1

Outline Day 1

- Docker principle
- Docker machine
- Image, Repository & Tag, container
- CPU, Memory and I/O
- Network
- Volume
- Inspect and Log
- Commit
- Kitematic (Alpha)

2

Outline Day 2

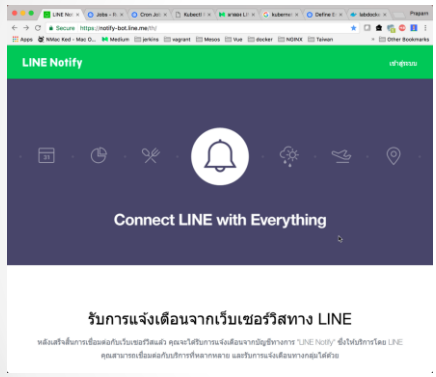
- Dockerfile and Build
- Compose
- Docker Security
- Registry
- Swarm Mode
  - Conceptual of Swarm
  - Swarm Mode Architecture
  - Swarm init/join cluster system
  - Swarm service
  - Orchestrator Assignment
  - Config and Secret
  - Network Overlay and Ingress
  - HA Manager Role
  - Docker Stack Deploy (Compose Swarm Mode)
- portainer for Docker
- Q&A

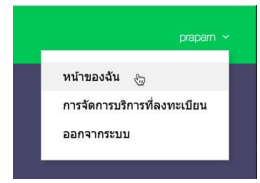
Prerequisite

- Windows (64 bit)/ Mac / Linux (64 bit)machine (ubuntu / alpine prefer)
- 1 email address (For register “hub.docker.com”) / hub.docker.com account
- Line Notify Token (https://notify-bot.line.me)
- Tool for editor (vscode etc)
- Tool for shell (putty / terminal etc)
- Tool for transfer file (winscp / scp)
- Basic understand for linux operate
- Basic text editor skill (vim prefer) and linux structure
- Internet for download / upload image

Prerequisite

- Generate LINE Token
  - https://notify-bot.line.me



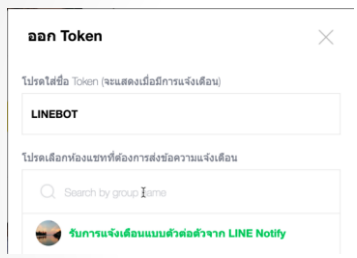


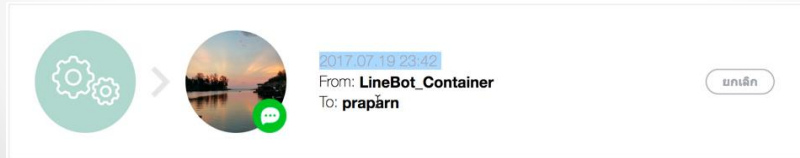
Docker: The Next-Gen of Virtualization

5

Prerequiste

- Generate LINE Token
  - https://notify-bot.line.me



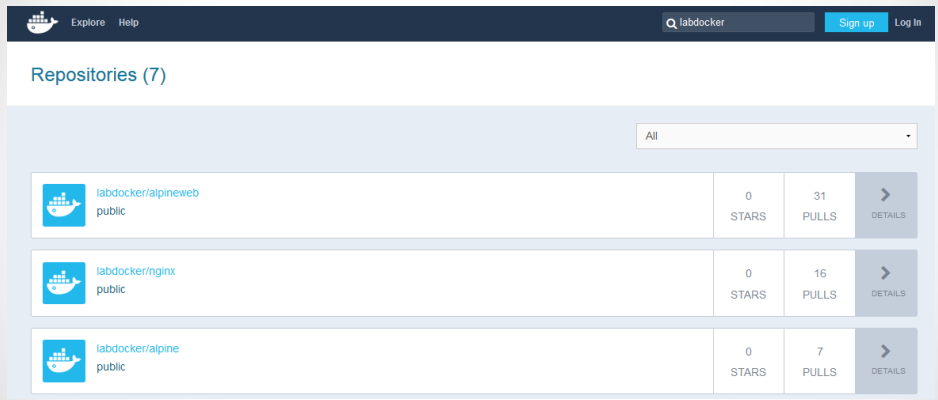


Docker: The Next-Gen of Virtualization

6

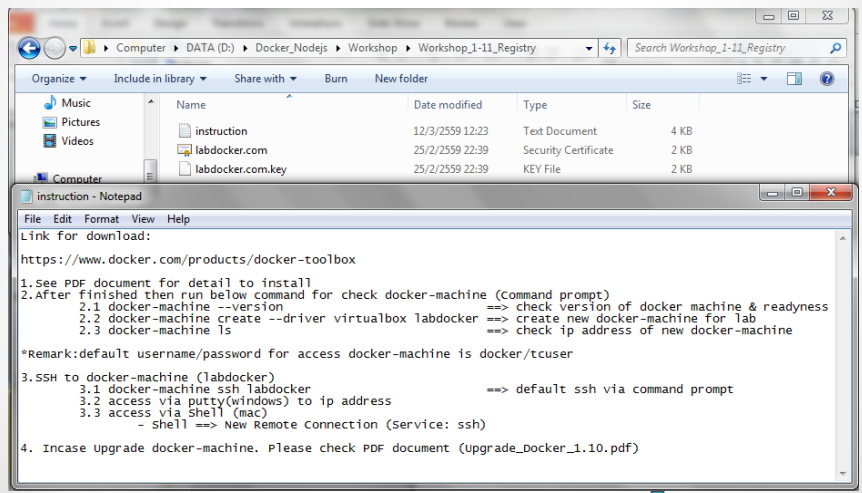
Lab Resource

- Repository for lab



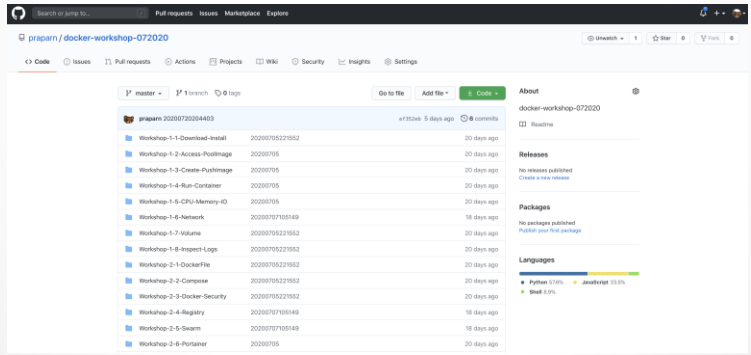
Lab Resource

- Software in lab



Lab Resource

- Download on Google Drive
  - https://tinyurl.com/yxb2fefo
- Download on GitHub
  - git clone https://github.com/praparn/docker-workshop-072020.git



Lab Resource

- https://tinyurl.com/y9svjua2

DockerCon2020

DockerCon2019

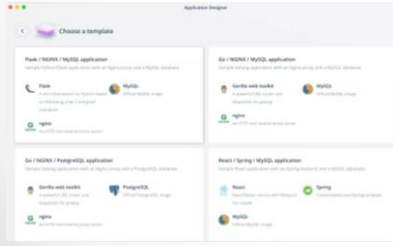
Docker
12 มิถุนายน เวลา 16:10 น. ·

Carnival Cruise Line, Citizens Bank, Liberty Mutual Insurance, Lindsay Irrigation, and Nationwide won the 2019 #Docker customer awards for #innovation and transformation. Discover their journeys using Docker Enterprise here: https://dockr.ly/2F4bcH7

Ref: https://www.docker.com/customers/innovation-awards?utm_campaign=IT+Pro&utm_content=156029737&utm_medium=social&utm_source=Organic&fbclid=IwAR0a7HfuEocGlzX-o3ziiYGnBd02ljPjfRT_V6_HiLs4iX2j3TtfPXBqXoo

DockerCon2019

- Docker Enterprise (Acquired by Mirantis)

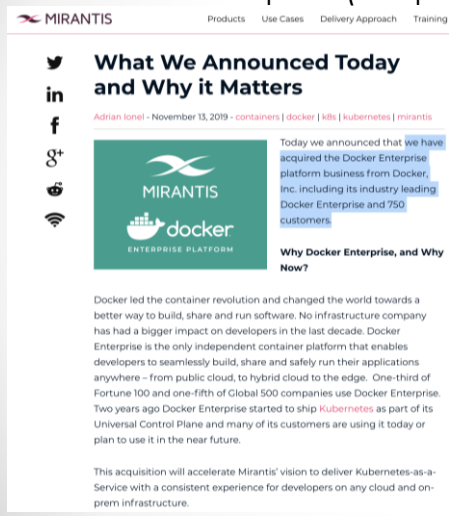


Docker: The Next-Gen of Virtualization

13

DockerCon2019

- Docker Enterprise (Acquired by Mirantis)



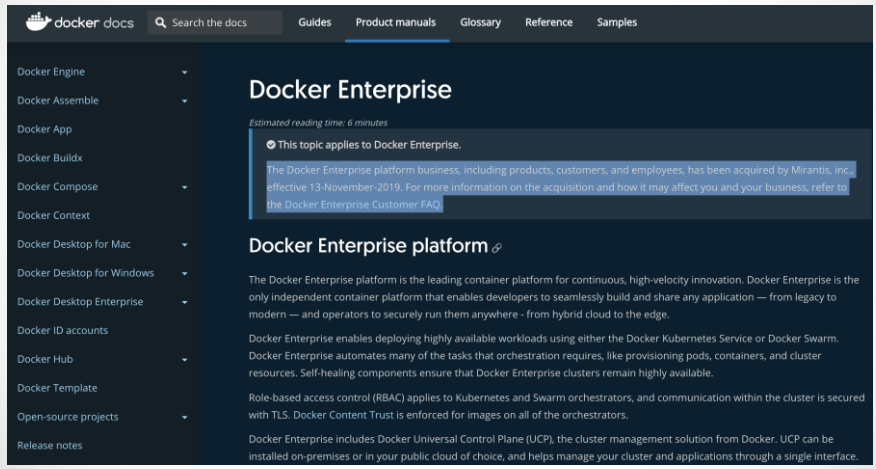
Ref: https://www.mirantis.com/blog/mirantis-acquires-docker-enterprise-platform-business/

Docker: The Next-Gen of Virtualization

14

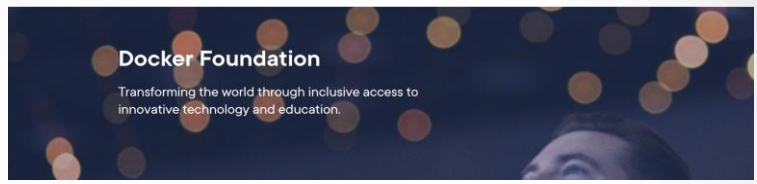
DockerCon2019

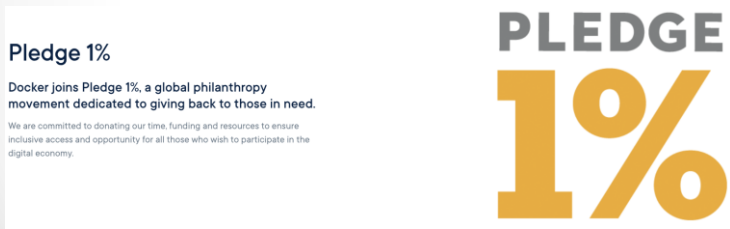
- Docker Enterprise (Acquired by Mirantis)



DockerCon2019

- Docker Foundation

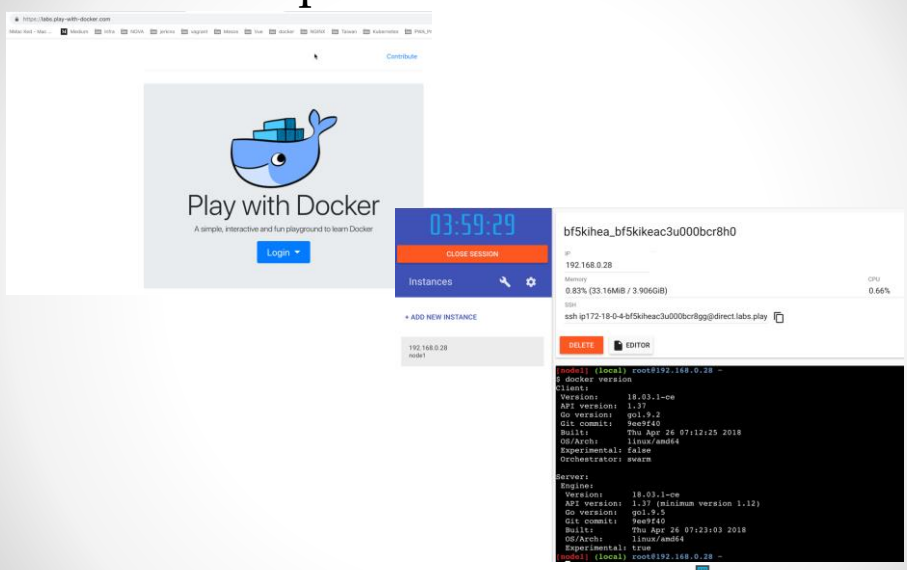




Workshop: Access Docker on AWS

17

Workshop: Access Docker on AWS



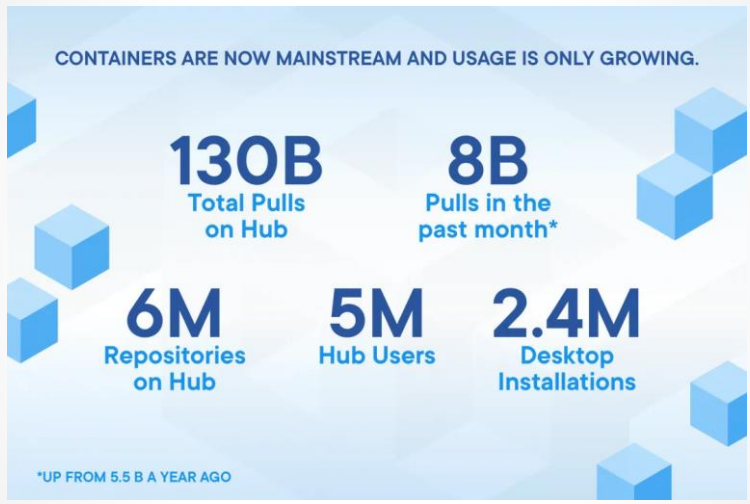
18

Who are we ? (Opcellent)

