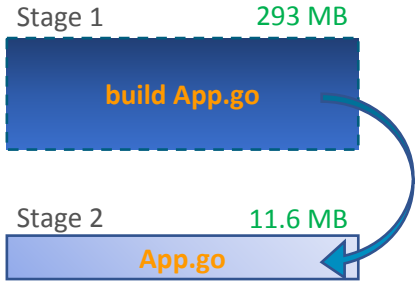
BENEFITS

- Improve administrative efficiency with automated scripts and policies
- Improve security through programmatic handling of user roles and permissions
- Integrate with 3rd party tools with open APIs

Multi-Stage Builds

OPTIMIZE IMAGES FOR MORE EFFICIENT RESOURCE UTILIZATION

```
# First Stage
FROM golang:1.6-alpine

RUN mkdir /app
ADD . /app/
WORKDIR /app
RUN CGO_ENABLED=0 GOOS=linux go build -a -installsuffix cgo -o main .

# Second Stage
FROM alpine
EXPOSE 80
CMD ["/app"]

# Copy from first stage
COPY --from=0 /app/main /app
```



KEY FEATURES

- Use multiple FROM statements to define stages
- Selectively copy artifacts from one stage to another

BENEFITS

- Create thinner images, optimized for production without manual tuning
- Accelerate image pulls and deployment time while also improving resource efficiency in both the registry and resulting containers

Multi-Stage Builds in Action

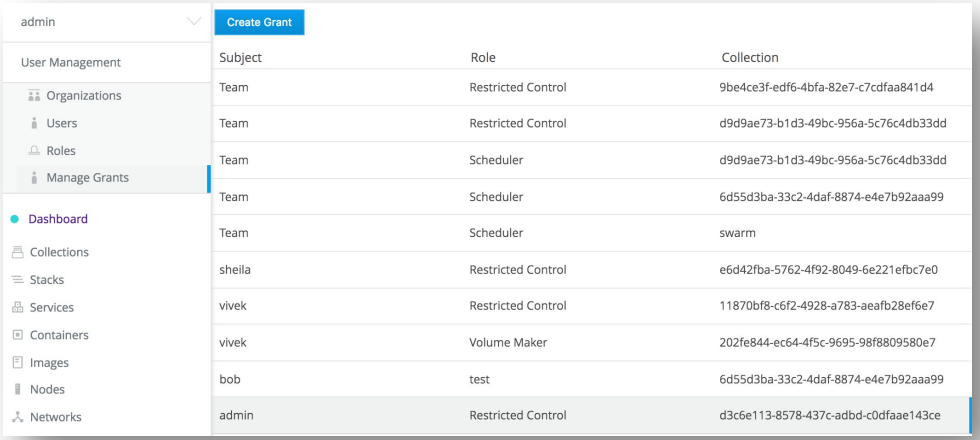
```
docker build -t mikegcoleman/multi:1 .
```

```
FROM node:latest AS storefront
WORKDIR /usr/src/atsea/app/react-app
COPY react-app .
RUN npm install
RUN npm run build

FROM maven:latest AS appserver
WORKDIR /usr/src/atsea
COPY pom.xml .
RUN mvn -B -f pom.xml -s /usr/share/maven/ref/settings-docker.xml dependency:resolve
COPY . .
RUN mvn -B -s /usr/share/maven/ref/settings-docker.xml package -DskipTests

FROM java:8-jdk-alpine
RUN adduser -Dh /home/gordon gordon
WORKDIR /static
COPY --from=storefront /usr/src/atsea/app/react-app/build/ .
WORKDIR /app
COPY --from=appserver /usr/src/atsea/target/AtSea-0.0.1-SNAPSHOT.jar .
ENTRYPOINT ["java", "-jar", "/app/AtSea-0.0.1-SNAPSHOT.jar"]
CMD ["--spring.profiles.active=postgres"]
```

```
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
mikegcoleman/multi  1                   dcb067be6d33        17 seconds ago      210MB
<none>              <none>              5a3dbc1cc11b        24 seconds ago      889MB
<none>              <none>              203fc1a9e91a        2 minutes ago       808MB
node                latest              5e553613f1d8        6 hours ago         669MB
maven               latest              88714384d642        2 weeks ago         749MB
java                8-jdk-alpine        3fd9dd82815c        5 months ago        145MB
```

Expanded Access Control

CUSTOMIZE ROLES AND IMPROVE ACCESS GRANULARITY AND CONTROL



KEY FEATURES

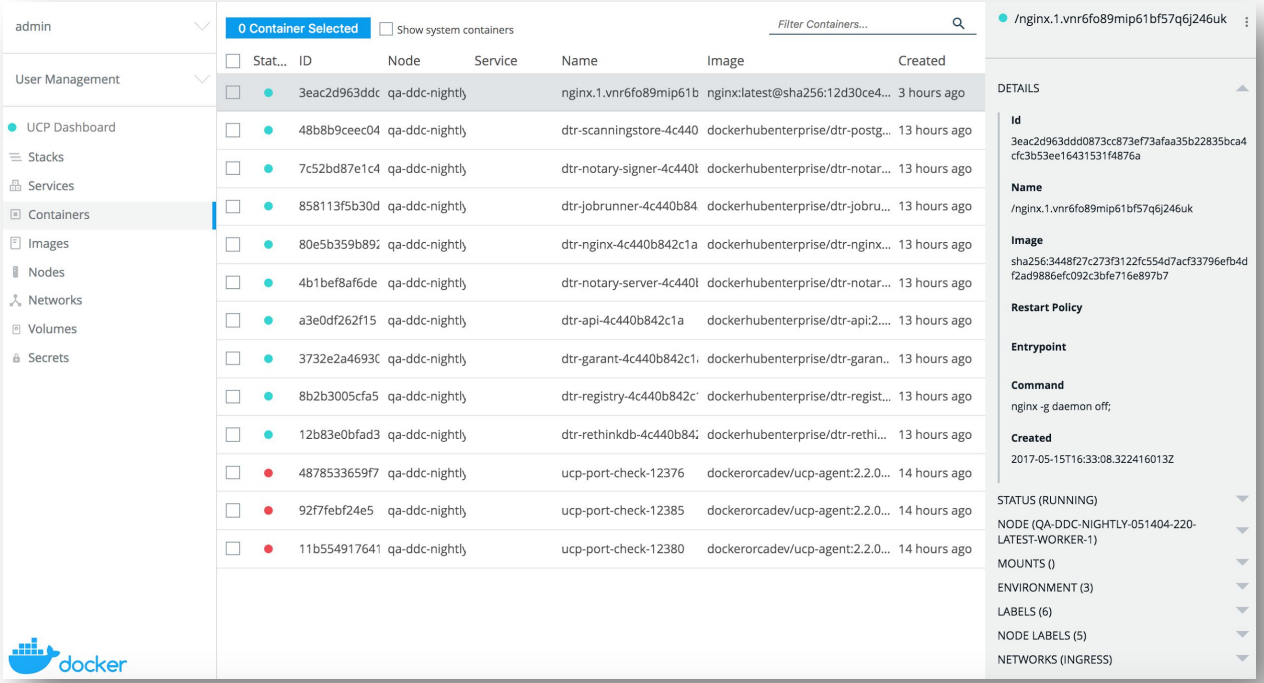
- Create custom roles with granular action permissions or leverage pre-defined default roles
- Define resource collections to more easily visualize and assign users to specific cluster resources
- Apply roles to orgs, teams, or users

BENEFITS

- Easily manage complex organizations by defining permissions across user groups and resource collections
- Improve security by setting permissions that align to your organization's requirements and practices
- Meet compliance and regulatory requirements through tight access control and separation of roles and responsibilities

Collections

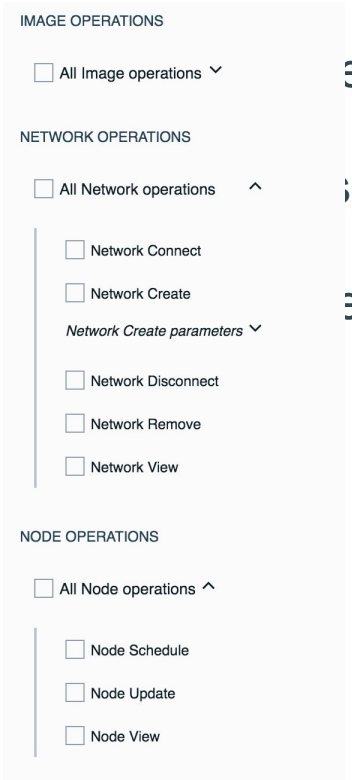
IDENTIFY AND LOCATE CONTAINERS AND RESOURCES MORE QUICKLY AND APPLY PERMISSIONS THROUGH RESOURCE COLLECTIONS



KEY FEATURES

- Create and filter by resource collections
- Inspect resource details
- Faster response time
- Used to apply permissions
- Defined via Docker label

Roles



efault roles

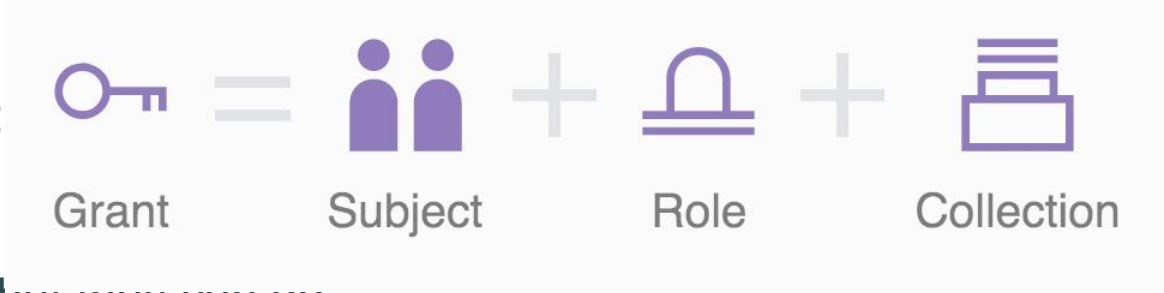
s can be selected to create arbitrary custom roles

ery granular permissions

a single operation (network create or node schedule)

Enhanced RBAC: Additional Details

Subject:



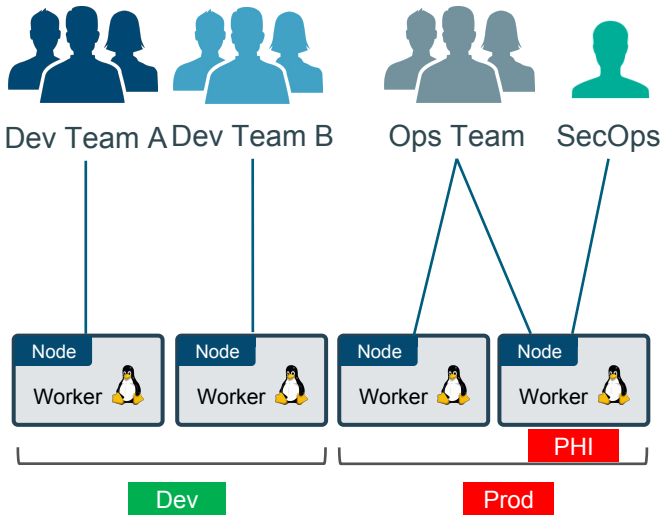
Role: What they can do

Collection: Where work can be done

Grant: 1:1:1 mapping of subject to role to collection.