Docker: The Next-Gen of Virtualization

19

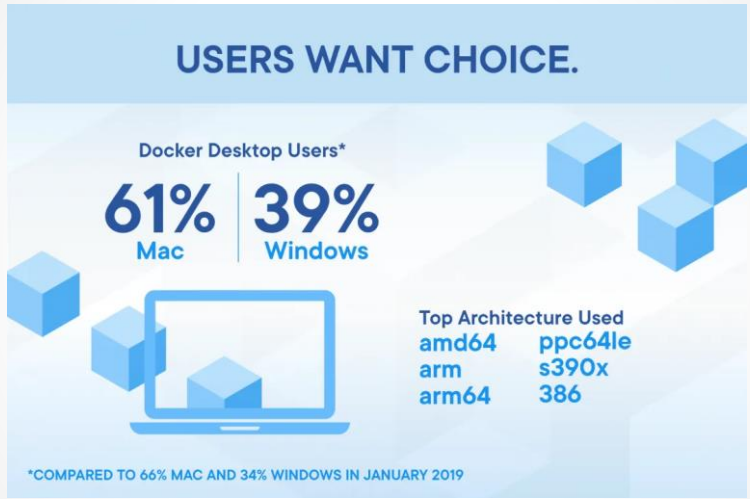
Landscape of the world now



Docker: The Next-Gen of Virtualization

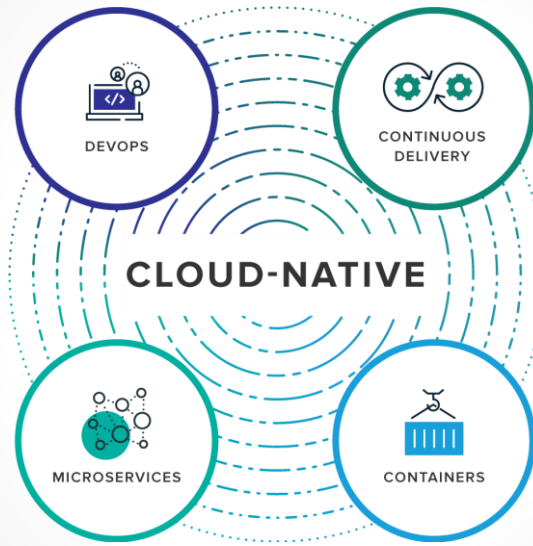
20

Landscape of the world now



21

Landscape of the world now



22

Landscape of the world now

sysdig

Key 2019 Insights

52% of containers live 5 minutes or less

2x the number of containers alive for 10 seconds or less

100% increase in container density year over year

Go and Node.js overtake Java as top cloud app frameworks

Prometheus rises to lead custom metric solution

Red Hat OpenShift is **top choice** for secure, on-prem Kubernetes

Containers frequently run as **root and in privileged mode**

2019 Container Usage Report

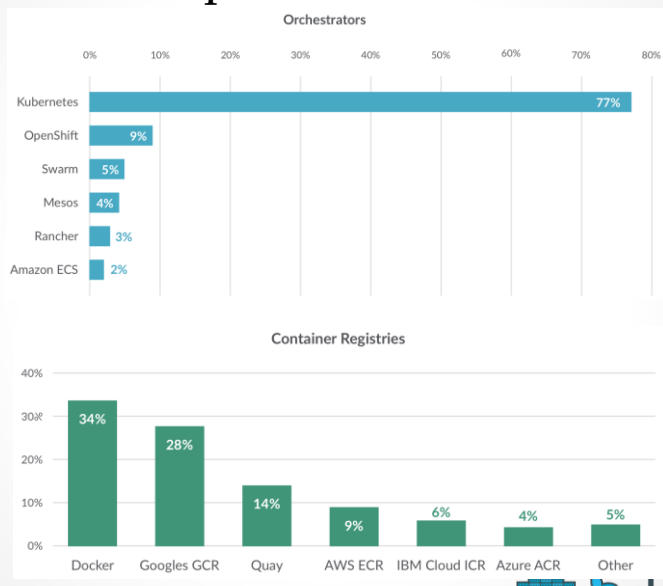
Five minute container life highlights need for specific security controls

Ref: https://sysdig.com/blog/sysdig-2019-container-usage-report/?fbclid=IwAR06qOb-M7imoS9FLmQQPySVQZIXxQYu2htTz9meL_XLdB5yn8bSVuYwACg

docker

23

Landscape of the world now

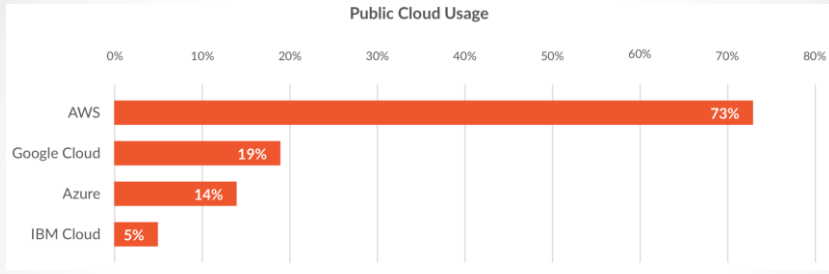


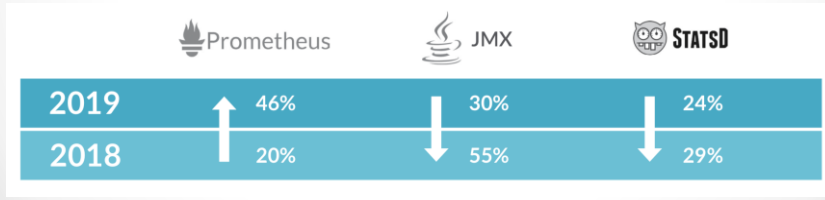
Docker: The Next-Gen of Virtualization

docker

24

Landscape of the world now

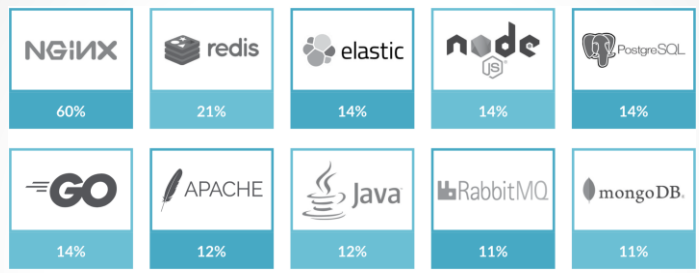


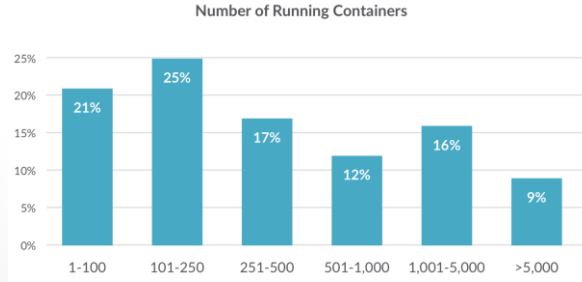


Docker: The Next-Gen of Virtualization

25

Landscape of the world now

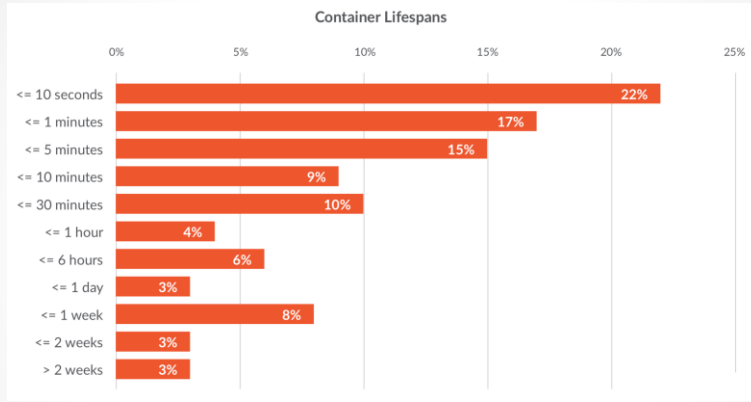




Docker: The Next-Gen of Virtualization

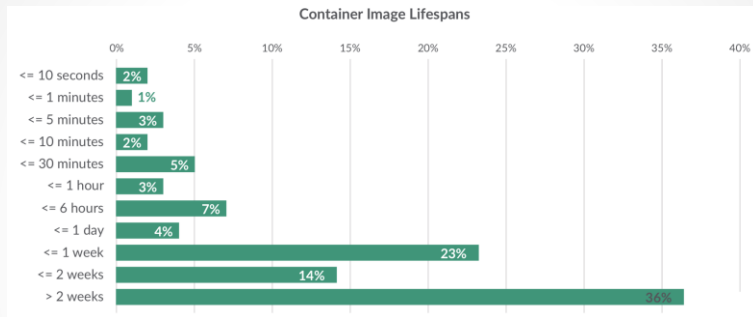
26

Landscape of the world now



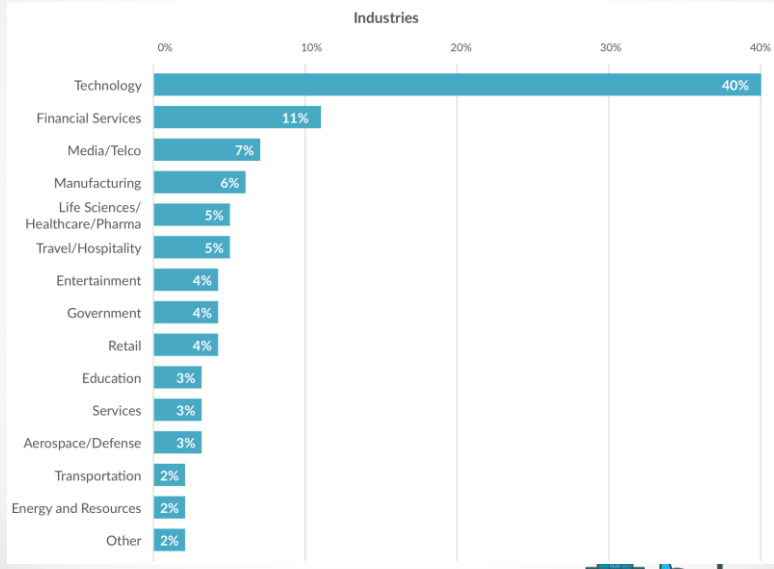
27

Landscape of the world now



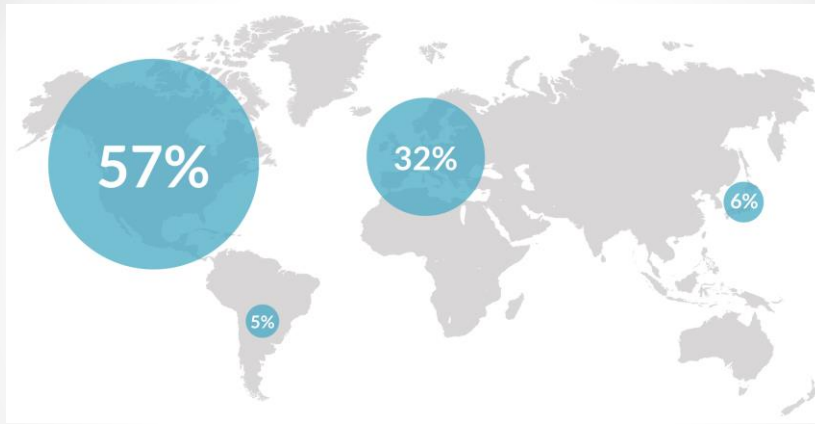
28

Landscape of the world now



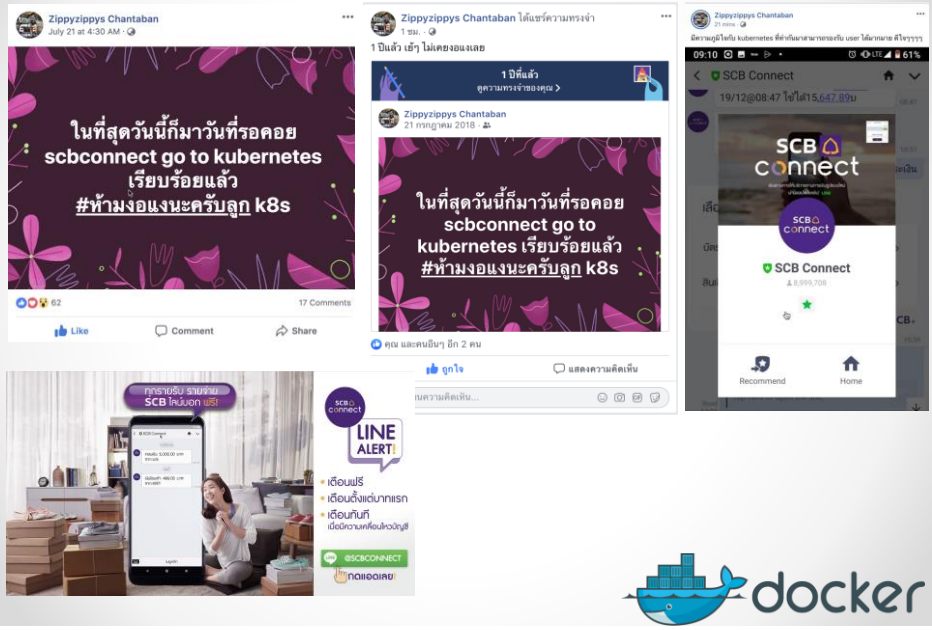
29

Landscape of the world now



30

Landscape of the world now

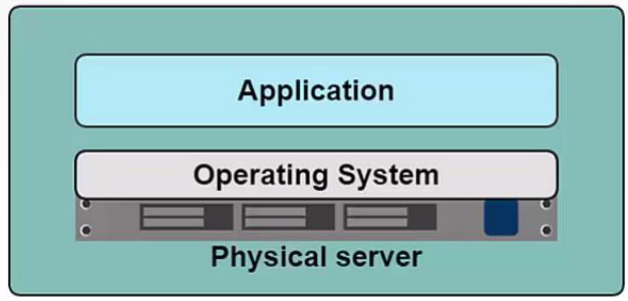


Docker Principle

• • •

Docker: The Next-Gen of Virtualization

What is docker ?

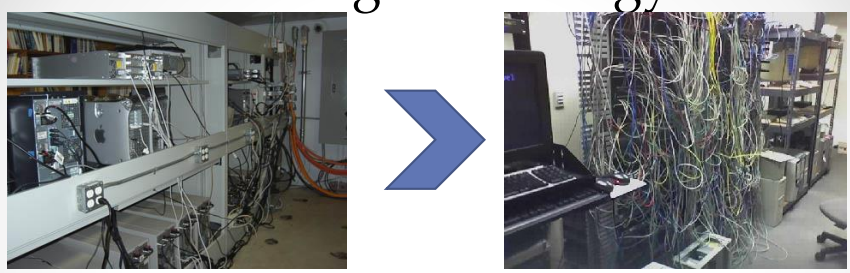


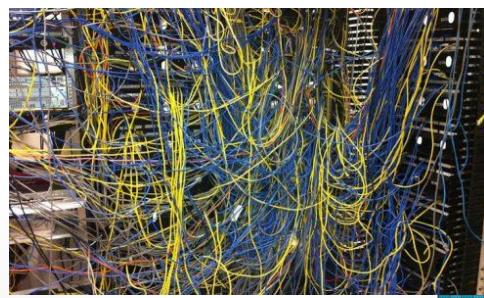
Docker: The Next-Gen of Virtualization

docker

33

Existing Technology





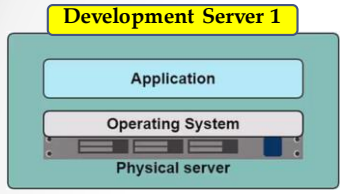
Docker: The Next-Gen of Virtualization

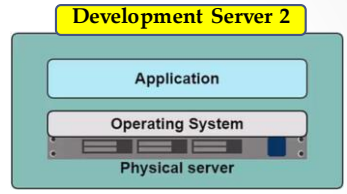
docker

34

Existing Technology

- Development Environment (Mix everything possible)





- Apache 2.20 Web Server
- PHP 5.5 Engine
- Larevel 4.1 Framework
- MaridDB 5.1
- Etc

(All-in-One Server)

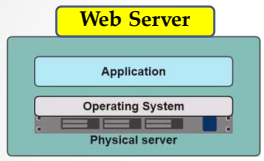
- IIS 8.0
- .Net Framework 3.5
- ASP.NET
- Etc

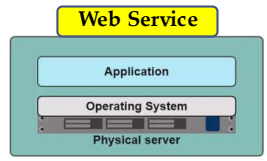
- Need concern about conflict component
- Survive among legacy dependency
- Lack for environment for fulfill develop & test (module test/integrate test/ UAT test / MOT test etc)
- Unexpected software conflict frequently occur
- Incomplete software's integrated test

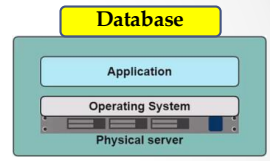
35

Existing Technology

- Production Environment (Best design)
- Day 1: Application 1: Implement







- Apache 2.20 Web Server
- PHP 5.5 Engine
- Larevel 4.1 Framework

- IIS 8
- .Net FrameWork 3.5

- MariaDB 5.1

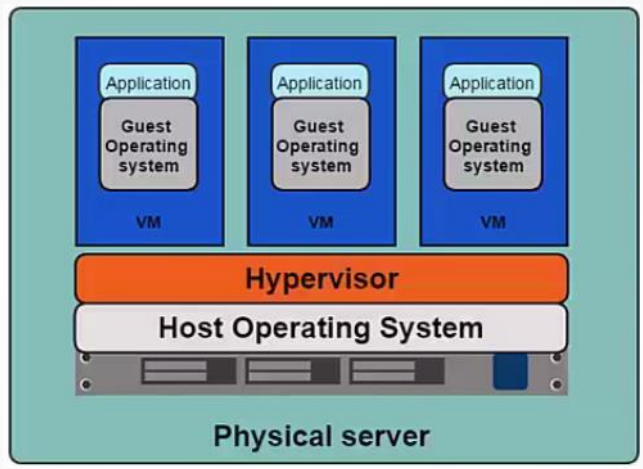
- Day 2: Application 2: Need to implement
  - Need PHP 7.0 ?
  - MariaDB 10.1.14 (Need search feature on 10.1)
- Problem ?
  - Possible to upgrade PHP to 7.0 ? / How to test existing application ?
  - What effect to MariaDB upgrade ?

36

Existing Technology

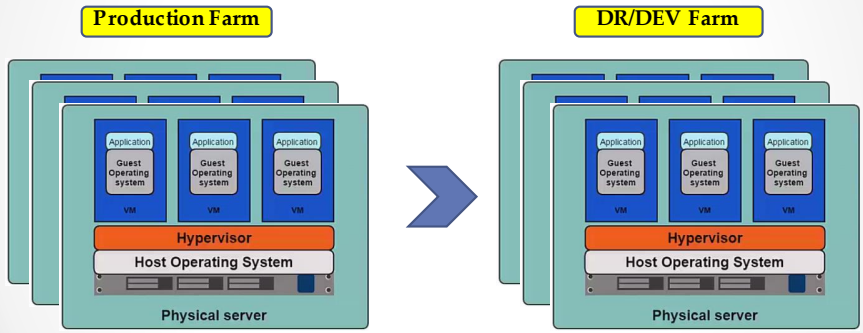
- What operation handle in production environment ?
  - Aware about huge of difference software component between development / production machine
  - Need to know in deep all application dependency (Wow !!!)
  - Take time for discussion and find solution to implement.
  - Possible to confusion and effect to other application that existing on share server.
  - Many unexpected problem & software bug.
  - Hard control software's quality assurance (QA)

What is docker ?



Existing Technology

- 1 Physical server : 1 – N VMWare (&OS)
- Virtualize Hardware (CPU, Memory, Disk, Network etc)



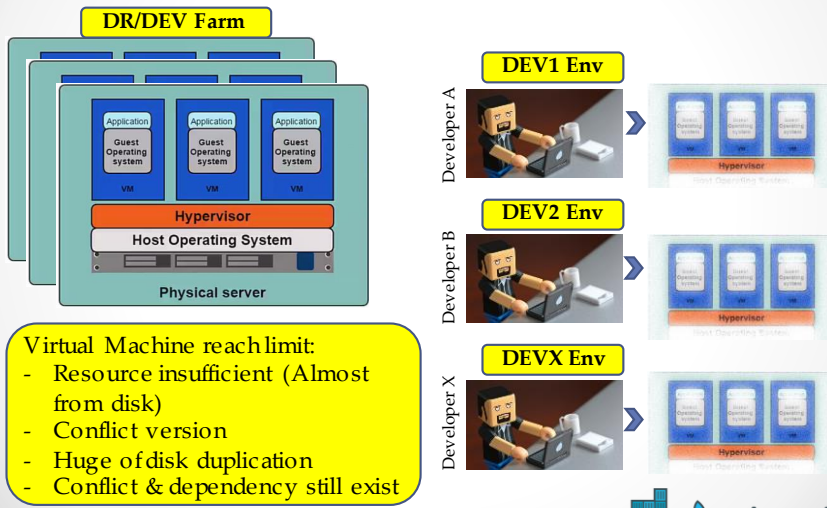
- Kernal-base virtual machine (KVM), Vmware, Virtualbox etc

Docker: The Next-Gen of Virtualization

39

Existing Technology

- Development Environment (Clone from Production)



Virtual Machine reach limit:
- Resource insufficient (Almost from disk)
- Conflict version
- Huge of disk duplication
- Conflict & dependency still exist

Docker: The Next-Gen of Virtualization

40

Existing Technology

- Production Environment
- Day 1: Application 1: Implement

- Apache 2.20 Web Server
- PHP 5.5 Engine
- Larevel 4.1 Framework

- IIS 8
- .Net FrameWork 3.5

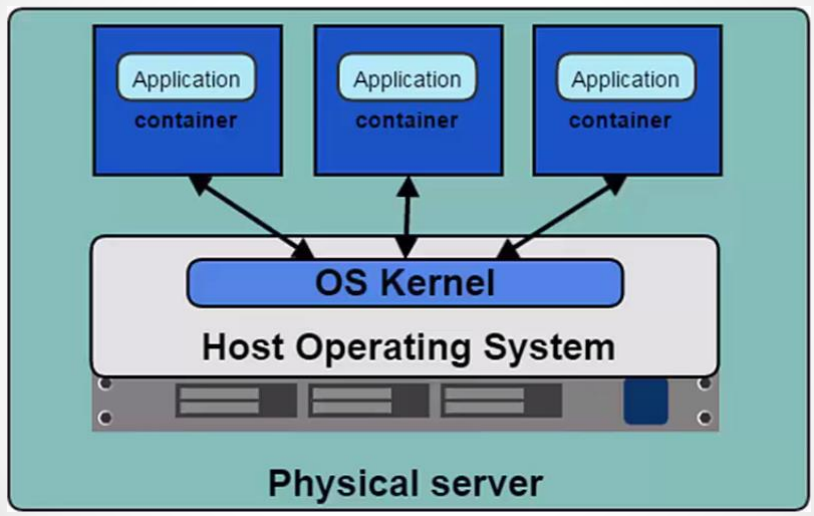
- MariaDB 5.1

- Day 2: Application 2: Need to implement
  - Need PHP 7.0 ?
  - MariaDB 10.1.14 (Need search feature on 10.1)
- So… The problem still exist.

Docker: The Next-Gen of Virtualization

41

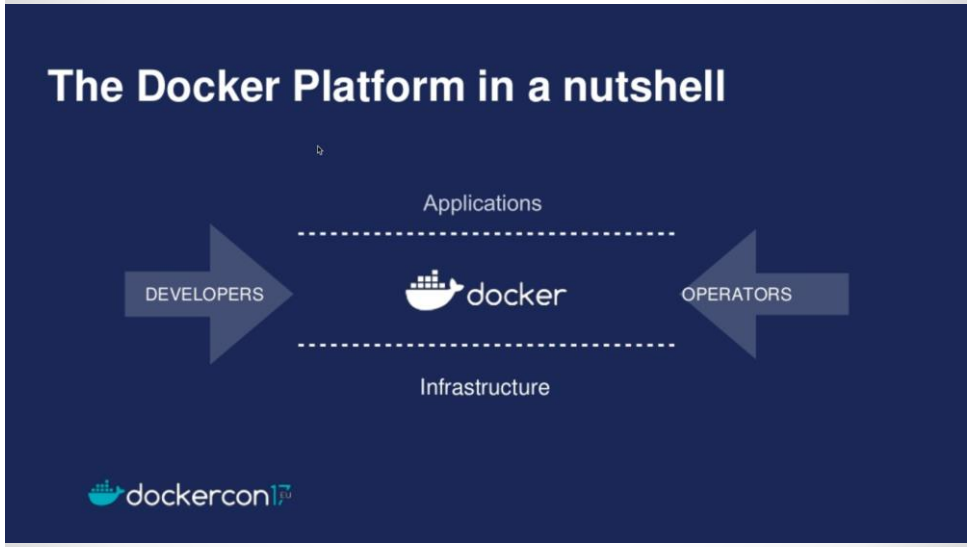
What is docker ?



Docker: The Next-Gen of Virtualization

42

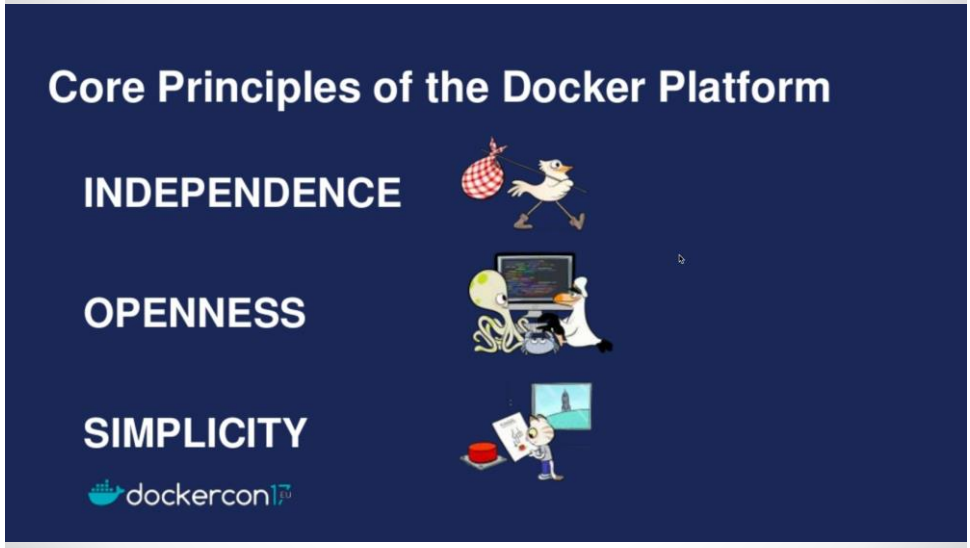
What is docker ?



Docker: The Next-Gen of Virtualization

43

What is docker ?



Docker: The Next-Gen of Virtualization

44

What is docker ?

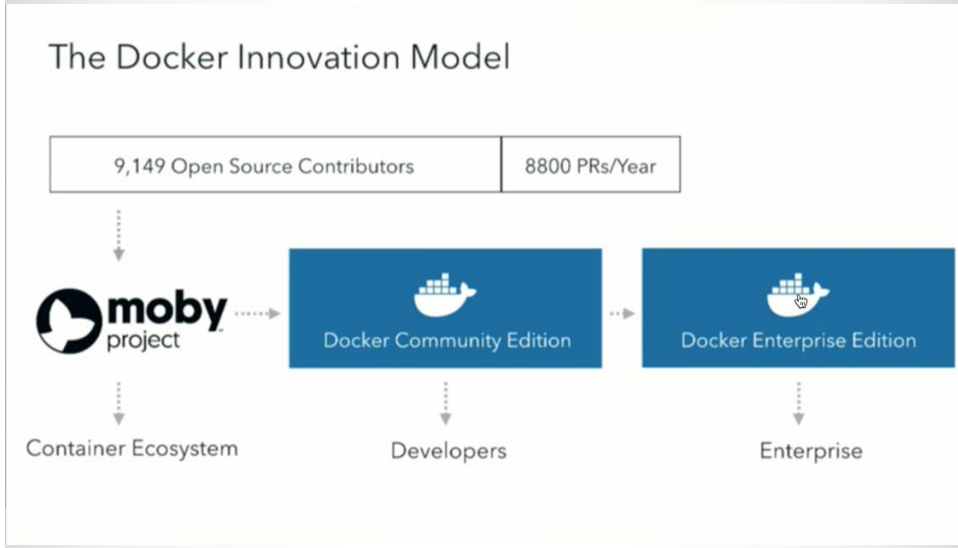
- Docker คือ open platform solution ที่ทำงานภายใต้คอนเซ็ปต์ของ container virtualize technology (operating -system –level virtualization)
- ผู้ใช้สามารถสร้างสภาพแวดล้อมเพื่อใช้ในพัฒนาโปรแกรมและส่งมอบเพื่อใช้งานในสภาพเดียวกัน
- Build, Ship, Run
- เหมาะสำหรับ Developer, DevOps, Architecture, Engineer
- เขียนด้วยภาษา Go
- รองรับการติดตั้งบนบนลินุกซ์ 64 บิต (kernel 3.1.0) (Official)
  - Ubuntu (X64/ARM/ARM64) (CE/EE Edition)
  - Debian (X64/ARM/ARM64) (CE Edition)
  - Oracle Linux (EE Edition)
  - CentOS (CE/EE Edition)
  - Fedora (CE Edition)
  - Red Hat Enterprise Linux (EE Edition)
  - Microsoft Windows Server 2016 (EE Edition)
  - Microsoft Windows Server 1709 (EE Edition)
  - Microsoft Windows Server 1803 (EE Edition)
  - Suse Linux Enterprise Server (EE Edition)

Operating-system-level virtualization

Mechanism	Operating system	License	Available since/between	Features									
				File system isolation	Copy on Write	Disk quotas	I/O rate limiting	Memory limits	CPU quotas	Network isolation	Nested virtualization	Partition checkpointing and live migration	Root privilege isolation
chroot	most UNIX-like operating systems	varies by operating system	1982	Partial[5]	No	No	No	No	No	No	Yes	No	No
Docker	Linux[7]	Apache License 2.0	2013	Yes	Yes	Not directly	Not directly	Yes	Yes	Yes	Yes	No	No
Linux-VServer (security context)	Linux	GNU GPLv2	2001	Yes	Yes	Yes	Yes[8]	Yes	Yes	Partial[9]	?	No	Partial[9]
lmctfy	Linux	Apache License 2.0	2013	Yes	Yes	Yes	Yes[8]	Yes	Yes	Partial[9]	?	No	Partial[9]
LXC	Linux	GNU GPLv2	2008	Yes[8]	Yes	Partial[4]	Partial[7]	Yes	Yes	Yes	Yes	No	Yes[8]
LXD	Linux	Apache License 2.0	2015	Yes	Yes	Partial(see LXC)	Partial(see LXC)	Yes	Yes	Yes	Yes	Partial[9]	Yes
OpenVZ	Linux	GNU GPLv2	2005	Yes	No	Yes	Yes[8]	Yes	Yes	Yes[8]	Partial[8]	Yes	Yes[8]
Virtuozzo	Linux, Windows	Proprietary	2000[14]	Yes	Yes	Yes	Yes[8]	Yes	Yes	Yes[8]	Partial[15]	Yes	Yes
Solaris Containers (Zones)	illumos (OpenSolaris), Solaris	CDDL, Proprietary	2004	Yes	Yes (ZFS)	Yes	Partial[16]	Yes	Yes	Yes[8][17][18]	Partial[19]	Partial[18][7]	Yes[8]
FreeBSD jail	FreeBSD	BSD License	2000[20]	Yes	Yes (ZFS)	Yes[8]	No	Yes[21]	Yes	Yes[22]	Yes	No	Yes[23]
sysjail	OpenBSD, NetBSD	BSD License	2006–2009 (As of March 3, 2009, it is no longer supported)	Yes	No	No	No	No	No	Yes	No	No	?
WPARs	AIX	Proprietary	2007	Yes	No	Yes	Yes	Yes	Yes	Yes[8]	No	Yes[26]	?
HP-UX Containers (SRP)[27]	HPUX	Proprietary	2007	Yes	No	Partial[28]	Yes	Yes	Yes	Yes	?	Yes	?
iCore Virtual Accounts	Windows XP	Proprietary/Freeware	2008	Yes	No	Yes	No	No	No	No	?	No	?
Sandboxie	Windows	Proprietary/Shareware	2004	Yes	Yes	Partial	No	No	No	Partial	No	No	Yes
Spoon	Windows	Proprietary	2012	Yes	Yes	No	No	No	No	Yes	No	No	Yes
VMware ThinApp	Windows	Proprietary	2008	Yes	Yes	No	No	No	No	Yes	No	No	Yes

Reference: https://en.wikipedia.org/wiki/Operating-system-level_virtualization

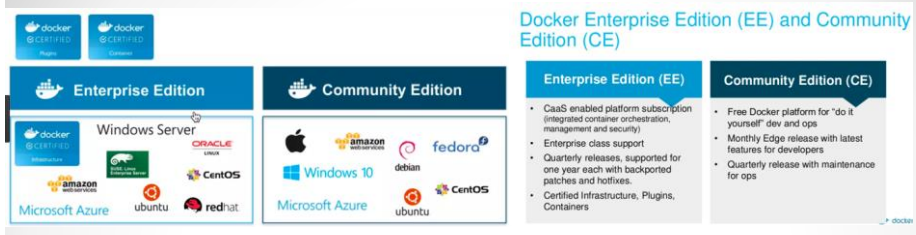
What is docker ?