RBAC for Nodes

SUPPORT SECURE MULTI-TENANCY ACROSS MULTIPLE TEAMS THROUGH NODE-BASED ISOLATION AND SEGREGATION



KEY FEATURES

- Enforce node affinity and node anti-affinity rules to allow certain users/teams/orgs to deploy within a subset of nodes or outside certain nodes (eg. Production nodes)
- Set up different security zones within the same cluster to isolate and segregate access of protected information

BENEFITS

- Support multiple teams within the same cluster while providing physical separation and isolation
- Prevent “noisy neighbors” by limiting a team’s resources to approved nodes
- Meet compliance and regulatory requirements by isolating sensitive workloads to certain nodes and limiting access to those nodes

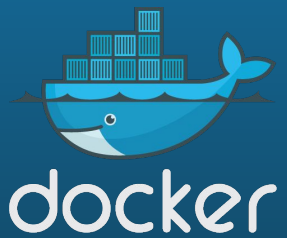
Additional Enhancements

- “docker service logs”
  - Batch-retrieve logs for the entire service
  - Previously experimental, now GA
- “docker prune --filter label”
  - Prune on an individual node
  - Target or avoid specific labels (e.g. label critical system or app resources)
- Healthcheck grace periods
  - `--start-period` provides delay before health check activates
  - Useful for long startup times
- Update/rollback order
  - Define whether old task is stopped before starting new one, or if old and new tasks should overlap
- Webhooks UI
  - Set up notifications for other 3rd party and monitoring tools
- Chinese language support

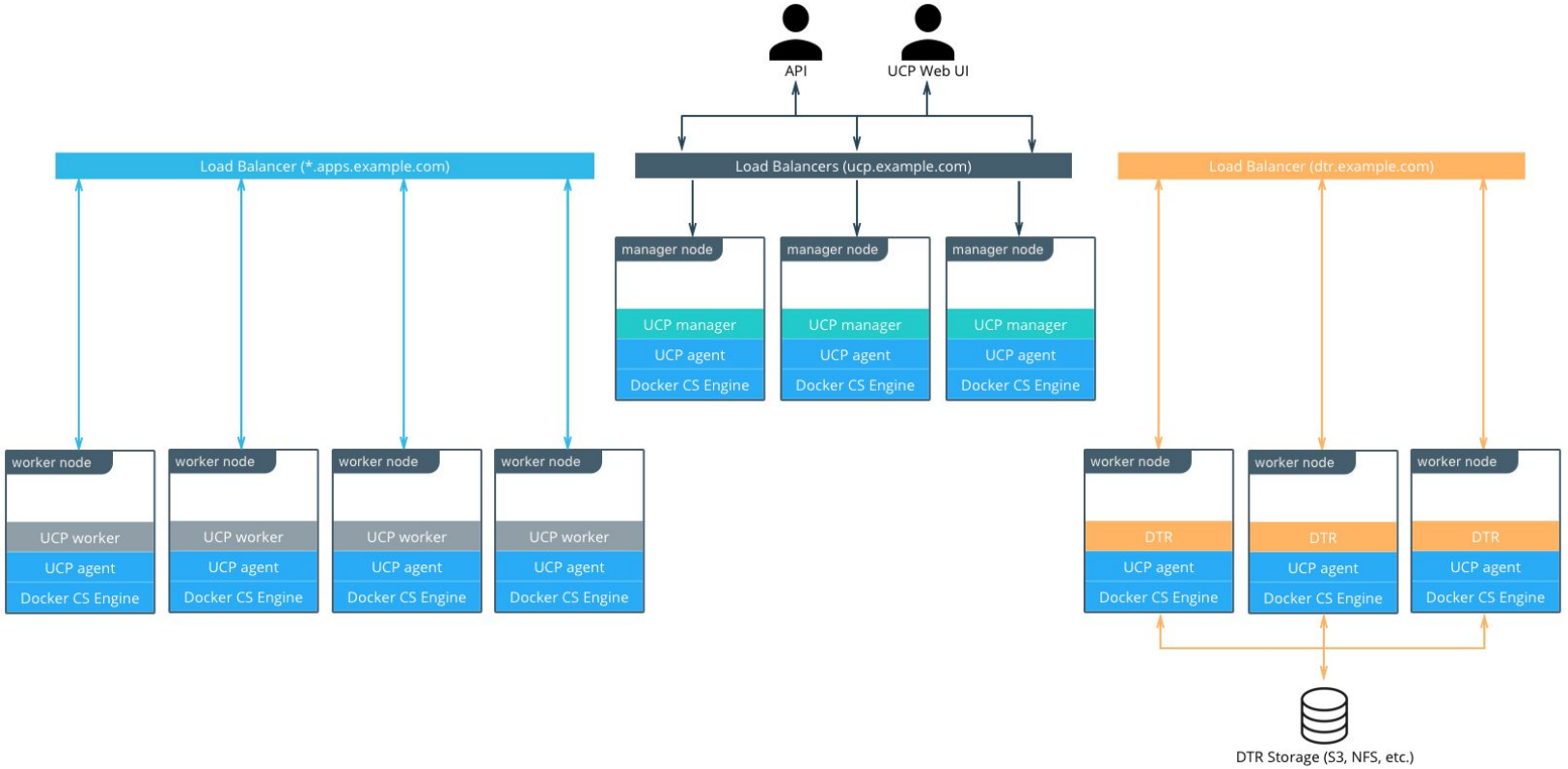
Docker Subscription

	CE	EE Basic Supported container runtime and orchestration	EE Standard Integrated security and management	EE Advanced Multi-tenancy and specialized compliance
Support	Community Support	Business Day or Business Critical	Business Day or Business Critical	Business Day or Business Critical
Container engine and built in orchestration, networking, security, plugins	x	x	x	x
CaaS enabled platform supporting both Windows and Linux		x	x	x
Docker Certified Infra, Plugins and ISV Containers		x	x	x
Image management with private registry, caching (Windows and Linux)			x	x
Integrated container app management			x	x
Multi-tenancy with RBAC, LDAP/AD			x	x
Integrated secrets mgmt, image signing, policy (Windows and Linux)			x	x
Secure multi-tenancy				x
Automated image promotion				x
Image security scanning and continuous vulnerability monitoring (Windows and Linux)				x

UCP Architecture



Docker Enterprise Advanced Architecture



docker

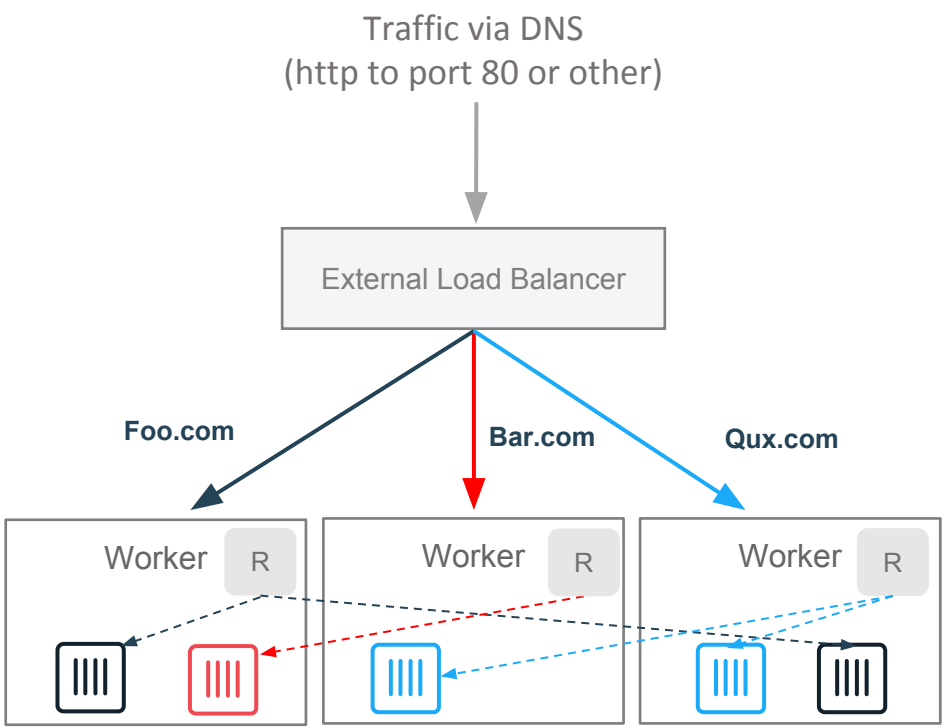
UCP Building Blocks

UCP component	Description
ucp-agent	Monitors the node and ensures the right UCP services are running
ucp-reconcile	When ucp-agent detects that the node is not running the right UCP components, it starts the ucp-reconcile container to converge the node to its desired state. It is expected for the ucp-reconcile container to remain in an exited state when the node is healthy.
ucp-auth-api	The centralized service for identity and authentication used by UCP and DTR
ucp-auth-store	Stores authentication configurations, and data for users, organizations and teams
ucp-auth-worker	Performs scheduled LDAP synchronizations and cleans authentication and authorization data
ucp-client-root-ca	A certificate authority to sign client bundles
ucp-cluster-root-ca	A certificate authority used for TLS communication between UCP components
ucp-controller	The UCP web server
ucp-kv	Used to store the UCP configurations. Don't use it in your applications, since it's for internal use only
ucp-metrics	Used to collect and process metrics for a node, like the disk space available
ucp-proxy	A TLS proxy. It allows secure access to the local Docker Engine to UCP components
ucp-swarm-manager	Used to provide backwards-compatibility with Docker Swarm

Client Bundle

```
root @ ~/bundle/ucp.dockerenterpris.dckr.org  [111] 🐳 → tree
.
|-- ca.pem
|-- cert.pem
|-- cert.pub
|-- env.cmd
|-- env.ps1
|-- env.sh
`-- key.pem

0 directories, 7 files

root @ ~/bundle/ucp.dockerenterpris.dckr.org  [112] 🐳 → openssl x509 -noout -text -in ca.pem | grep 'Subject\|Issuer'
        Issuer: O=Digital Signature Trust Co., CN=DST Root CA X3
        Subject: O=Digital Signature Trust Co., CN=DST Root CA X3
        Subject Public Key Info:
            X509v3 Subject Key Identifier:

root @ ~/bundle/ucp.dockerenterpris.dckr.org  [113] 🐳 → openssl x509 -noout -text -in cert.pem | grep 'Subject\|Issuer'
        Issuer: CN=swarm-ca
        Subject: C=, ST=, L=, O=Orca: NZDQ:ES53:V5PR:POSH:Z2BI:EI3D:CAEA:45SM:LHTP:QA3Z:Q33E:A4U2, OU=Client, CN=moby
        Subject Public Key Info:
            X509v3 Subject Key Identifier:
            X509v3 Subject Alternative Name:

root @ ~/bundle/ucp.dockerenterpris.dckr.org  [114] 🐳 → cat env.sh
export DOCKER_TLS_VERIFY=1
export DOCKER_CERT_PATH="$(pwd)"
export DOCKER_HOST=tcp://ucp.dockerenterprise.dckr.org:443
#
# Bundle for user moby
# UCP Instance ID NZDQ:ES53:V5PR:POSH:Z2BI:EI3D:CAEA:45SM:LHTP:QA3Z:Q33E:A4U2
#
# This admin cert will also work directly against Swarm and the individual
# engine proxies for troubleshooting.  After sourcing this env file, use
# "docker info" to discover the location of Swarm managers and engines.
# and use the --host option to override $DOCKER_HOST
#
# Run this command from within this directory to configure your shell:
# eval $(<env.sh)
```