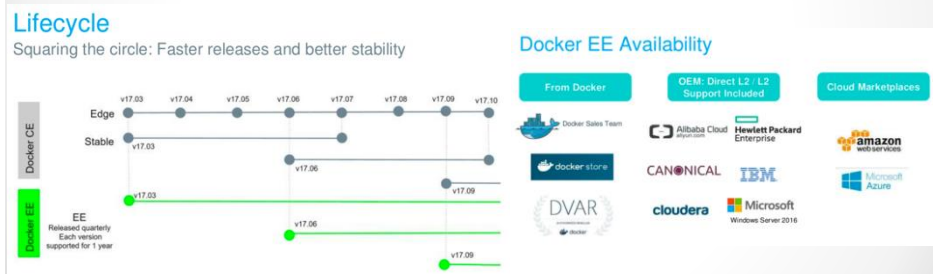


Docker: The Next-Gen of Virtualization

47

What is docker ?





https://blog.docker.com/2018/07/extending-support-cycle-docker-community-edition/

Docker: The Next-Gen of Virtualization

48

What is docker ?

About Docker CE

Estimated reading time: 7 minutes

Docker Community Edition (CE) is ideal for developers and small teams looking to get started with Docker and experimenting with container-based apps. Docker CE has three types of update channels, **stable**, **test**, and **nightly**:

- **Stable** gives you latest releases for general availability.
- **Test** gives pre-releases that are ready for testing before general availability.
- **Nightly** gives you latest builds of work in progress for the next major release.

For more information about Docker CE, see Docker Community Edition.

Releases

For the Docker CE engine, the open repositories Docker Engine and Docker Client apply.

Releases of Docker Engine and Docker Client for general availability are versioned using dotted triples. The components of this triple are `YY.mm.<patch>` where the `YY.mm` component is referred to as the year-month release. The version numbering format is chosen to illustrate cadence and does not guarantee SemVer, but the desired date for general availability. The version number may have additional information, such as beta and release candidate qualifications. Such releases are considered "pre-releases".

The cadence of the year-month releases is every 6 months starting with the `18.09` release. The patch releases for a year-month release take place as needed to address bug fixes during its support cycle.

Docker CE binaries for a release are available on download.docker.com as packages for the supported operating systems. Docker EE binaries are available on the Docker Hub for the supported operating systems. The release channels are available for each of the year-month releases and allow users to "pin" on a year-month release of choice. The release channel also receives patch releases when they become available.

Ref: http://dockerdocs.gclearning.cn/install/

What is docker ?

- DOCKER CE

DESKTOP

Platform	x86_64
Docker Desktop for Mac (macOS)	✓
Docker Desktop for Windows (Microsoft Windows 10)	✓

SERVER

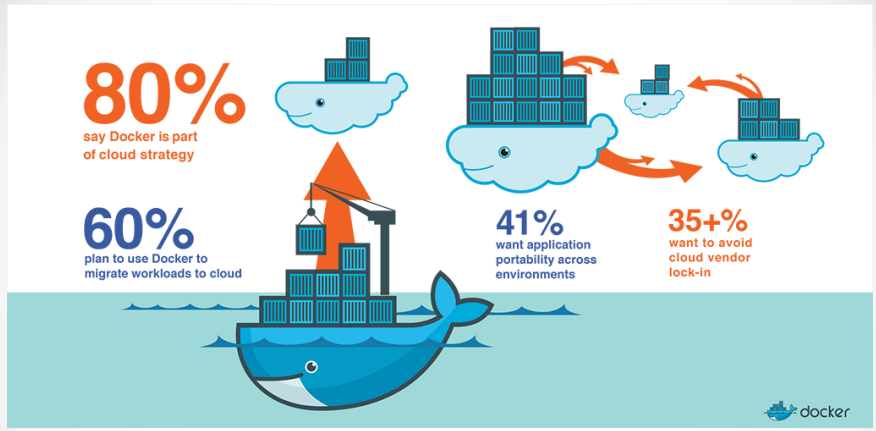
Platform	x86_64 / amd64	ARM	ARM64 / AARCH64	IBM Power (ppc64le)	IBM Z (s390x)
CentOS	✓		✓		
Debian	✓	✓	✓		
Fedora	✓		✓		
Ubuntu	✓	✓	✓	✓	✓

Docker History

- A dotCloud (PAAS provider) project
- Initial commit January 18, 2013
- Docker 0.1.0 released March 25, 2013
- 18,600+ github stars, 3800+ forks,740 Contributors…. and continues
- dotCloud pivots to docker inc. October 29, 2013

Growth of Docker

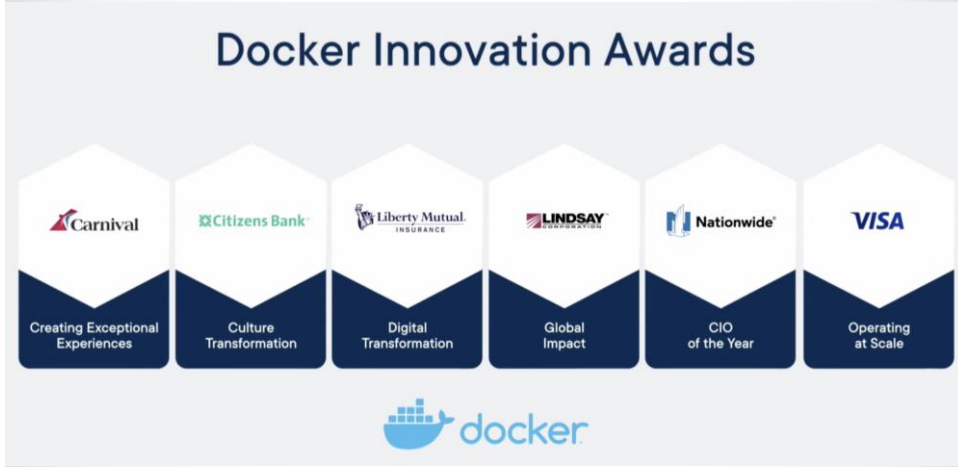
Could Strategy Survey



Docker in Thailand
- …Who not use container tech ?

Who use docker now ?

Who use docker now ?



55

Who use docker now ?

56

Who use docker now ?

PayPal

Docker: The Next-Gen of Virtualization

docker

57

Who use docker now ?

PayPal

Stage 1 Benefits

Decouple

Standardize deployments around Docker containers, rather than individual processes built around app stacks.

Modernize

With apps & dependencies Dockerized, move to modern OS & kernel.

10-20% performance boost to some apps for free.

150,000 containers 700+ apps 18 months

0 code changes

Docker: The Next-Gen of Virtualization

docker

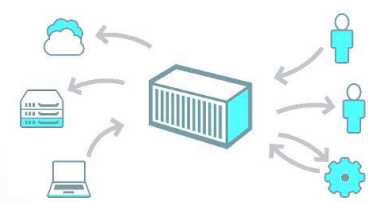
58

Who use docker now ?

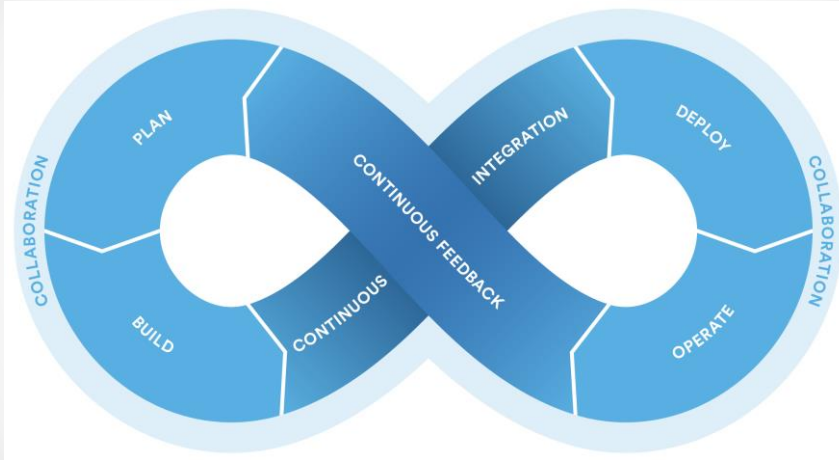
UBER

Container Life Cycle

- Developer
  - สร้าง template สำหรับโปรแกรม (build)
  - เริ่มรัน template สำหรับพัฒนาโปรแกรม (run)
  - พัฒนาเสร็จเรียบร้อย สั่ง save version เพื่อเตรียมนำขึ้นใช้งาน (commit)
- Operation
  - เริ่มรัน template ที่ได้รับจาก developer (run) บนเครื่อง production
  - หยุดการให้บริการโปรแกรม (stop, kill)
  - ลบโปรแกรมออกจากเครื่อง production (rm, rmi)



Container Life Cycle

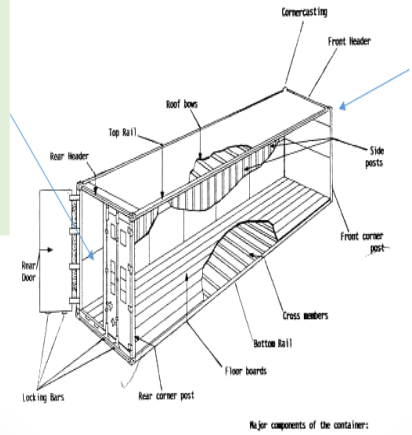


What Cool of Docker ?

- รวบรวมทุกสิ่งที่จำเป็นต้องใช้ในการรันโปรแกรมไว้ใต้ container (component, library etc)
- ขนาดไฟล์ container มีขนาดเล็กมาก (เทียบกับขนาดไฟล์ของ virtual machine หรือ os)
- มี overhead ในการรันโปรแกรมทรัพยากรต่ำ
- ลดระยะเวลาในการติดตั้งและทดสอบโปรแกรม
- ส่งมอบโปรแกรมไปทำงานบนเครื่องแม่ข่าย production ได้โดยไม่มีความจำเป็นต้องปรับแต่งระบบใหม่ (zero configure)
- สามารถรันโปรแกรมได้บนเครื่องแม่ข่ายทุกๆระบบปฏิบัติการฯ ที่ติดตั้ง docker ได้
- สามารถ scale-out ได้ง่ายในอนาคต
- World open for docker !!!

Separate of Concern

- Dan the Developer
  - Worries about what's "inside" the container
    - His code
    - His Libraries
    - His Package Manager
    - His Apps
    - His Data
  - All Linux servers look the same



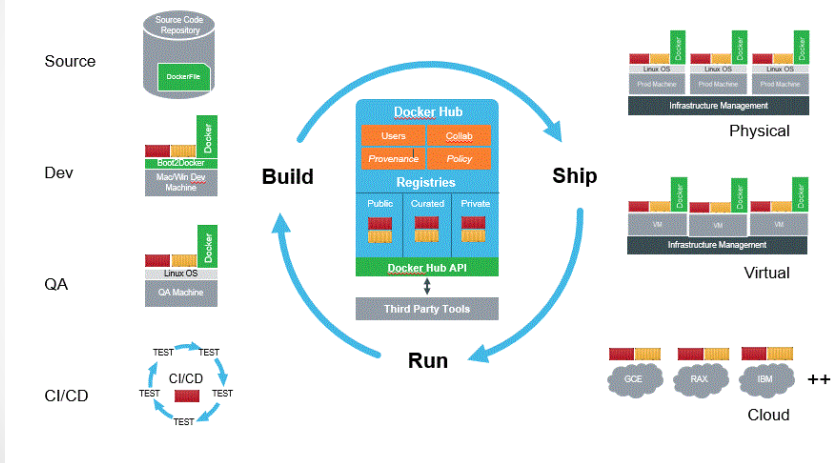
- Oscar the Ops Guy
  - Worries about what's "outside" the container
    - Logging
    - Remote access
    - Monitoring
    - Network config
  - All containers start, stop, copy, attach, migrate, etc. the same way

Docker: The Next-Gen of Virtualization

63

Benefit of docker for DevOps

- Build-Ship-Run



Present by: Praparn L. (eva10409@gmail.com)

64

Docker Version

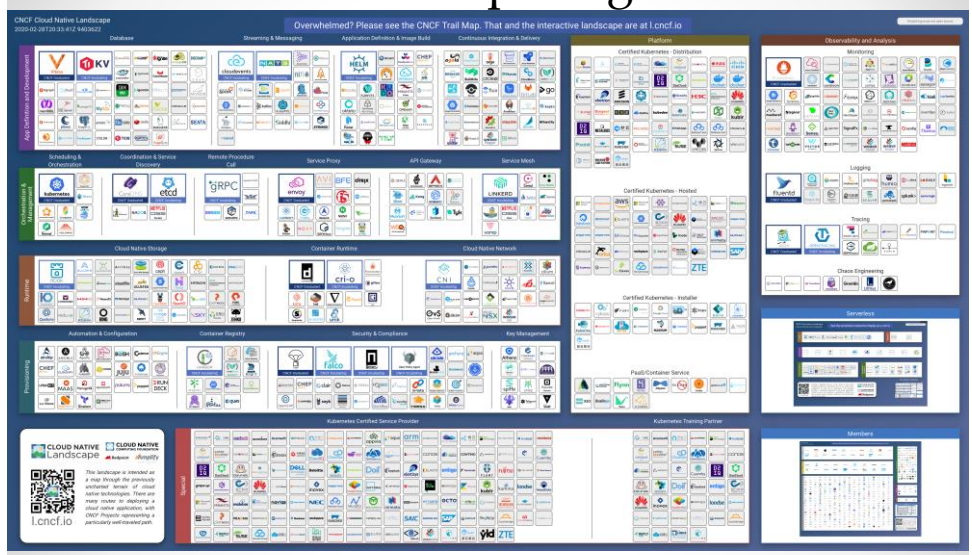
```
ubuntu@ip-10-0-1-234:~$ docker version
Client: Docker Engine - Community
 Version:           19.03.6
 API version:       1.40
 Go version:        go1.12.16
 Git commit:        369ce74a3c
 Built:             Thu Feb 13 01:27:49 2020
 OS/Arch:           linux/amd64
 Experimental:      false

Server: Docker Engine - Community
 Engine:
  Version:          19.03.6
  API version:      1.40 (minimum version 1.12)
  Go version:       go1.12.16
  Git commit:       369ce74a3c
  Built:            Thu Feb 13 01:26:21 2020
  OS/Arch:          linux/amd64
  Experimental:     false
 containerd:
  Version:          1.2.10
  GitCommit:        b34a5c8af56e510852c35414db4c1f4fa6172339
 runc:
  Version:          1.0.0-rc8+dev
  GitCommit:        3e425f80a8c931f88e6d94a8c831b9d5aa481657
 docker-init:
  Version:          0.18.0
  GitCommit:        fec3683
ubuntu@ip-10-0-1-234:~$
```

```
ubuntu@ip-10-0-1-234:~$ docker info
Client:
 Debug Mode: false

Server:
 Containers: 1
  Running: 0
  Paused: 0
  Stopped: 1
 Images: 1
 Server Version: 19.03.6
 Storage Driver: overlay2
  Backing Filesystem: extfs
  Supports d_type: true
  Native Overlay Diff: true
 Logging Driver: json-file
 Cgroup Driver: systemd
 Plugins:
  Volume: local
  Network: bridge host ipvlan macvlan null overlay
  Log: awslogs fluentd gcplogs gelf journald json-file local logentries splunk syslog
 Swarm: inactive
 Runtimes: runc
 Default Runtime: runc
 Init Binary: docker-init
 containerd version: b34a5c8af56e510852c35414db4c1f4fa6172339
 runc version: 3e425f80a8c931f88e6d94a8c831b9d5aa481657
 init version: fec3683
 Security Options:
  apparmor
  seccomp
   Profile: default
 Kernel Version: 4.15.0-1044-aws
 Operating System: Ubuntu 18.04.2 LTS
 OSType: linux
 Architecture: x86_64
 CPUs: 2
 Total Memory: 1.916GiB
 Name: ip-10-0-1-234
 ID: XQKI:QL5O:RQ2O:ATEC:JSMN:SELY:4IIY:UFTU:P4MD:YLBW:6SI4:CRZR
 Docker Root Dir: /var/lib/docker
 Debug Mode: false
 Registry: https://index.docker.io/v1/
 Labels:
 Experimental: false
 Insecure Registries:
  127.0.0.0/8
 Live Restore Enabled: false

WARNING: No swap limit support
ubuntu@ip-10-0-1-234:~$
```