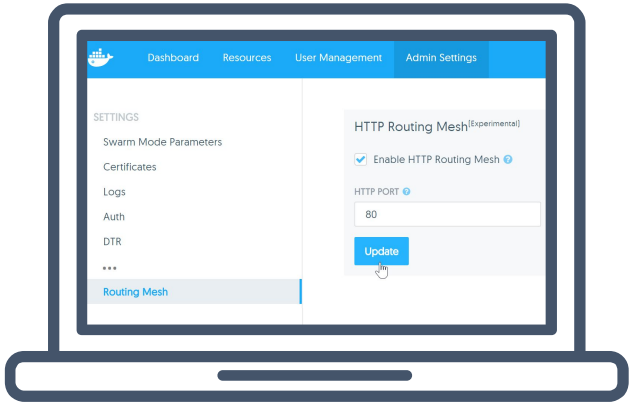
Built in HTTP Routing Mesh



- Extend TCP routing mesh to HTTP hostname routing for services
- HTTPS support via SNI protocol
- Support for multiple HRM networks for enhanced app isolation
- External LB routes hostnames to nodes
- Can add hostname routing via UI
- Non-service containers continue to use Interlock ref arch

docker

Enabling and Using the HTTP Routing Mesh




```
docker service create -p 8080
\
--network ucp-hrm \
--label
com.docker.ucp.mesh.http=8080=
http://foo.example.com \
...
```

Enable HTTP routing mesh in DDC

1

a) Creates **ucp-hrm** *network*

b) Creates **ucp-hrm** *service* and exposes it on a port (80 by default)

Create new service

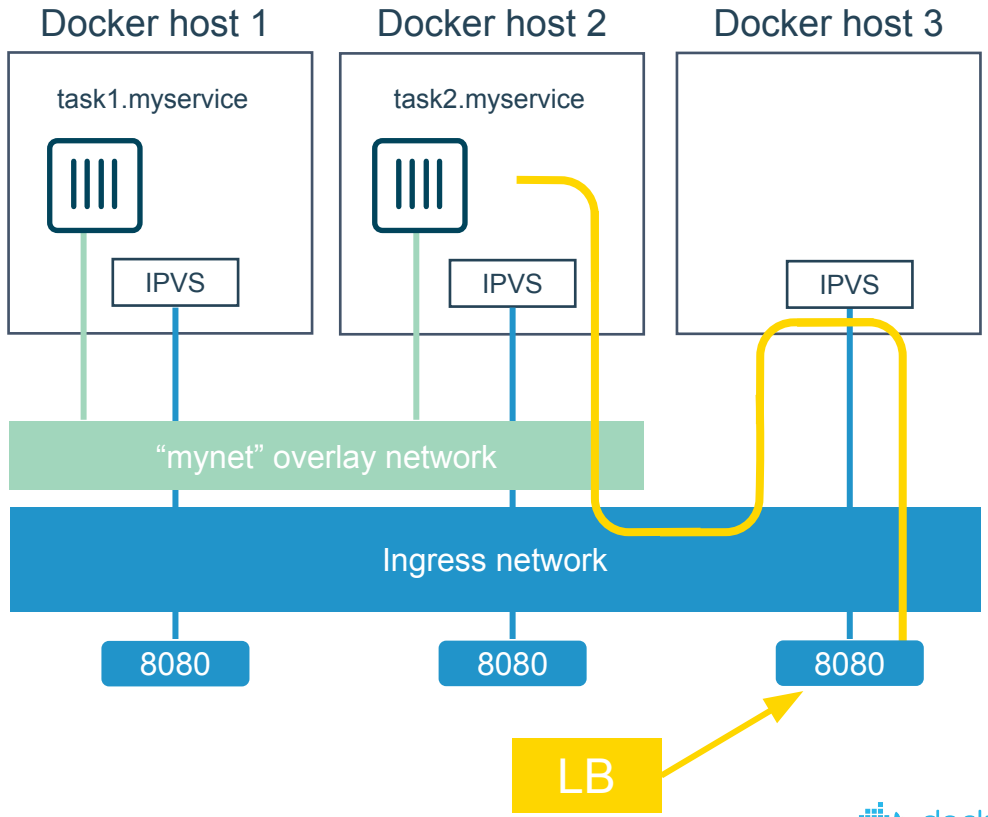
2

a) Add to **ucp-hrm** network

b) Assign **label** specifying hostname
(links service to http://foo.example.com)

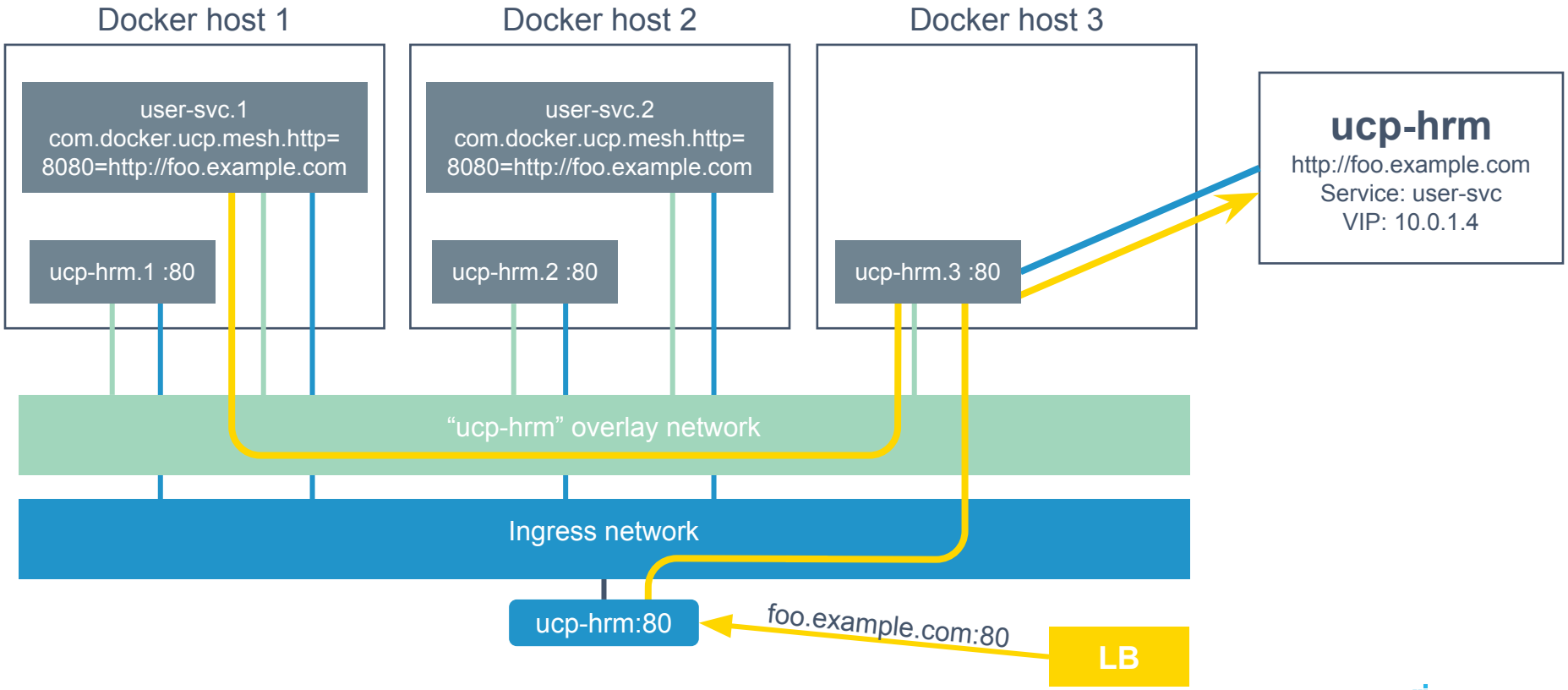
Routing Mesh Example

1. Three Docker hosts
2. New service with 2 tasks
3. Connected to the **mynet** overlay network
4. Service published on port 8080 swarm-wide
5. External LB sends request to Docker host 3 on port 8080
6. Routing mesh forwards the request to a healthy task using the ingress network