Docker: The Next-Gen of Virtualization

65

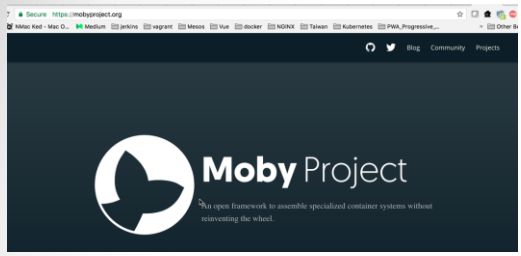
Cloud Native Computing Foundation

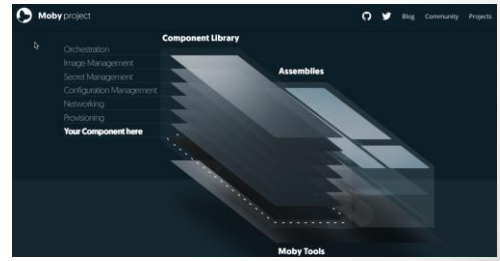


Kubernetes: Production Workload Orchestration

66

What's New





Docker: The Next-Gen of Virtualization

67

What's News

19.03.6 (2020-02-12)

Builder

- builder-next: Allow modern sign hashes for ssh forwarding. docker/engine#453
- builder-next: Clear onbuild rules after triggering. docker/engine#453
- builder-next: Fix issue with directory permissions when usernamespaces is enabled. moby/moby#40440
- Bump hcsshim to fix docker build failing on Windows 1903. docker/engine#429

Networking

- Shorten controller ID in exec-root to not hit UNIX_PATH_MAX. docker/engine#424
- Fix panic in drivers/overlay/encryption.go. docker/engine#424
- Fix hwaddr set race between us and udev. docker/engine#439

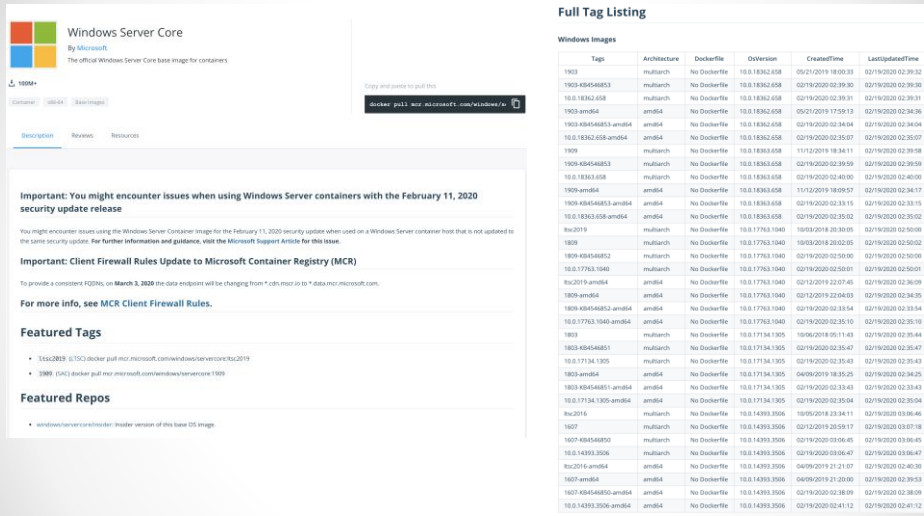
Runtime

- Bump Golang 1.12.16. moby/moby#40433
- Update containerd binary to v1.2.12. moby/moby#40433
- Update to runc v1.0.0-rc10. moby/moby#40433
- Fix possible runtime panic in Lgetxattr. docker/engine#454
- rootless: fix proxying UDP packets. docker/engine#434

Docker: The Next-Gen of Virtualization

68

What's News



REF:https://support.microsoft.com/en-us/help/4542617/you-might-encounter-issues-when-using-windows-server-containers-with-t

Docker: The Next-Gen of Virtualization

What's News

You might encounter issues when using Windows Server containers with the February 11, 2020 security update release

Applies to: Windows Server 2016, Windows Server 2019, all versions, Windows Server version 1803, More

Last updated February 18, 2020 6:30pm PST

Symptoms

You might encounter issues using Windows Server containers, unless both the Windows container host and Windows Server containers are matched with the February 11, 2020 security update. Compatibility was affected by a security change that must be addressed in both the container host and the container image, requiring them to match.

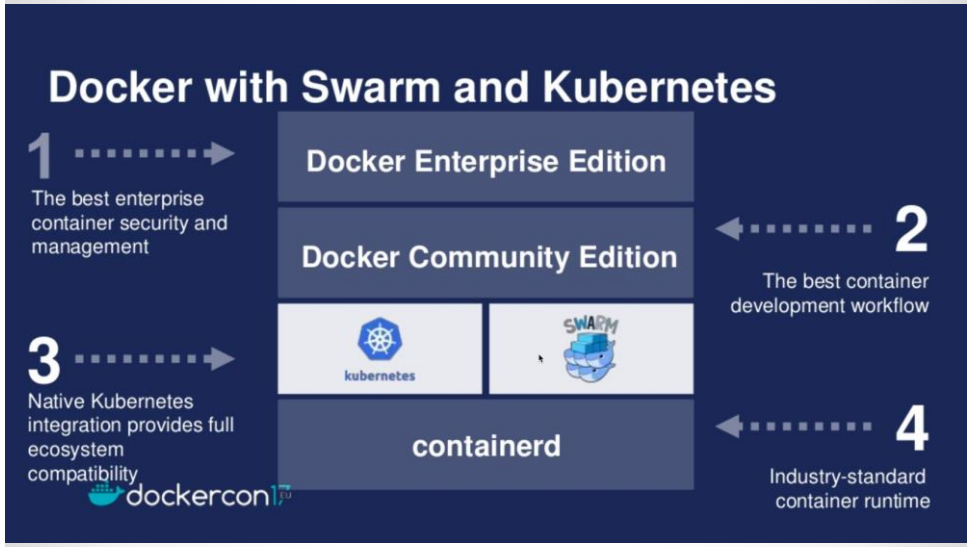
Symptoms when running or building a container might include:

1. When you run the command "docker run" or "docker build" you might not receive output and it might become non-responsive.
2. Your Windows Server Container in Kubernetes does not reach the "running" state.
3. You receive the error, "docker: Error response from daemon: container <id> encountered an error during Start: failure in a Windows system call: The wait operation timed out. (0x102)."
4. Your 32-bit application or processes running inside the container might silently fail.

REF:https://support.microsoft.com/en-us/help/4542617/you-might-encounter-issues-when-using-windows-server-containers-with-t

Docker: The Next-Gen of Virtualization

What's News

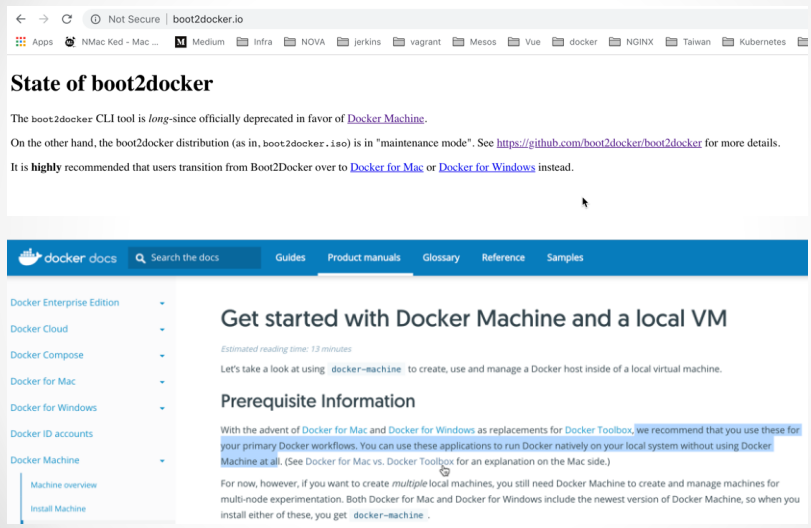


Docker Machine

Platform of Docker

- Docker Toolbox (Obsolete) for Desktop (Docker CE)
  - Install docker toolbox on machine will Create VM (Oracle VirtualBox)
  - Dockertoolbox for MAC
  - Dockertoolbox for Windows (7,8,10)
- Docker Native for Desktop (Docker CE)
  - Docker for MAC (Moby Linux (xhyve engine))
  - Docker for Windows (Moby Linux (hyper-v engine))
- Docker Native for Server (Docker CE/EE)
  - Docker for Windows 2016 (EE)
  - Docker for Ubuntu,CENTOS (CE/EE)
  - Docker for Debian (EE/ARM)
  - Docker for Red Hat Enterprise/SUSE/Oracle Linux (EE)
  - Docker for Fedora (CE)

Linux vs Windows vs MAC OS



Docker-machine CLI

- ตรวจสอบสถานะ docker-machine

```
docker-machine ls
```

- สั่งเริ่มการทำงานของ docker-machine

```
docker-machine start <machine name>
```

- สั่งหยุดการทำงานของ docker-machine

```
docker-machine stop <machine name>
```

- สั่งสร้าง docker-machine เครื่องใหม่

```
docker-machine create --driver virtualbox/hyperv <name>
```


Workshop 1-2: Pull Image

ทำการ download image ubuntu ลงมาที่เครื่อง boot2docker โดยใช้คำสั่งดังนี้

```
docker image pull labdocker/alpine:latest
```

```
docker image pull labdocker/alpineweb:latest
```

```
docker image pull labdocker/cadvisor:latest
```

Compare with Ubuntu image

```
docker images/docker image ls
```

```
[ubuntu@ip-10-0-1-104:~$ docker image ls
REPOSITORY            TAG                 IMAGE ID            CREATED             SIZE
hello-world           latest              fce289e99eb9        2 months ago        1.84kB
labdocker/alpineweb   latest              5770233f642f        4 months ago        50.5MB
labdocker/ubuntu      latest              ea4c82dcd15a        4 months ago        85.8MB
labdocker/alpine      latest              196d12cf6ab1        5 months ago        4.41MB
ubuntu@ip-10-0-1-104:~$
```


Workshop 1-2: Pull Image

ทำการตรวจสอบประวัติของ image ที่ใช้งานผ่านคำสั่ง docker image history

docker image history labdocker/alpine:latest

docker image history labdocker/alpineweb:latest

```
ubuntu@ip-10-0-1-104:~$ docker image history labdocker/alpine:latest
IMAGE          CREATED         CREATED BY                                      SIZE      COMMENT
196d12cf6ab1   5 months ago    /bin/sh -c #(nop)  CMD ["/bin/sh"]              0B
<missing>      5 months ago    /bin/sh -c #(nop) ADD file:25c10b1d1b41d46a1…   4.41MB
ubuntu@ip-10-0-1-104:~$ docker image history labdocker/alpineweb:latest
IMAGE          CREATED         CREATED BY                                      SIZE      COMMENT
5770233f642f   4 months ago    /bin/sh -c #(nop)  EXPOSE 3000                  0B
<missing>      4 months ago    /bin/sh -c #(nop)  ENTRYPOINT ["node" "hello…   0B
<missing>      4 months ago    /bin/sh -c #(nop) WORKDIR /nodejs               0B
<missing>      4 months ago    /bin/sh -c #(nop) COPY file:b974a437806b927a…   263B
<missing>      4 months ago    /bin/sh -c mkdir /nodejs                        0B
<missing>      4 months ago    /bin/sh -c apk update &&     apk add nodejs …   46.1MB
<missing>      4 months ago    /bin/sh -c #(nop)  ENV NODE_VERSION=v8.11.4 …   0B
<missing>      4 months ago    /bin/sh -c #(nop)  LABEL Description=NodeJS/…   0B
<missing>      4 months ago    /bin/sh -c #(nop)  MAINTAINER Praparn Lueang…   0B
<missing>      5 months ago    /bin/sh -c #(nop)  CMD ["/bin/sh"]              0B
<missing>      5 months ago    /bin/sh -c #(nop) ADD file:25c10b1d1b41d46a1…   4.41MB
ubuntu@ip-10-0-1-104:~$
```


General Command in Docker

Command	Description
docker attach	Attach local standard input, output, and error streams to a running container
docker build	Build an image from a Dockerfile
docker checkpoint	Manage checkpoints
docker commit	Create a new image from a container's changes
docker config	Manage Docker configs
docker container	Manage containers
docker cp	Copy files/folders between a container and the local filesystem
docker create	Create a new container
docker deploy	Deploy a new stack or update an existing stack
docker diff	Inspect changes to files or directories on a container's filesystem
docker events	Get real time events from the server
docker exec	Run a command in a running container
docker export	Export a container's filesystem as a tar archive
docker history	Show the history of an image
docker image	Manage images
docker images	List images
docker import	Import the contents from a tarball to create a filesystem image
docker info	Display system-wide information
docker inspect	Return low-level information on Docker objects

docker kill	Kill one or more running containers
docker load	Load an image from a tar archive or STDIN
docker login	Log in to a Docker registry
docker logout	Log out from a Docker registry
docker logs	Fetch the logs of a container
docker network	Manage networks
docker node	Manage Swarm nodes
docker pause	Pause all processes within one or more containers
docker plugin	Manage plugins
docker port	List port mappings or a specific mapping for the container
docker ps	List containers
docker pull	Pull an image or a repository from a registry
docker push	Push an image or a repository to a registry
docker rename	Rename a container
docker restart	Restart one or more containers
docker rm	Remove one or more containers
docker rmi	Remove one or more images
docker run	Run a command in a new container
docker save	Save one or more images to a tar archive (streamed to STDOUT by default)
docker search	Search the Docker Hub for images
docker secret	Manage Docker secrets