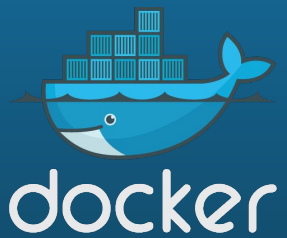


docker

HTTP Routing Mesh Example



UCP Operations

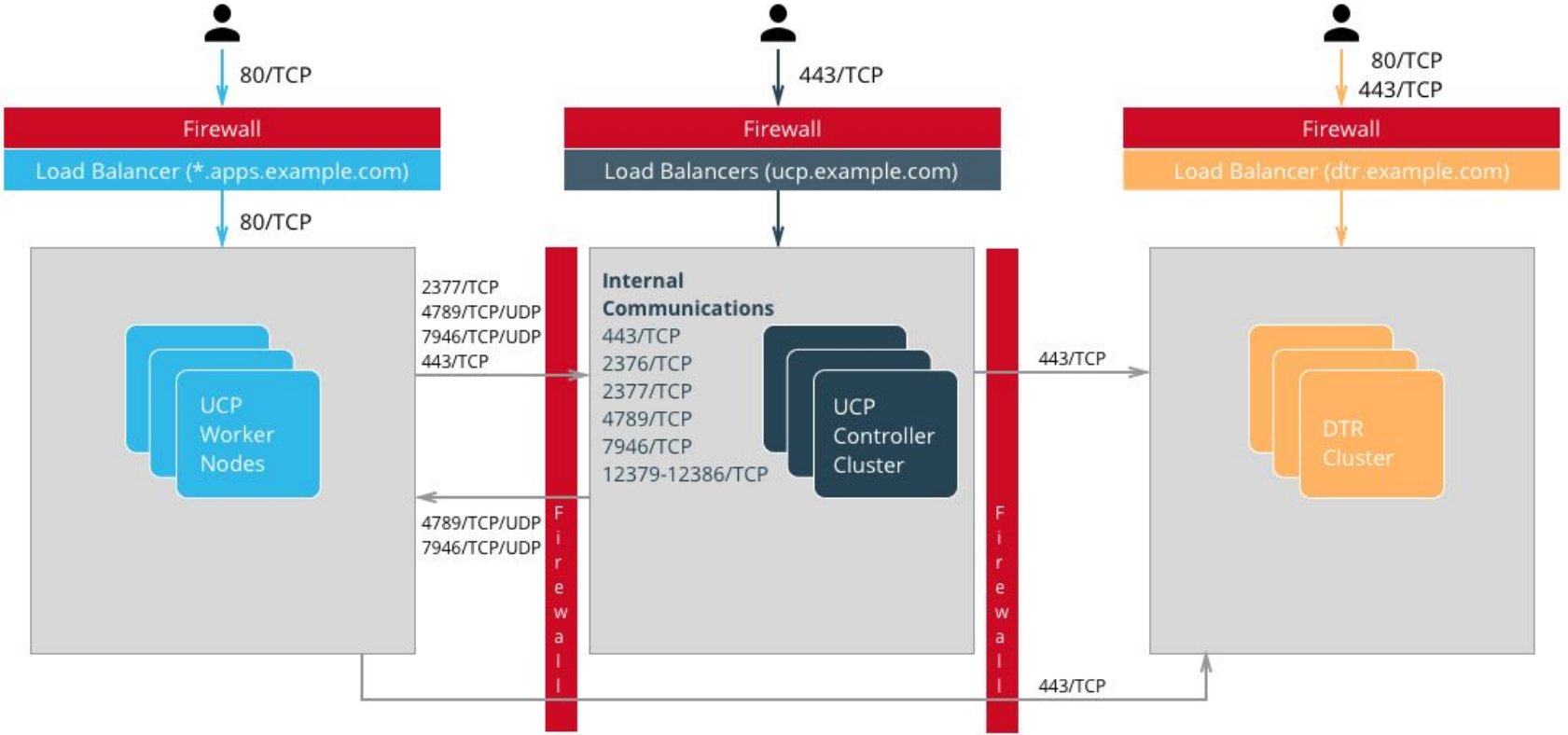


UCP Installation

- Single operation on Swarm manager node
- UCP will bootstrap itself on every node in the cluster

```
# Install UCP
$ docker container run --rm -it --name ucp \
  -v /var/run/docker.sock:/var/run/docker.sock \
  docker/ucp:2.2.2 install \
  --host-address <node-ip-address> \
  --controller-port <port> \
  --san team1.ucp-lb.dockerpartners.org \
  --debug \
  --interactive
```

Environment Network Requirements



Network Latency Consideration

Role	Component	Heartbeat (ms)	Timeout (ms)	Impact
Swarm Manager	Raft (SwarmKit)*	1000	3000	swarm ops
Swarm Manager, Swarm Worker	Gossip (libnetwork)	1000	5000	overlay, ingress, routing mesh, dns, lb
UCP Manager	Etcd*	500	5000	UCP ops.
UCP Manager, DTR	Rethink*	2000	10000	UCP and DTR Ops.

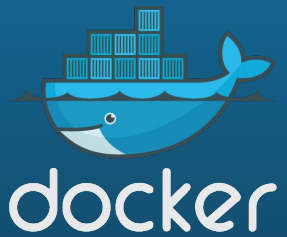
Load Balancer Configuration

- DNS entry for UCP
- TCP / SSL passthrough
- Set idle timeout to 300s
- Health checks
  - https://<ucp_controller>/_ping

Backup & Restore

- Set automated backups (separate for UCP and DTR)
- Impact
  - HA: one manager will be down → no impact
  - non-HA: there will be some downtime (no impact to applications)
- What do Backups do:
  - Users, Teams and Permissions.
  - Cluster Configuration, such as the default Controller Port or the KV sto timeout.
  - DDC Subscription License.
  - Options on Scheduling, Content Trust, Authentication Methods and Reporting
- ALWAYS backup before upgrades!
- Swarm Backup is separate (need to backup /var/lib/docker/swarm)

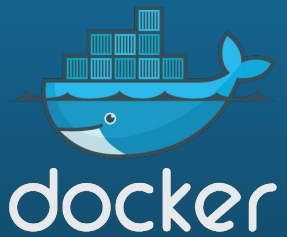
UCP Lab



Lab 2 Summary

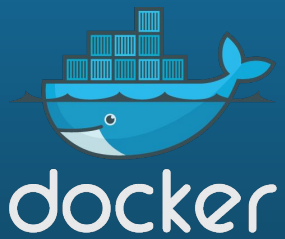
- ❑ Installed Docker EE Standard (UCP)
- ❑ Generated Let's Encrypt Certs
- ❑ Installed generated certs
- ❑ Configured a Loadbalancer
- ❑ Installed your license
- ❑ Set up HRM
- ❑ Configured node labels
- ❑ Performed a backup

Break



Docker Enterprise Edition Standard

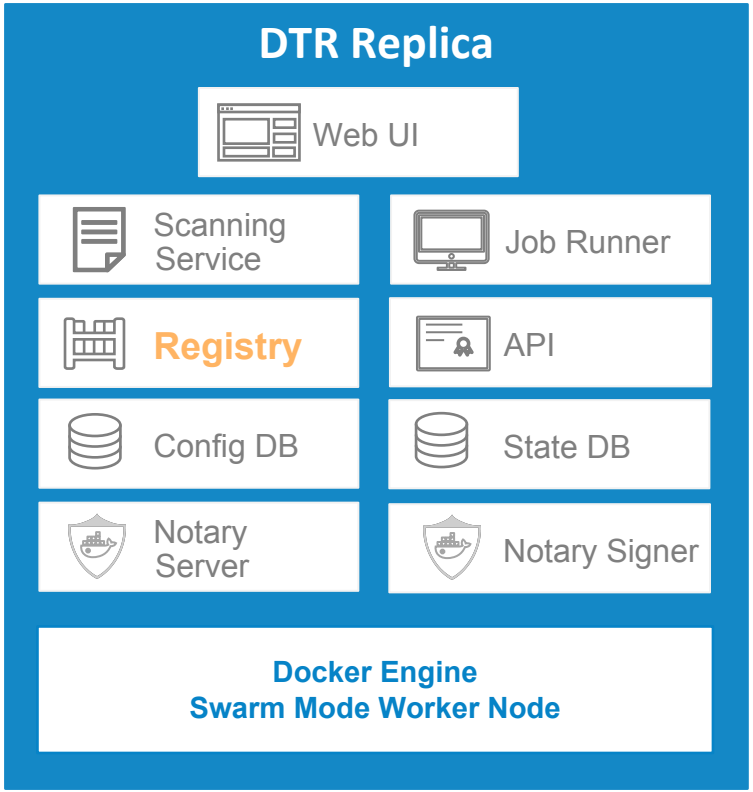
Docker Trusted Registry



DTR Overview

- Overview and Value Prop
- Architecture
- Deep Dives
  - API
  - Storage
  - Garbage Collection
  - Configuration Data
  - Content Caching
  - Webhooks
- Installation Best Practices
- Troubleshooting