https://docs.docker.com/engine/reference/commandline/docker/

General Command in Docker

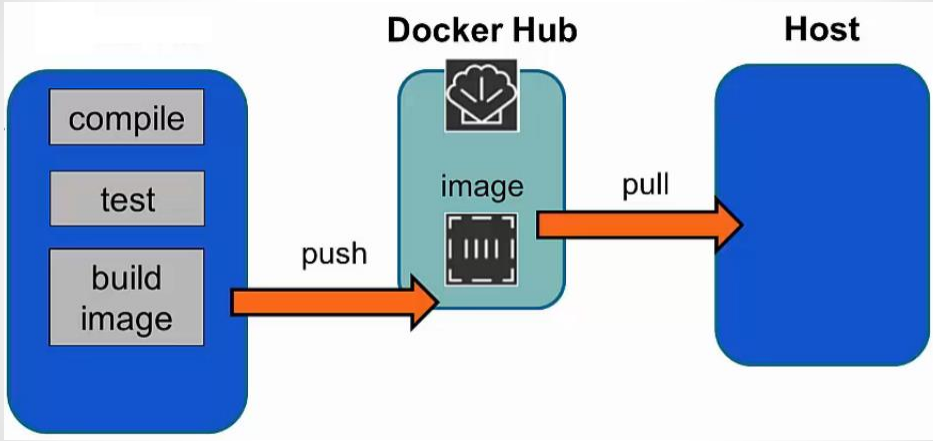
docker secret	Manage Docker secrets
docker service	Manage services
docker stack	Manage Docker stacks
docker start	Start one or more stopped containers
docker stats	Display a live stream of container(s) resource usage statistics
docker stop	Stop one or more running containers
docker swarm	Manage Swarm
docker system	Manage Docker
docker tag	Create a tag TARGET_IMAGE that refers to SOURCE_IMAGE
docker top	Display the running processes of a container
docker trust	Manage trust on Docker images (experimental)
docker unpause	Unpause all processes within one or more containers
docker update	Update configuration of one or more containers
docker version	Show the Docker version information
docker volume	Manage volumes
docker wait	Block until one or more containers stop, then print their exit codes

https://docs.docker.com/engine/reference/commandline/docker/

Image, Repository and Container

• • •

Docker Deployment

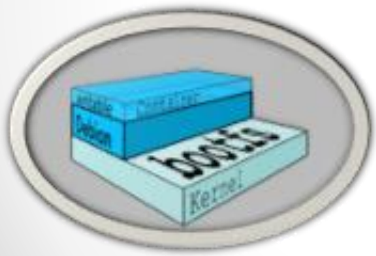


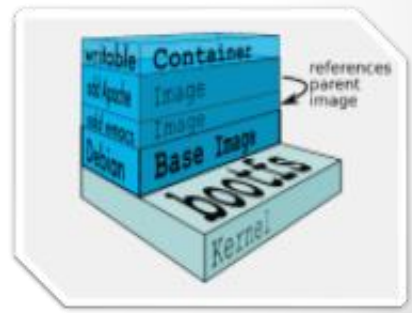
Docker: The Next-Gen of Virtualization

81

Docker Image

- Image คือtemplate ที่ถูกสร้างขึ้นเพื่อเตรียมใช้ในการรัน container
- เป็นไฟล์ที่อ่านได้อย่างเดียว
- ถูกสร้างโดยผู้ใช้งานเอง หรือผู้อื่น
- จัดเก็บไว้ใน repository (hub.docker.com, registry, trust registry)





Docker: The Next-Gen of Virtualization

82

Docker Image

- เรียกดู image ที่อยู่ภายในเครื่อง

docker images /docker image ls

```
ubuntu@ip-10-0-1-104:~$ docker image ls
REPOSITORY            TAG                 IMAGE ID            CREATED             SIZE
hello-world           latest              fce289e99eb9        2 months ago        1.84kB
labdocker/alpineweb   latest              5770233f642f        4 months ago        50.5MB
labdocker/ubuntu      latest              ea4c82dcd15a        4 months ago        85.8MB
labdocker/alpine      latest              196d12cf6ab1        5 months ago        4.41MB
ubuntu@ip-10-0-1-104:~$
```

- tag image ใหม่เพื่อให้ตรงตามความต้องการในการใช้งาน

docker image tag <image id> <acc name/imagename: version>

Ex: docker image tag 14f89d0e6257 labdocker/alpinelab:1.0

Docker Image

- ตรวจสอบรายละเอียดของ image

docker images history <image id/image name>

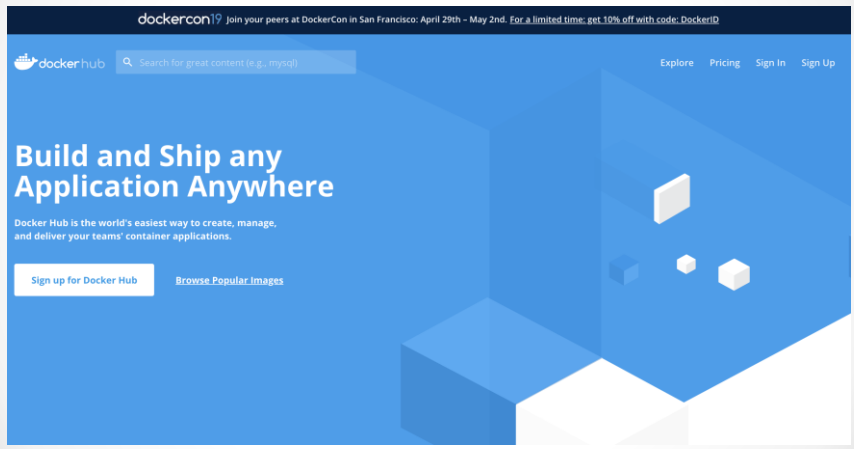
```
ubuntu@ip-10-0-1-58:~$ docker image history labdocker/alpine:latest
IMAGE               CREATED             CREATED BY                                      SIZE                COMMENT
196d12cf6ab1        7 months ago        /bin/sh -c #(nop)  CMD ["/bin/sh"]              0B
<missing>           7 months ago        /bin/sh -c #(nop) ADD file:25c10b1d1b41d46a1…   4.41MB
ubuntu@ip-10-0-1-58:~$ docker image history labdocker/alpineweb:latest
IMAGE               CREATED             CREATED BY                                      SIZE                COMMENT
5770233f642f        5 months ago        /bin/sh -c #(nop)  EXPOSE 3000                  0B
<missing>           5 months ago        /bin/sh -c #(nop)  ENTRYPOINT ["node" "hello…   0B
<missing>           5 months ago        /bin/sh -c #(nop) WORKDIR /nodejs               0B
<missing>           5 months ago        /bin/sh -c #(nop) COPY file:b974a437806b927a…   263B
<missing>           5 months ago        /bin/sh -c mkdir /nodejs                        0B
<missing>           5 months ago        /bin/sh -c apk update &&     apk add nodejs …   46.1MB
<missing>           5 months ago        /bin/sh -c #(nop)  ENV NODE_VERSION=v8.11.4 …   0B
<missing>           5 months ago        /bin/sh -c #(nop)  LABEL Description=NodeJS/…   0B
<missing>           5 months ago        /bin/sh -c #(nop)  MAINTAINER Praparn Lueang…   0B
<missing>           7 months ago        /bin/sh -c #(nop)  CMD ["/bin/sh"]              0B
<missing>           7 months ago        /bin/sh -c #(nop) ADD file:25c10b1d1b41d46a1…   4.41MB
ubuntu@ip-10-0-1-58:~$
```


Repository (Registry)

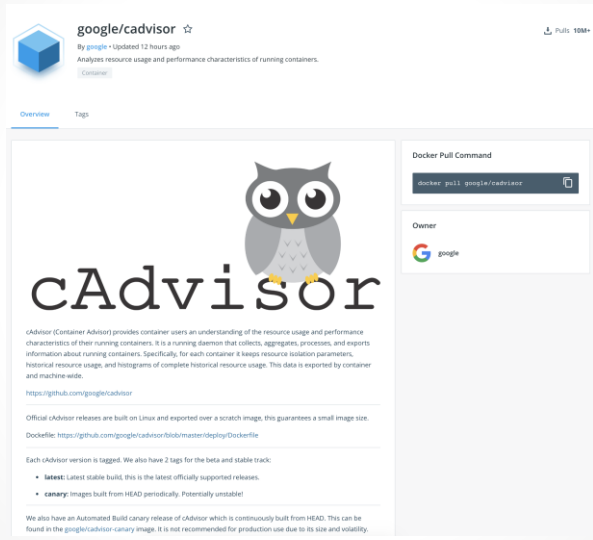
- component ในการจัดเก็บ docker (image) ต่าง ๆรวมไปที่ศูนย์กลาง เพื่อให้ docker engine บนเครื่องต่าง ๆมาเรียก image ไปใช้ทำงาน
- รองรับการเก็บ version ของ image อย่างเป็นระบบ
- สามารถให้ข้อมูลหรือคู่มือแนะนำการใช้งานกับผู้ download image ได้
- มี official image ที่สร้างจากผู้พัฒนาโปรแกรมเอง
- Docker มีให้บริการ repository บน cloud แก่ผู้ใช้งาน
- Url: https://hub.docker.com/
- Free registry without cost
- Private repository (registry, trust registry)

Repository (Registry)

- Hub.docker.com



Repository (Registry)



Repository (Registry)

- download image ออกจาก registry

  docker image pull <account name/image name: tags>

  Ex: docker image pull labdocker/alpine:latest

- Upload image ขึ้นไปเก็บบน registry
  - Login

docker login <url> -u <username> -p <password> -e <email>

Ex: docker login -u labdocker –p xxxxxxx –e xxxx@xxx.xxx

Ex: docker login 10.38.7.248:8080 –u labdocker

Repository (Registry)

- Push image ขึ้นไปเก็บบน registry

```
docker image push<account name/image name: tags>
```

```
Ex: docker image push labdocker/alpinelab:1.0
```

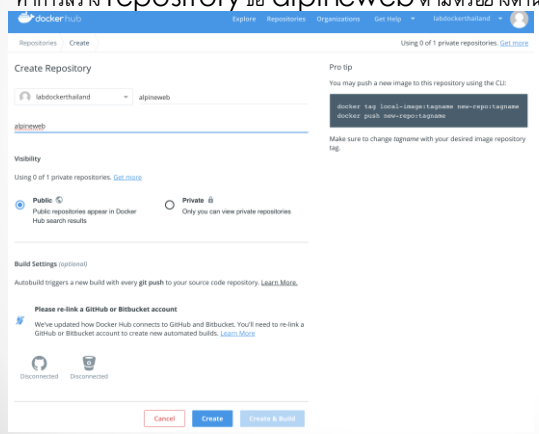
- Logoff ออกจาก Repository

```
docker logoff
```

*Docker 1.10 (upper) จะทำการ push แบบ parallel layer ทำให้สามารถ push image ได้เร็วขึ้น สามเท่าจากเดิม

Workshop 1-3: Create & Push Image

- ใน workshop นี้สอนการสร้าง image file สำหรับใช้เป็น web server และจัดเก็บ image file ลงใน repository ส่วนตัวเพื่อเตรียมไว้ใช้งาน
- สมัครใช้งาน http://hub.docker.com และแจ้งยืนยันอีเมล์เพื่อเริ่มใช้งาน
- ทำการสร้าง repository ชื่อ alpineweb ตามตัวอย่างด้านล่าง



Workshop 1-3: Build & Push Image

- ตรวจสอบ image id ด้วยคำสั่ง

```
docker image ls
```

- tag image ใหม่เป็น <accountname>/alpineweb:latest

```
docker image tag labdocker/alpineweb:latest \
<accountname>/alpineweb:latest
```

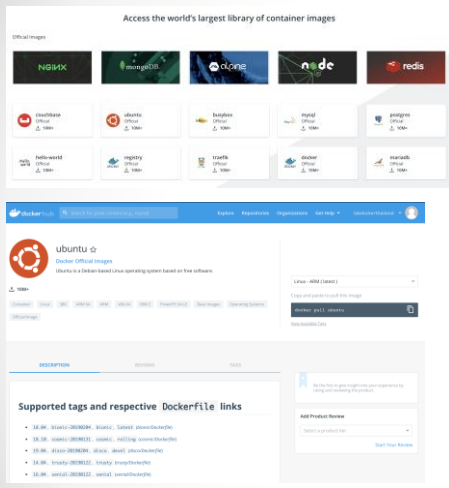
- Login เข้า hub.docker.com ด้วย username/password ที่ตั้งไว้

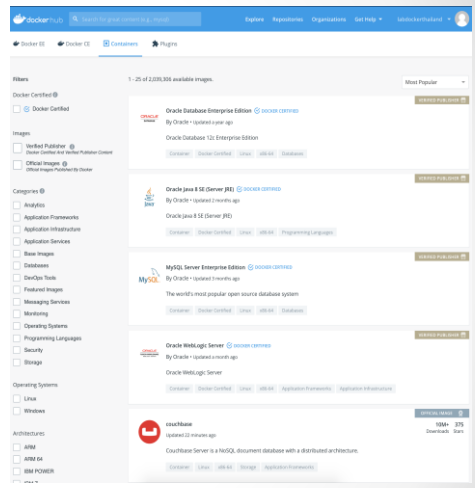
```
docker login –u <xxxx>
```

- Push image alpine ที่ tag ไว้ขึ้น repository

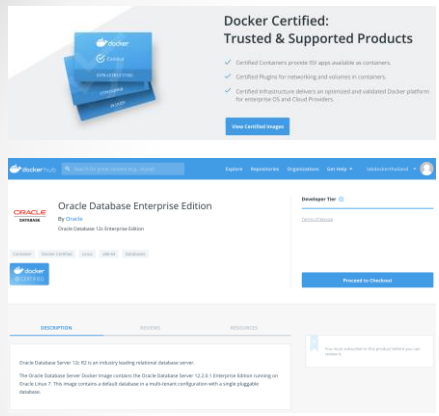
```
docker image push <accountname>/alpineweb:latest
```