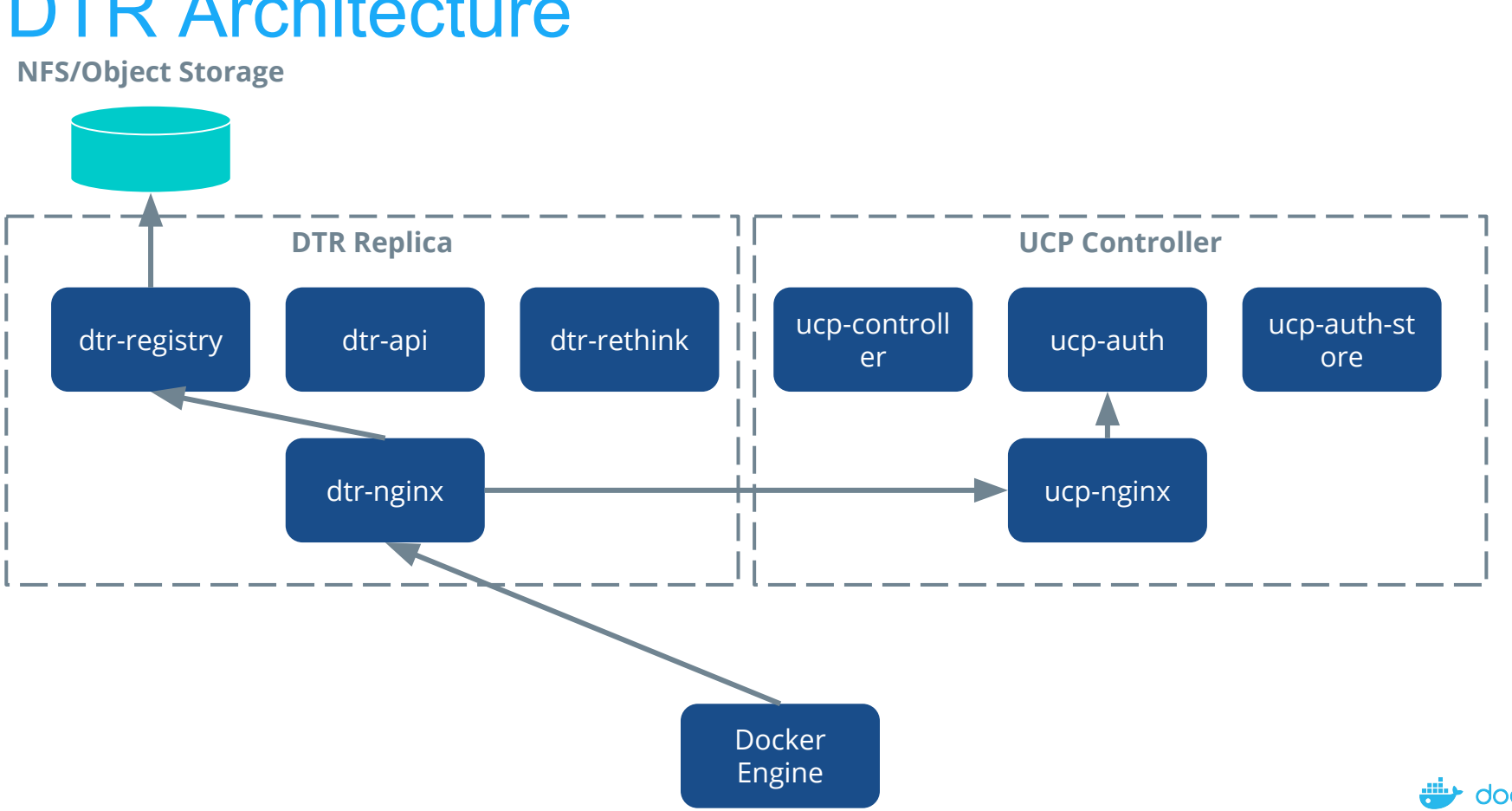
Deep Dive: DTR Replica Worker Nodes



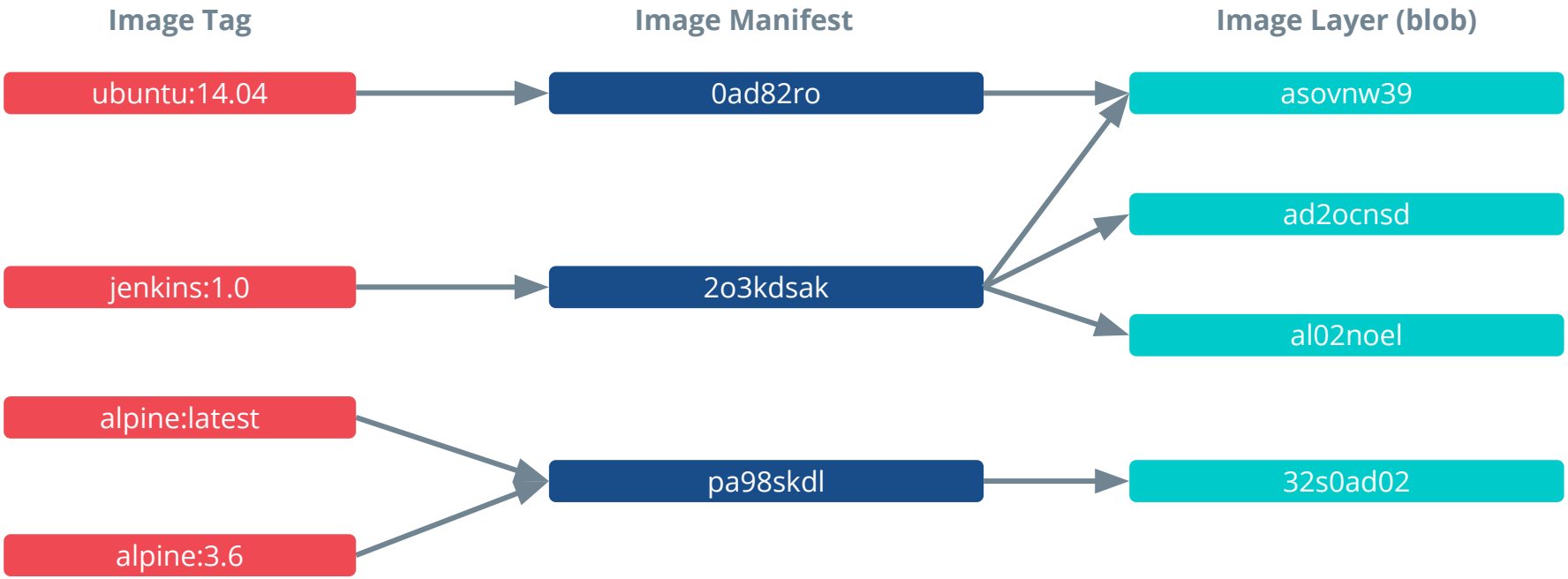
- Point and click UI to manage repos, images and team collaboration
- Image management with labels, tag store and garbage collection
- HA and redundant system
- Content security with built in image signing and verification
- Wide variety of storage driver support for image store

docker

DTR Architecture



DTR Image Objects

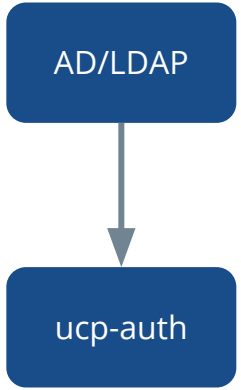


docker

DTR State

- Image Blobs
- Image Manifests

- Repository Structure/Metadata
- DTR Configurations
- Repo-Team Membership



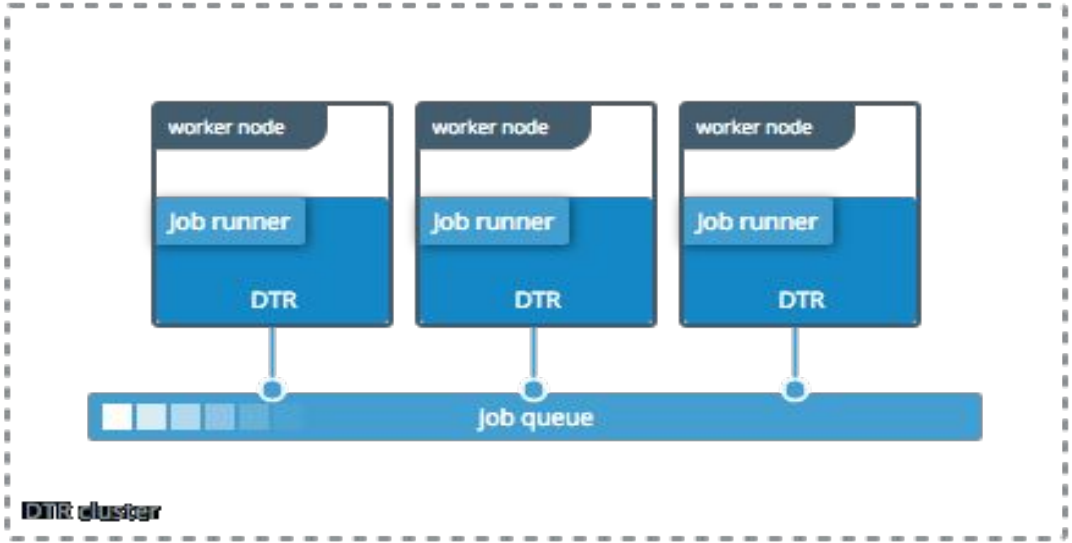
- Users
- Teams
- Orgs

DTR Jobs

- Garbage Collection
- Security Vulnerability Scanning
- Webhooks
- Image Promotions

Future

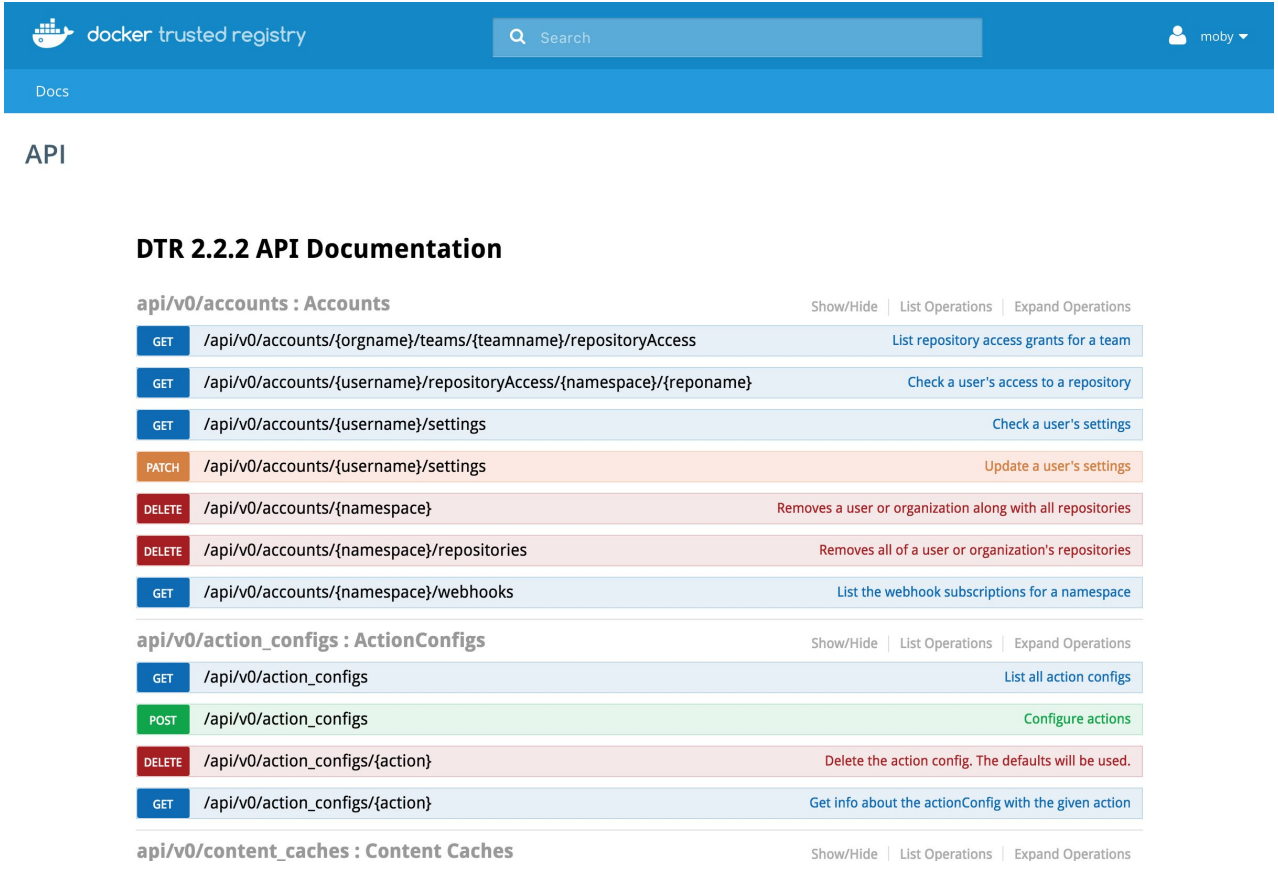
- Image Mirroring
- Image Pruning Policies



DTR Building Blocks

Name	Description
dtr-api-<replica_id>	Executes the DTR business logic. It serves the DTR web application, and API
dtr-garant-<replica_id>	Manages DTR authentication
dtr-jobrunner-<replica_id>	Runs cleanup jobs in the background
dtr-nautilusstore-<replica_id>	Stores security scanning data
dtr-nginx-<replica_id>	Receives http and https requests and proxies them to other DTR components. By default it listens to ports 80 and 443 of the host
dtr-notary-server-<replica_id>	Receives, validates, and serves content trust metadata, and is consulted when pushing or pulling to DTR with content trust enabled
dtr-notary-signer-<replica_id>	Performs server-side timestamp and snapshot signing for content trust metadata
dtr-registry-<replica_id>	Implements the functionality for pulling and pushing Docker images. It also handles how images are stored
dtr-rethinkdb-<replica_id>	A database for persisting repository metadata

DTR API

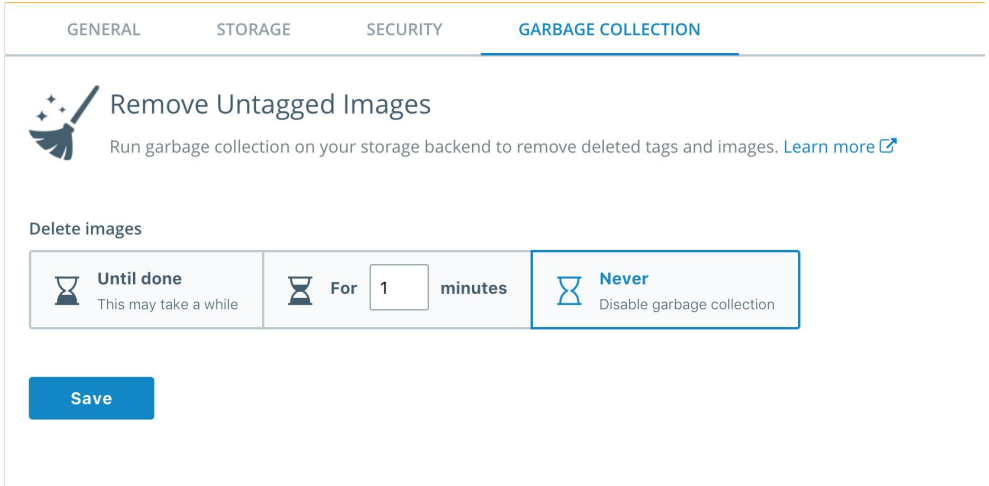


** This is not the registry API

docker

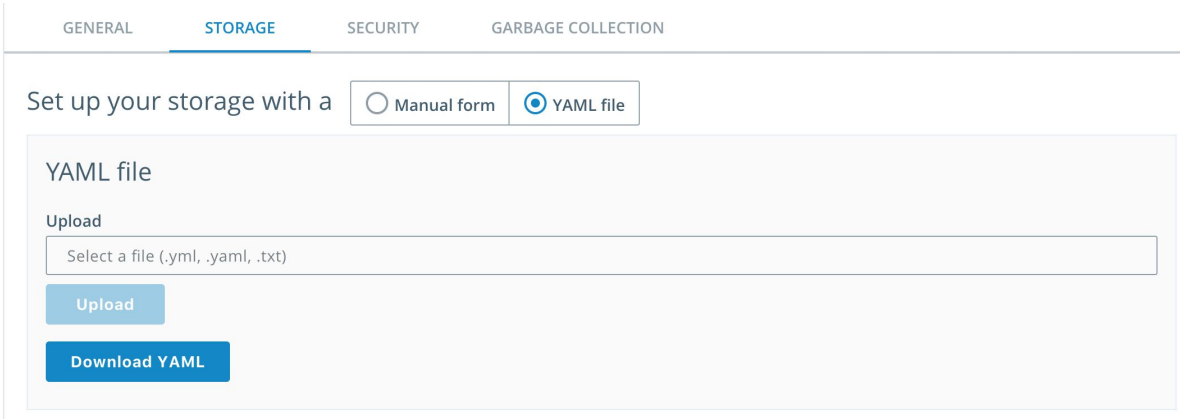
Garbage Collection

- Garbage collection is the process of removing blobs from the filesystem which are no longer referenced by a manifest. Blobs can include both layers and manifests.
- Configured in DTR
- Runs as a Cron job



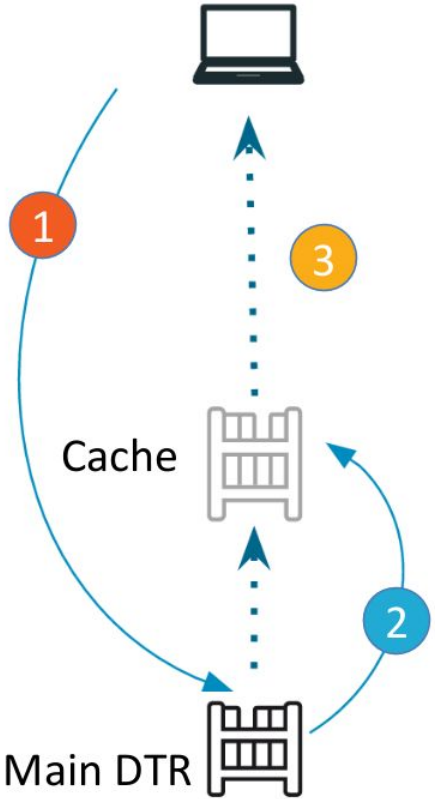
Configuration Data

- YAML configuration of the registry component
- Can be configured in UI or API
- Stored in distributed DB and presented to each replica as a YAML config file

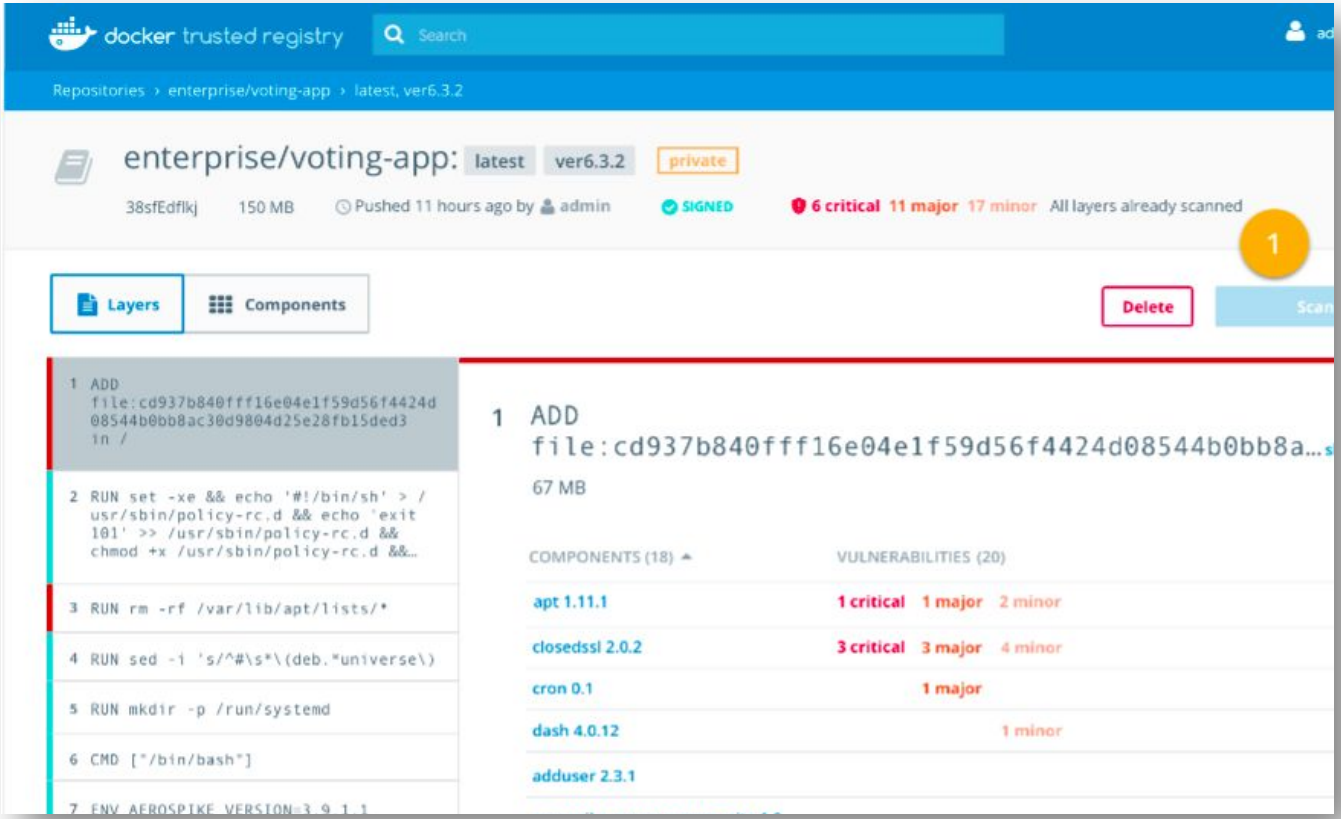


Content Caching

- Faster Pulls
- Reduces WAN Traffic
- Per User Configuration
- Chaining OK
- Configurable TTL
- Supports Same Storage backends as DTR
- Advanced Caching (e.g Secure Image Caching)