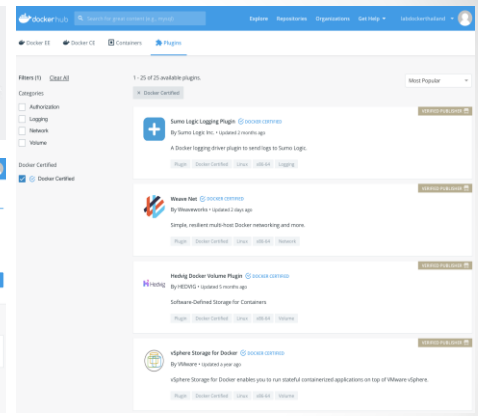

Other service in hub.docker.com



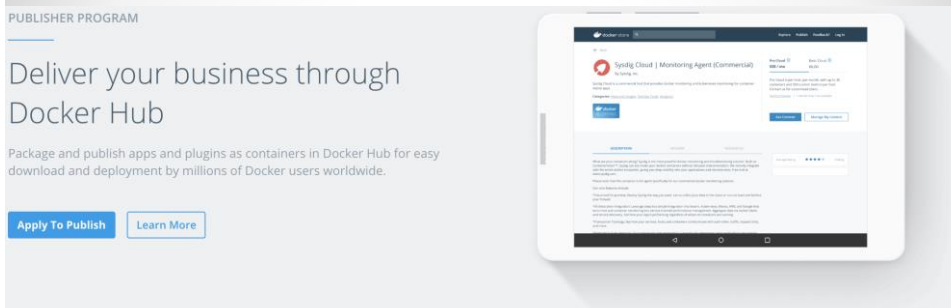


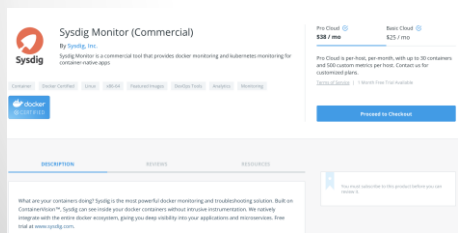
Other service in hub.docker.com

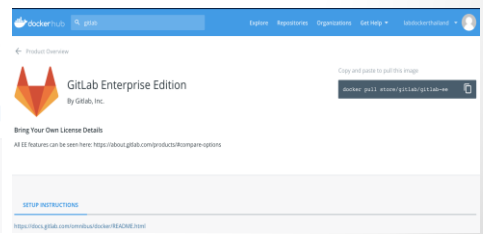




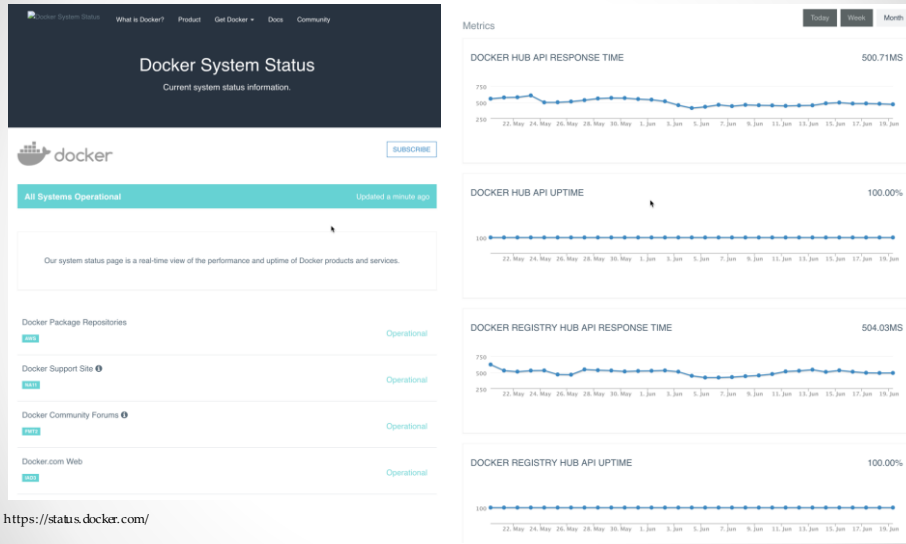
Other service in hub.docker.com







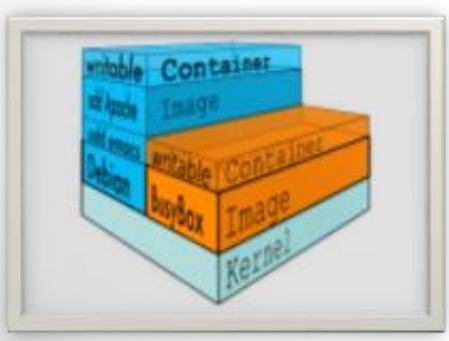
Status.docker.com

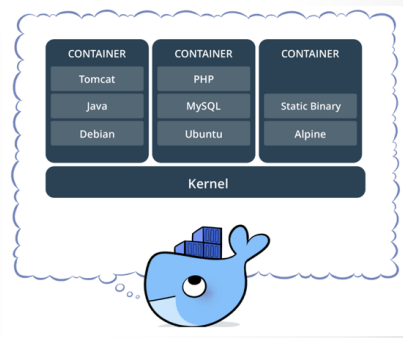


https://status.docker.com/

Docker Container

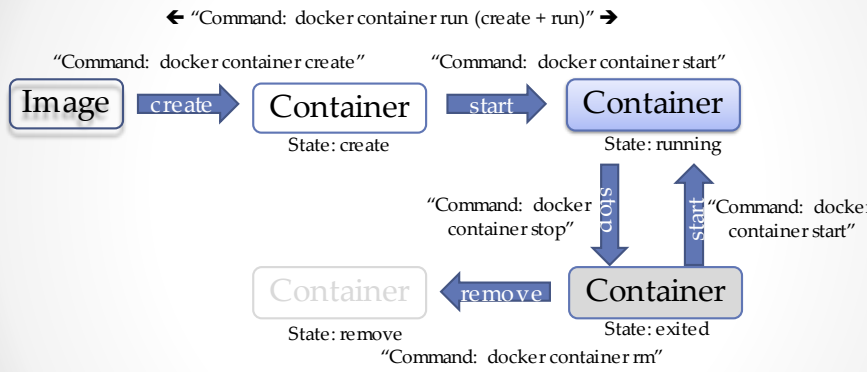
- Container คือชุดของ software layer ที่รันอิสระโดยอ้างอิงจาก image (run)
- ใช้สำหรับสร้างสภาพแวดล้อมที่จำเป็นต้องใช้ในการรันหรือพัฒนาโปรแกรม
- เมื่อพัฒนาโปรแกรมเสร็จเรียบร้อยแล้ว หรือต้องการ backup container สามารถสั่งเก็บ container ชุดปัจจุบันไปเป็น image เพื่อรอการเรียกใช้งานต่อไป (commit)





Docker Container

- Container State:



Docker Container

- Container Different (Compare with Image):

```
docker container diff <container name>
```

```
ubuntu@ip-10-0-1-58:~$ docker container ls
CONTAINER ID        IMAGE                  COMMAND             CREATED             STATUS              PORTS                    NAMES
115bb4a5b92b        labdocker/alpineweb:latest   "node hello.js"     34 seconds ago      Up 32 seconds       0.0.0.0:3000->3000/tcp   nodejs
ubuntu@ip-10-0-1-58:~$ docker container diff nodejs
C /nodejs
A /nodejs/test.js
C /root
A /root/.ash_history
ubuntu@ip-10-0-1-58:~$
```

Docker Container

- Container Performance/Port:

  docker container stats <container name>

  docker container top <container name>

  docker container port <container name>

```
CONTAINER ID        NAME                CPU %               MEM USAGE / LIMIT     MEM %               NET I/O             BLOCK I/O           PIDS
115bb4a5b92b        nodejs              0.00%               8.375MiB / 1.91GiB    0.43%               5.9kB / 2.3kB       36.9kB / 0B         6
^C
ubuntu@ip-10-0-1-58:~$ docker container top nodejs
UID                 PID                 PPID                C                   STIME               TTY                 TIME                CMD
root                3069                3043                0                   14:15               pts/0               00:00:00            node
hello.js
ubuntu@ip-10-0-1-58:~$ docker container port nodejs
3000/tcp -> 0.0.0.0:3000
ubuntu@ip-10-0-1-58:~$
```


Docker Container

- Container change name on-the-fly:

  docker container rename <old name> <new name>

```
ubuntu@ip-10-0-1-58:~$ docker container ls
CONTAINER ID        IMAGE                          COMMAND             CREATED             STATUS              PORTS                    NAMES
115bb4a5b92b        labdocker/alpineweb:latest     "node hello.js"     13 minutes ago      Up 13 minutes       0.0.0.0:3000->3000/tcp   nodejs
ubuntu@ip-10-0-1-58:~$ docker container rename nodejs nodejsnew
ubuntu@ip-10-0-1-58:~$ docker container ls
CONTAINER ID        IMAGE                          COMMAND             CREATED             STATUS              PORTS                    NAMES
115bb4a5b92b        labdocker/alpineweb:latest     "node hello.js"     13 minutes ago      Up 13 minutes       0.0.0.0:3000->3000/tcp   nodejsnew
ubuntu@ip-10-0-1-58:~$
```


Docker Container

- สั่ง run docker เพื่อสร้าง container จาก image file

```
docker container run <option><image id/name><command>
```

```
Ex: docker container run  -i -t --rm -p 3000:3000 \
labdocker/alpineweb:latest node hello.js
```

- สั่ง exec command ไปบน container ที่รันอยู่

```
docker container exec –it <container id/name> <command>
docker container attach <container id/name>
```

- เริ่ม/หยุด container

```
docker container <start/stop> <container id/name>
```

- ลบ container

```
docker container rm <containerid/name>
```

Docker: The Next-Gen of Virtualization

101

Workshop: Run Container

- Interactive NODEJS
- สั่งรัน container แบบ Interactive โดยตั้งชื่อว่า nodejs และ map network 3000:3000

```
docker container run  -i -t--rm --name nodejs -p 3000:3000 \
labdocker/alpineweb:latest node hello.js
```

- ทดสอบเปิดหน้าเว็บบน url: http://<ip address>:3000
- ตรวจสอบ container ด้วยคำสั่ง

```
docker container ps -a
```

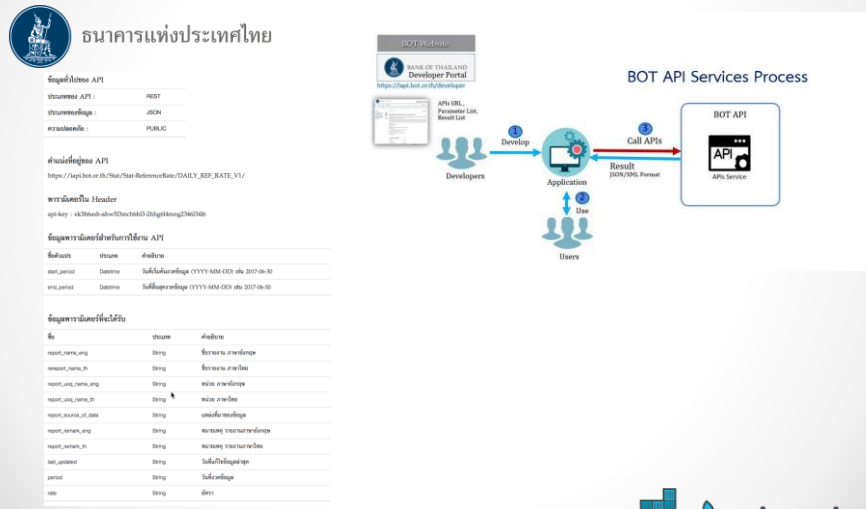
- Exist with Ctrl+C

Docker: The Next-Gen of Virtualization

102

Workshop: Run Container

- DAEMON LINE BOT

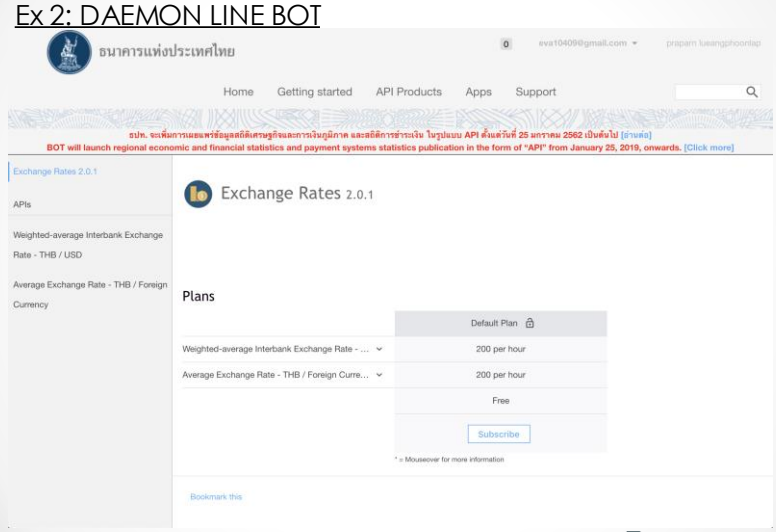


Docker: The Next-Gen of Virtualization

103

Workshop: Run Container

- Ex 2: DAEMON LINE BOT



Docker: The Next-Gen of Virtualization

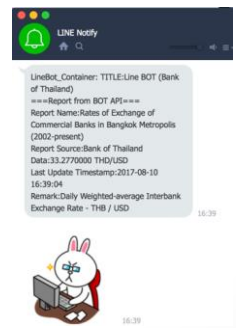
104

Workshop: Run Container

- DAEMON LINE BOT

```
docker@labdocker:~$ docker container run --rm --name linebot -e "TITLE=Line BOT (Bank of Thailand)" -e "TOKEN=EIeqyillzkzpaCo1ROrebZTcGbIyzDZHpOjcdd0t6CX" labdocker/linenotify:bot_v1
null
{"statusCode":200,"body":"{\"status\":200,\"message\":\"ok\"}","headers":{"server":"nginx","date":"Sat, 20 Jan 2018 03:12:22 GMT","content-type":"application/json;charset=UTF-8","transfer-encoding":"chunked","connection":"keep-alive","keep-alive":"timeout=3","x-ratelimit-limit":"1000","x-ratelimit-imagelimit":"50","x-ratelimit-remaining":"998","x-ratelimit-imageremaining":"50","x-ratelimit-reset":"1516421345"},"request":{"uri":{"protocol":"https:","slashes":true,"auth":null,"host":"notify-api.line.me","port":443,"hostname":"notify-api.line.me","hash":null,"search":null,"query":null,"pathname":"/api/notify","path":"/api/notify","href":"https://notify-api.line.me/api/notify"},"method":"POST","headers":{"Content-Type":"application/x-www-form-urlencoded","authorization":"Bearer EIeqyillzkzpaCo1ROrebZTcGbIyzDZHpOjcdd0t6CX","content-length":466}}}
"{\"status\":200,\"message\":\"ok\"}"
docker@labdocker:~$
```

```
const request = require('request');
const qs = require('querystring');
const TITLE=process.env.TITLE;
const KEY =process.env.KEY; //Input API-KEY to Header
//const KEY="U8G1L4S7H6DCugT7VmBaEacbHV9RX8PySQB5cYaGsm";
const URL =process.env.URL; //Input URL for Request
//const URL="https://imgl.bot.or.th/Stat/Stat-ReferenceRate/DAILY_REF_RATE_V1/Z";
//const TOKEN = 'EIeqyillzkzpaCo1ROrebZTcGbIyzDZHpOjcdd0t6CX';
const TOKEN=process.env.TOKEN; //Input TOKEN LINE
//Set Date
var dateFormat = require('dateformat');
var daynow = new Date(); // Today!
daynow.setDate(daynow.getDate() - 1); // Yesterday!
var daynow=dateFormat(daynow, "yyyy-mm-dd");
var DAYSTARTPERIOD=daynow;
var DAYENDPERIOD=daynow;
//Set Date
var stickerPkg=2; //stickerPackageId
var stickerId=161; //stickerId
var Message="";
//Setup QueryString
var querystring = qs.stringify({
    start_period: DAYSTARTPERIOD,
    end_period: DAYENDPERIOD
});
//Setup QueryString
function callback(error, response, body) {
  //console.log(URL+querystring);
  //console.log('Response Code: '+ response.statusCode);
  //console.log(body)
  if (!error && response.statusCode == 200) {
    var info = JSON.parse(body);
```



Workshop: Run Container

- DAEMON LINE BOT
- สั่งรัน container แบบ Daemon โดยตั้งชื่อว่า linebot เพื่อทำการดึงข้อมูลจาก API ของธนาคารแห่งประเทศไทยออกมาแล้วส่ง LINE Notify ไปหา Token Key ที่กำหนด

```
docker container run -it --rm --name linebot \
-e TITLE="Line BOT (Bank of Thailand)" \
 -e "TOKEN=<LINE TOKEN>"
labdocker/linenotify:bot_v2
```

Workshop: Run Container

- Detach Mode NODEJS
- สั่งรัน container แบบ detach (daemon) โดยตั้งชื่อว่า nodejs และ map network 3000:3000

```
docker container run -d -t --name nodejs -p 3000:3000 \
labdocker/alpineweb:latest node hello.js
```

- ทดสอบเปิดหน้าเว็บบน url: http://<ip address>:3000
- ตรวจสอบ container ด้วยคำสั่ง

```
docker container ps -a
```

- ทดสอบ Shell เข้าสู่ container ด้วยคำสั่ง

```
docker container exec –i –t nodejs sh
```


Workshop: Run Container

- Detach Mode NODEJS
- สั่งหยุดเริ่ม container ด้วยคำสั่ง stop

```
docker container stop nodejs
```

```
docker container start nodejs
```

- ทำการตรวจสอบ container offline ด้วยคำสั่ง

```
docker container ls -a
```

- ทดสอบ Shell เข้าสู่ container ด้วยคำสั่ง

```
docker container exec –i –t nodejs sh
```

```
docker container attach nodejs
```


Workshop: Run Container

- Detach Mode NODEJS
- ทำการตรวจสอบ process ภายใน container

```
docker container top nodejs
```

```
docker container stats nodejs
```

- ทำการตรวจสอบความแตกต่างระหว่าง container กับ image ต้นฉบับ

```
docker container diff nodejs
```