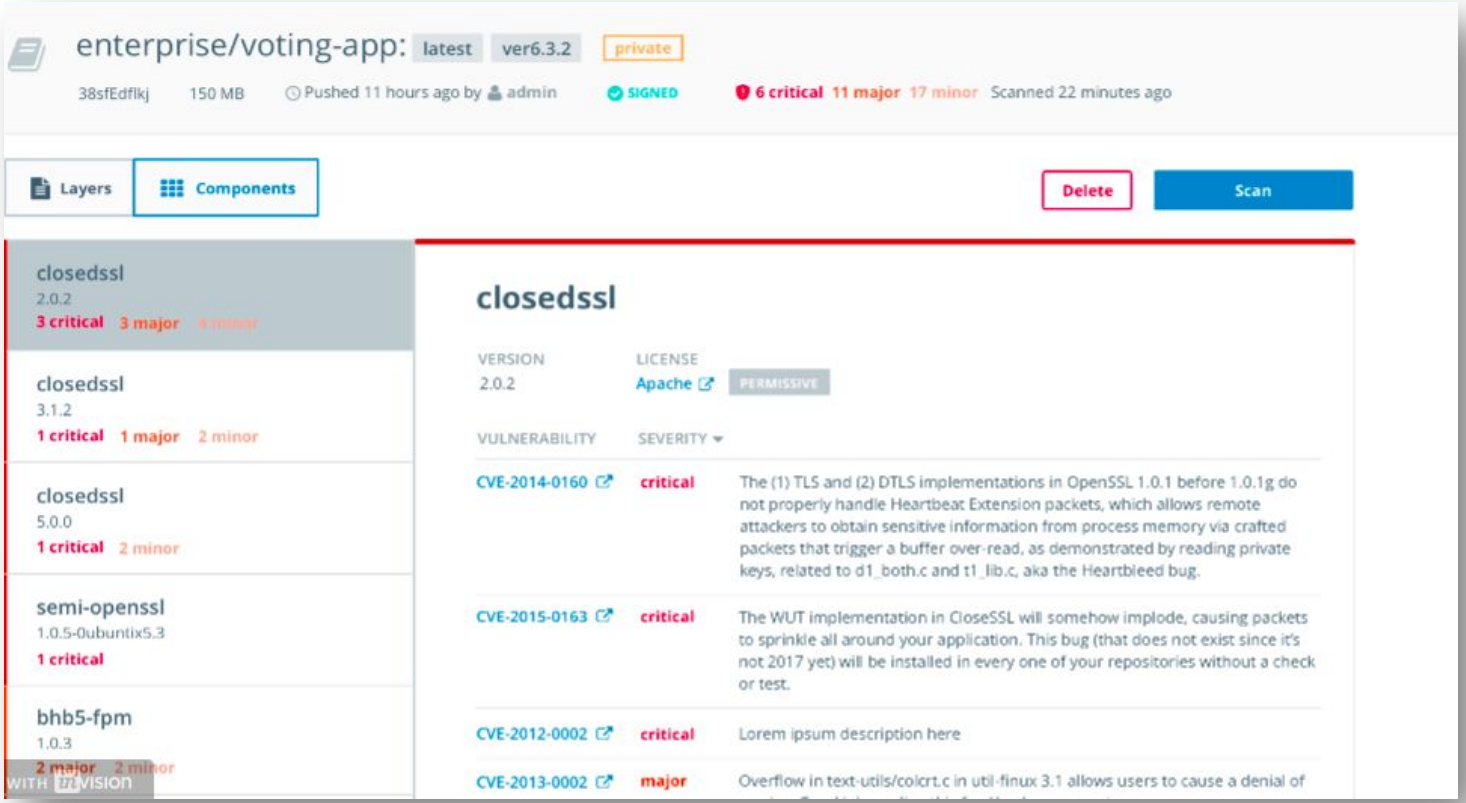


Security Scanning:
Get a full BOM for a Docker Image

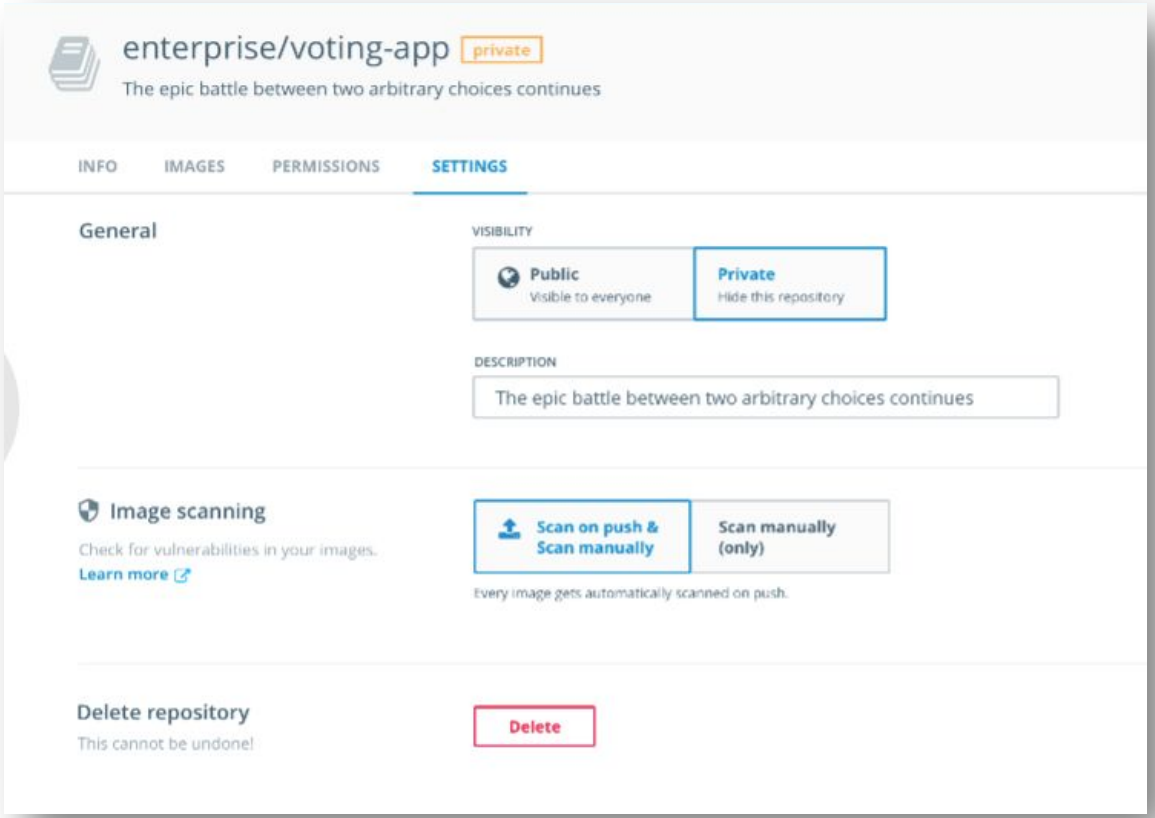


docker

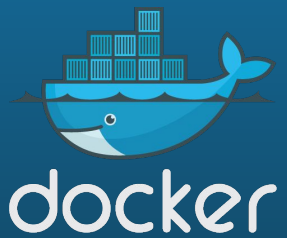
Security Scanning:
Vulnerabilities and Licensing for Each Component



Security Scanning:
Set Automated Policy for Scanning



DTR Installation & Operations



DTR Installation

- Install first replica with the “install” bootstrapper operation
- Join other replicas with the “join” bootstrapper operation

```
# Installing First DTR Replica

$ docker run -it --rm \
  docker/dtr install \
  --ucp-node <ucp-node-name> \
  --ucp-insecure-tls


# Joining other Replicas to existing DTR

$ docker run -it --rm \
  docker/dtr join \
  --ucp-node <ucp-node-name> \
  --existing-replica-id <id> \
  --ucp-insecure-tls
```

Backup and Restore

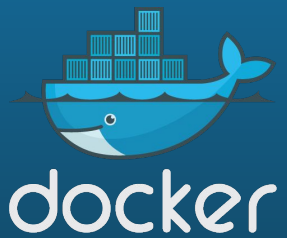
- Set automated backups (separate for UCP and DTR)

- What do Backups do:
  - Configurations
  - Repository metadata
  - Certificates and keys used by DTR.
- What they do NOT do:
  - Backup image blobs
- ALWAYS backup before upgrades!

Load Balancer Configuration

- DNS entry for DTR
- TCP / SSL passthrough
- Health checks
  - https://<dtr_replica>/health OR
  - https://<dtr_replica>/_ping (similar to UCP)

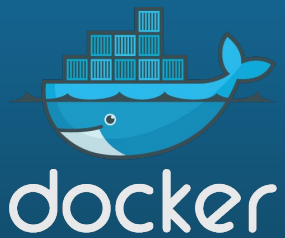
DTR Lab



Lab 4 Summary

- ❑ Generated valid certs
- ❑ Installed DTR LB
- ❑ Installed DTR
- ❑ Configured Certs
- ❑ Configured storage
- ❑ Configured security scanning
- ❑ Created repos
- ❑ Backup DTR
- ❑ Upgraded DTR

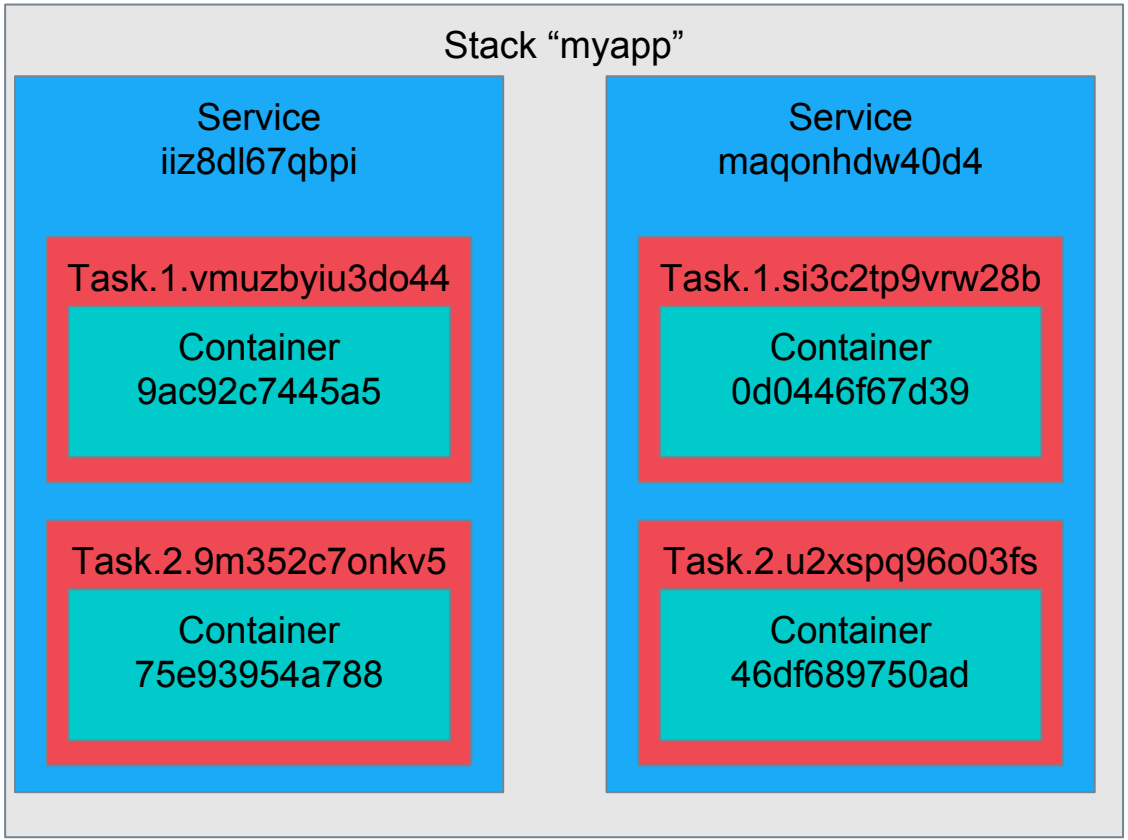
Day 3
MTA Application Deployment on EE



Application Deployment on Docker EE

- Stacks, Services, Tasks and Containers
- Scheduling Modes
- Health Checks
- Networks
- Secrets
- Config
- Rolling Updates
- Labels & Constraints

Stacks, Services, Tasks and Containers



docker

Stacks

- A Stack is a collection of services making up an application.
- Define a stack using a compose yaml file.
- Manage stacks using cli or UCP UI.

```
# Deploy or update a stack
$ docker stack deploy -c pets-prod-compose.yml pets

# List all stacks
$ docker stack ls

# List all tasks of a stack
$ docker stack ps pets

# List all services of a specific stack
$ docker stack services pets

# Remove a stack
$ docker stack rm pets
```

Services

- A service represents a single unique component of an application.
- Composed of one or more tasks
- Created in docker cli, compose, and UCP

```
# Create a Service
$ docker service create --name proxy nginx

# Inspect an existing Service
$ docker service inspect proxy

# View all service tasks logs.
$ docker service logs proxy

# List all services
$ docker service ls

# List all service tasks along with their status
$ docker service ps proxy

# Remove a service
$ docker service rm proxy

# Scale a service
$ docker service scale proxy=5

# Update a Service
$ docker service update --image nginx:v2 proxy
```

Scheduling Mode

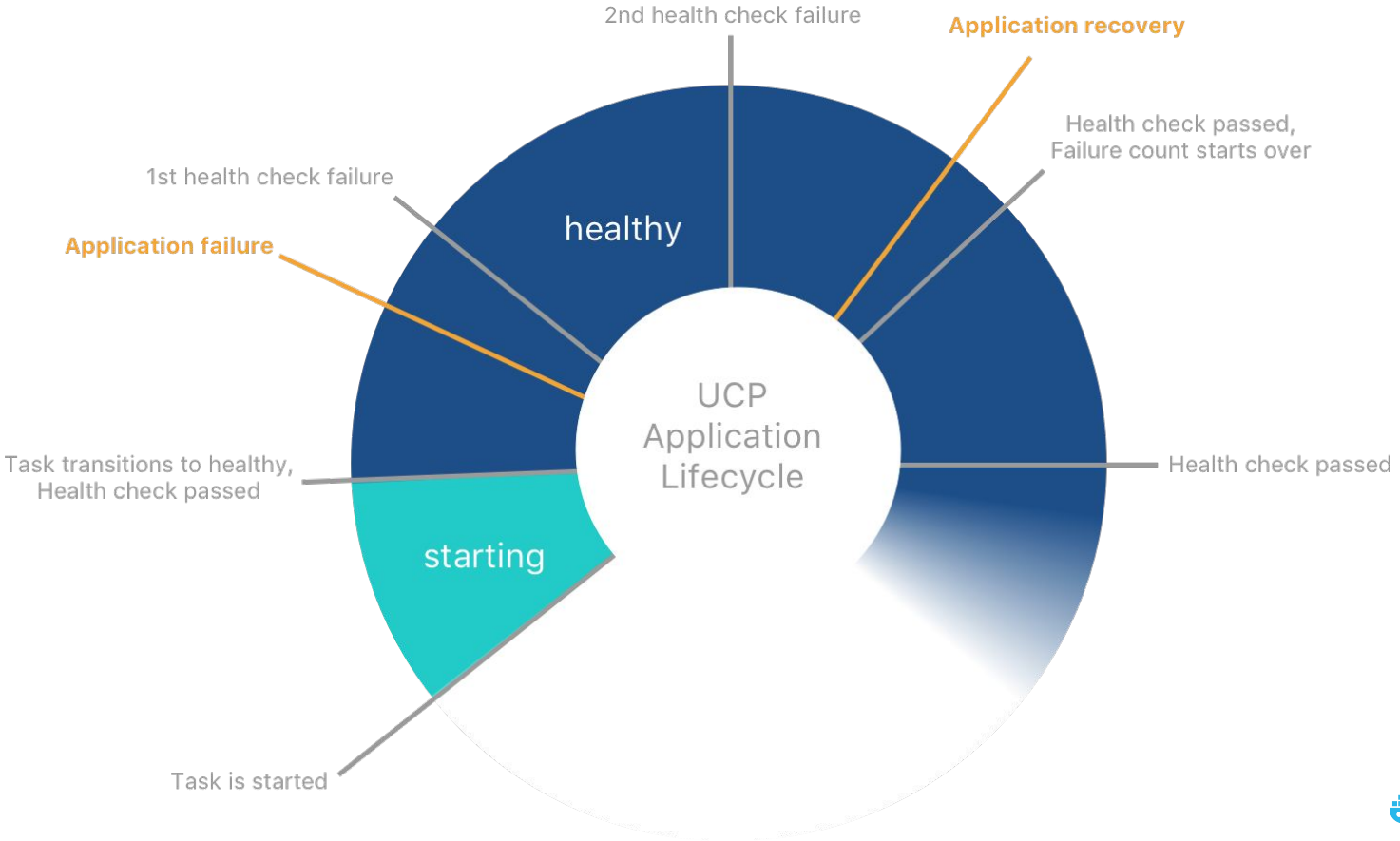
- Global: runs a task on every (worker or manager) node in the cluster

```
# Docker CLI

docker service create --name=proxy --mode=global nginx

# Docker Compose Syntax

services:
    proxy:
        image: nginx
        deploy:
            mode: global
```

- Replicated: runs N number of tasks across the cluster based on scheduling algorithm + provided constraint

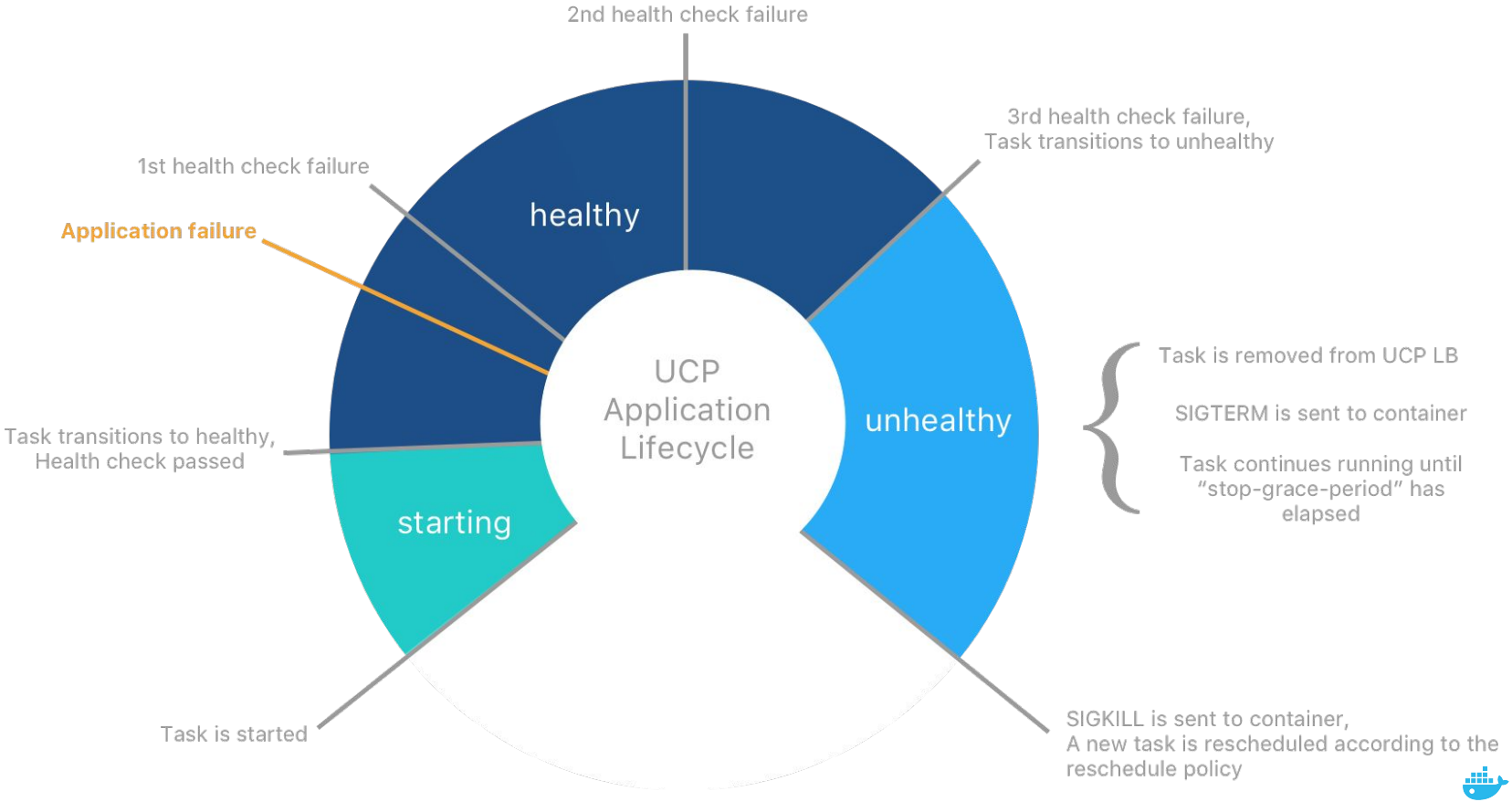
```
# Docker CLI

docker service create --name=proxy --mode=replicated --replicas=2 nginx

# Docker Compose Syntax

services:
    proxy:
        image: nginx
        deploy:
            mode: replicated
            replicas: 2
```

Health Checks



docker

Health Checks



docker

Health Checks

```
# Dockerfile

HEALTHCHECK CMD curl --fail http://localhost || exit 1

# CLI

docker service create --health-cmd "curl --fail http://localhost || exit 1"  nginx

# Compose File

services:
    proxy:
        image: nginx
        deploy:
            mode: replicated
            replicas: 2
        healthcheck:
            test: ["CMD", "curl", "-f", "http://localhost"]
            interval: 10s
            timeout: 2s
            retries: 3
```

Networks and Load Balancing

- Default unpublished services will use “bridge” network of the node they get deployed on
- Published services will use `ingress` network by default and all nodes in cluster will listen on the published port (if any)
- If using `--publish mode=host`, task will be exposed on the local host only and attached to the `docker_gwbridge`
- If attached to an overlay network, loadbalancing mode options are `vip` and `dnsrr`

Networks and Load Balancing

```
# Publishing Modes

# Host Mode
$ docker service create --publish mode=host,target=80,published=8080,protocol=tcp --name proxy nginx

# Ingress Mode (Default)
$ docker service create --publish mode=ingress,target=80,published=8080,protocol=tcp --name proxy nginx


# Loadbalancing Modes (with overlay networks only)

# Virtual IP (VIP)
$ docker service create --endpoint-mode=vip --network=mynet --name proxy nginx

# DNS Round Robin
$ docker service create --endpoint-mode=dnsrr --network=mynet --name proxy nginx
```

Networks and Load Balancing with Compose

- When using Compose v3, you need to define networks under the networks section.
- You can refer to pre-created external networks
- If no network is provided, a new overlay one will be created for the stack and all services will be attached to it.

```
version: '3.1'
services:
    web:
        image: webimage
        deploy:
            mode: replicated
            replicas: 2
        networks:
            - mynet
            - ucp-hrm

    db:
        image: dbimage
        deploy:
            mode: replicated
            replicas: 2
        networks:
            - mynet
networks:
    mynet:
      driver: overlay
      ipam:
       driver: default
       config:
       -
        subnet: 10.200.10.0/24
    ucp-hrm:
        external: true
```

docker

Secrets

- Need to pre-create the secret from STDIN or file before you can use it
- In Compose, you can create secrets from local files and assign them to services
- In UCP, secret and service labels must match to attach a secret to a service

```
# Creating a Secret

# STDIN
$ echo "dockerdocker" | docker secret create mysecret -

# File
$ docker secret create mysecret cert.pem


# Attaching a secret to a service

$ docker service create --secret mysecret redis

# With Compose
services:
  redis:
    image: redis:latest
    deploy:
      replicas: 1
    secrets:
      - mysecret
      - myothersecret
secrets:
  mysecret:
    file: ./cert.pem
  myothersecret:
    external: true
```

Configs

- Store non-sensitive data outside the image or running container
- Operate similar to secrets, except they're not encrypted and don't use a temp fs.
- Supported on Linux and Windows Swarm Services (not standalone containers)

```
# Creating a Config
$ docker config create app-nginx-v1 app-nginx-v1.conf
kwasrrry30ccn671n7y5a41ti

# Creating a Service with the config
$ docker service create --name nginx \
  --config source=app-nginx-v1,target=/etc/nginx/conf.d/nginx.conf \
  nginx:latest

# Creating a new version of the config
$ docker config create app-nginx-v2 app-nginx-v2.conf

# Updating the service with the new config

$ docker service update \
  --config-rm app-nginx-v1 \
  --config-add source=app-nginx-v2,target=/etc/nginx/conf.d/nginx.conf \
  nginx
```

Rolling Updates and Automated Rollbacks

- Rolling updates rules are applied when updating one or more service attribute (image,network, published port..etc)
- Rollback rules are applied when a rolling update fails

```
# Rolling Update

$ docker service create \
  --replicas 6 \
  --name pets \
  --update-delay 10s \
  --update-parallelism 2 \
  --update-max-failure-ratio 0.25 \
  --update-failure-action pause \
  --update-monitor 10s \
  --update-order start-first \
  chrch/paas:v1

# Automated Rollbacks

$ docker service update \
  --rollback-delay 10s \
  --rollback-failure-action pause \
  --rollback-max-failure-ratio 0.25 \
  --rollback-monitor 10s \
  --rollback-order stop-first \
  --rollback-parallelism 0 \
  --image chrch/paas:v2 \
  pets
```

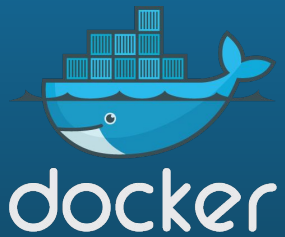
Labels and Deployment Constraints

- Labels are key/value identifiers for cluster resources (services, containers, networks, volumes, nodes, secrets)
- Use labels to apply RBAC in UCP
- Use labels as scheduling constraints

```
# Service Labels
$ docker service create \
  --label foo=bar \
  --label bar=foo \
  --label com.docker.ucp.access.label=production \
  --name proxy \
  nginx


# Node Labels
$ docker node update --label-add com.docker.ucp.access.label=production worker-01

# Service Constraints
$ docker service create \
  --constraint 'node.labels.com.docker.ucp.access.label == production ' \
  --constraint 'node.role == manager' \
  --name proxy \
  nginx
```

docker

MTA Application Deployment Lab



Lab 3 Summary

- ❑ Configured an application loadbalancer
- ❑ Deployed your MTA application using Stacks and Compose v3
- ❑ Exposed the Application with HRM
- ❑ Configured Rolling Updates
- ❑ Scaled the application

Thank you!