- ตรวจสอบการ map port container

```
docker container port nodejs
```

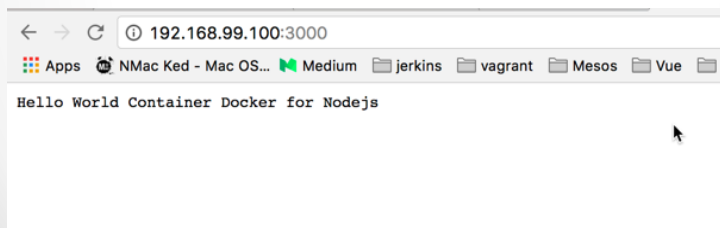
- เปลี่ยนแปลงชื่อ container แบบ online

```
docker container rename nodejs nodejsnew
```


Workshop: Run Container

- Detach Mode NODEJS

```
1  var http = require('http');
2
3  http.createServer(function (req, res) {
4    res.writeHead(200, {'Content-Type': 'text/plain'});
5    res.end('Hello World Container Docker for Nodejs\n');
6  }).listen(3000, '0.0.0.0');
7
8  console.log('Server running at http://0.0.0.0:3000/');
```



Workshop: Run Container

- Detach Mode Python
- สั่งสร้าง container แบบ detach (daemon) โดยตั้งชื่อว่า pythonและ map network 5000:5000

```
docker create run -t --name python -p 5000:5000 \
labdocker/cluster:webservicelite
```

- ทำการรัน

```
docker container ls –a
docker container start python
```

- ทดสอบเปิดหน้าเว็บบน url: http://<ip address>:5000
- ทดสอบ Shell เข้าสู่ container ด้วยคำสั่ง

```
docker container exec –i –t python sh
```

```
docker container attach python
```

Docker: The Next-Gen of Virtualization

111

Workshop: Run Container

- Detach Mode PYTHON

```
from flask import Flask
import os
import time
app = Flask(__name__)

@app.route('/')
def hello():
    return '<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: ' + time.strftime("%c") +'\n'

if __name__ == "__main__":
    app.run(host="0.0.0.0", port=5000, debug=True)
```

Docker: The Next-Gen of Virtualization

112

CPU, Memory & I/O

CPU

- Default container จะมองเห็น CPU resource ทั้งหมดในเครื่องระหว่าง runtime และ share เวลาการทำงานให้ทุก container เท่ากัน
- config share time ในการใช้งาน (default: 1024)

```
--cpu-shares, -c =“<0 (default): Ratio>”
```

- config share core cpu

```
--cpuset-cpus=“1, 3"
```

- กำหนด cpu quota & period (default: 100 ms)

```
--cpu-period=100000 --cpu-quota=500000
```

- NUMA (non-uniform memory access) architcture

```
--cpuset-mems=“1,3”
```


Workshop: CPU Configure

- Download cAdvisor

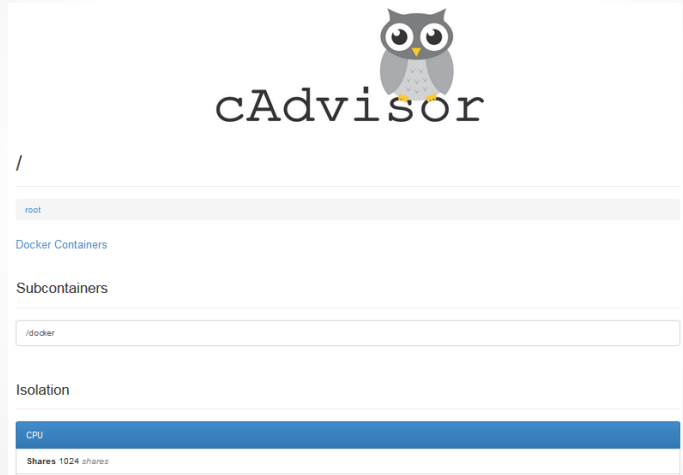
```
docker image pull labdocker/cadvisor:latest
```

- สั่งรัน cAdvisor ตาม command ดังนี้

```
docker container run \
        --mount type=bind,source=/var/run,target=/var/run \
        --mount type=bind,source=/sys,target=/sys,readonly \
        --mount
type=bind,source=/var/lib/docker,target=/var/lib/docker,readonly \
        --publish=8080:8080 \
        --detach=true \
        --name=cadvisor \
        labdocker/cadvisor:latest
```


Workshop: CPU Configure

- cAdvisor



Workshop: CPU Configure

- Download busybox เพื่อใช้ในการทดสอบ

```
docker image pull labdocker/busybox:latest
```

- Scenario 1 (Single CPU: 70/30)

```
docker container run -d \
--name='Share_30' \
--cpuset-cpus=0 \
--cpu-shares=30 \
labdocker/busybox:latest md5sum /dev/urandom
```

```
docker container run -d \
--name='Share_70' \
--cpuset-cpus=0 \
--cpu-shares=70 \
labdocker/busybox:latest md5sum /dev/urandom
```


Workshop: CPU Configure

- Result

Quiz ?

- Scenario (Multiple CPU: 70/30)

```
docker container run -d \
--name='Share_30' \
--cpuset-cpus=0 \
--cpu-shares=30 \
labdocker/busybox:latest md5sum /dev/urandom
```

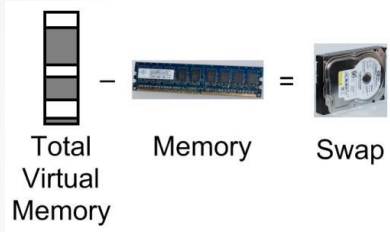
```
docker container run -d \
--name='Share_70' \
--cpuset-cpus=1 \
--cpu-shares=70 \
labdocker/busybox:latest md5sum /dev/urandom
```

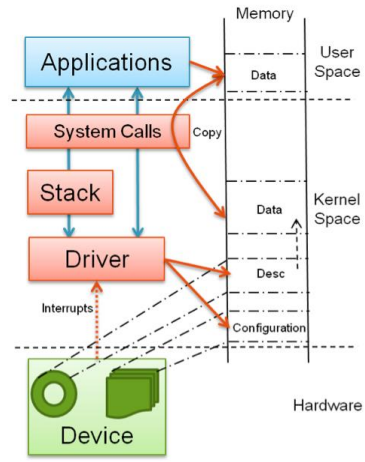

Quiz ?

- Result

Memory

- Default container จะมองเห็น memory resource ทั้งหมดในเครื่องระหว่าง runtime และสามารถใช้งาน memory resource ทั้งหมดเท่าที่ต้องการ





Docker: The Next-Gen of Virtualization

121

Memory

- การคอนฟิก memory บน container สามารถกำหนดได้ดังนี้
- memory limit and reservation (default: unlimit) (B:byte, K:kilobyte, M:megabyte, G:gigabyte)

```
--memory, -m =10G --memory-reservation= 1G
```

- memory swap (default: unlimit)

```
-- memory-swap= -1
```

- kernel memory

```
-- kernel-memory= 500M
```

- memory swappiness (kernel)(0=no swap)

```
-- memory-swappiness =0
```

Docker: The Next-Gen of Virtualization

122

Memory

- memory ใน production system
- กำหนด memory-swappiness = 0 (no swappiness for kernel memory)
- กำหนด memory swap (--memory-swap) เป็น 2 เท่าของ memory (Limit)
- monitor footprint ในการใช้งาน memory ของ application system แล้วกำหนดเป็น "--memory-reservation"
- ทำ capacity testing เพื่อกำหนด maximum memory ที่ต้องการในการใช้งาน (+30%) แล้วกำหนด "--memory" (Limit)
- สำหรับ critical system ให้กำหนด "--memory-reservation" เท่ากับ "--memory" (Limit)
- Memory Priority ? (Still waiting)

I/O

- โดย default ทุก container จะมีโอกาสใช้ I/O เท่าๆกัน (500 weight)
- กำหนดค่า weight ในการใช้งาน I/O (สำหรับ Direct IO เท่านั้น)

```
--blkio-weight 300, --blkio-weight-device "/s01/tdb:500"
```

- จำกัดการอ่านข้อมูล เป็น bps (kb: kilobyte, mb: megabyte, gb: gigabyte) / iops

```
--device-read-bps /s01/tdb:1mb
--device-read-iops /s01/tdb:20000
```

- จำกัดการเขียนข้อมูล เป็น bps , iops

```
--device-write-bps /s01/tdb:1mb
--device-write-iops /s01/tdb:20000
```


I/O

- I/O configure in production system
- weight I/O ควรกำหนดเฉพาะในกรณีที่ application ต้องทำงานกับ direct i/o (slow than cache)
- Monitor การใช้งาน I/O ของ container (IOSTAT –xtc) และปรับแต่ง

```
$ iostat -xtc
                 extended device statistics                      tty         cpu
device       r/s    w/s   kr/s   kw/s wait actv  svc_t  %w  %b tin tout  us sy wt id
fd0          0.0    0.0    0.0    0.0  0.0  0.0    0.0   0   0   0    0   0  0  0 100
sd0          0.0    0.0    0.4    0.4  0.0  0.0   49.5   0   0
sd6          0.0    0.0    0.0    0.0  0.0  0.0    0.0   0   0
nfs1         0.0    0.0    0.0    0.0  0.0  0.0    0.0   0   0
nfs49        0.0    0.0    0.0    0.0  0.0  0.0   15.1   0   0
nfs53        0.0    0.0    0.4    0.0  0.0  0.0   24.5   0   0
nfs54        0.0    0.0    0.0    0.0  0.0  0.0    6.3   0   0
nfs55        0.0    0.0    0.0    0.0  0.0  0.0    4.9   0   0
```

- Web server / Application server ➔ IOPS สูง / Transfer ต่ำ
- Database server ➔ IOPS ต่ำ / Transfer สูง
- คำนึงถึง physical storage performance

I/O

- Normal disk iops

Disk Speed	IOPS
15,000	175
10,000	125
7200	75
5400	50

RAID	Write Penalty
0	1
1	2
5	4
6	6
DP	2
10	2

- Raw disk performance: disk iops x unit of disk
  - **Ex:** SAS 128GB (15K) x 6 units => 175 x 6 = 1060 iops
- Raid disk performance:
  - ((raw iops x %write)/penalty)+(raw x %read)
  - Normal situation (write 30%, read 70%)
  - **Ex:** Raid 5 ((1060 x .3)/4)+(1060x.7) ➔ 821.6 iops
  - **Ex**: Raid 1 ((1060 x .3)/2)+(1060x.7) ➔ 901 iops

Network

Network

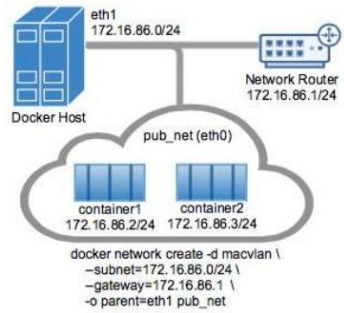
- Software define network by design (virtual switch)
- default docker จะจัดเตรียม network มาให้สามรูปแบบ

```
docker@labdocker:~$ docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
0dc1bbf00498        bridge              bridge              local
91d6dd4056a9        host                host                local
fa786a00adda        none                null                local
docker@labdocker:~$
```

- **Bridge/User Defined** คือ default network สำหรับให้ container เชื่อมต่อออกสู่โลกภายนอกผ่าน virtual switch "docker0" โดยใช้network stack ของ container เองในการเชื่อมต่อ (route mode)
- **none** คือ network loopback (127.0.0.1) สำหรับ container ที่ไม่มีการเชื่อมต่อออกไปด้านนอก หรือใช้งานกับการเชื่อมต่อแบบอื่นๆ
- **host** คือ network host ที่ container ใช้งาน host network stack ในการทำงาน (ใช้ในกรณี ต้องการ network performance สูงสุด) (security concern)

Network

- Additional network type
- **MACVLAN**



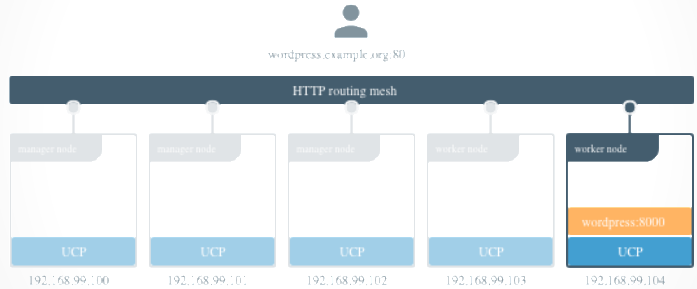
- **Overlay (Swarm Mode)**
- **3rd Party Network Plugin (Swarm Mode)**

Network

- Summary
  - **Bridge/User Defined Network**: best when you need multiple containers to communicate on the same Docker host.
  - **Host networks:** best when the network stack should not be isolated from the Docker host, but you want other aspects of the container to be isolated.
  - **Overlay networks:** best when you need containers running on different Docker hosts to communicate, or when multiple applications work together using swarm services.
  - **Macvlan networks:** best when you are migrating from a VM setup or need your containers to look like physical hosts on your network, each with a unique MAC address
  - **Third-party network:** allow you to integrate Docker with specialized network stacks.

Network

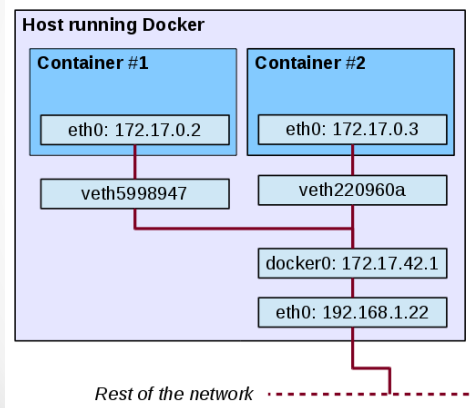
- Docker EE Network Feature:
  - **HTTP Route Mesh**: load balance L4 to target container on specific docker host



  - **Session Stickiness**: (Cookies Base) for re-route traffic from original to same end-point container (Stateful)

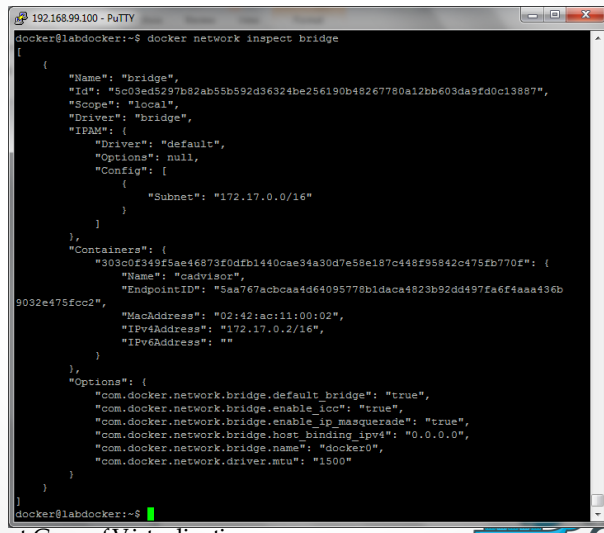
Network

- bridge (default) เมื่อสั่งรัน container ในระบบโดยไม่ได้ระบุ network ใดๆ container จะถูกเพิ่ม ipaddress, subnet เข้าสู่ bridge network โดยอัตโนมัต



Network

- docker network inspect bridge



Network

- Option เกี่ยวกับ network สำหรับสั่ง run container

--dns= x.x.x.x (Default --name,--net-alias,--link also dns internal docker)
--net="<bridge/none/host/custom>"
--net-alias = "xxxx"
--add-host="xxxx"
--mac-address="xx:xx:xx:xx"
--ip="x.x.x.x"
--ipv6="xx:xx:xx:xx" <new in 1.11>
-p, --publish = 9999:9999
-P, --publish-all ➔ Auto map network

```
docker container run -i -t --rm --name nodejs -p 3000:3000 \
    labdocker/alpineweb:latest node nodejs/hello.js
```

Network

- สร้าง custom virtual switch เพื่อจัดระเบียบและแบ่งแยก network ของ application ออกจากกัน (Recommend for Production)

```
docker network create --driver  <default/null/host> name
```

```
Ex: docker network create --driver  default netweb
```

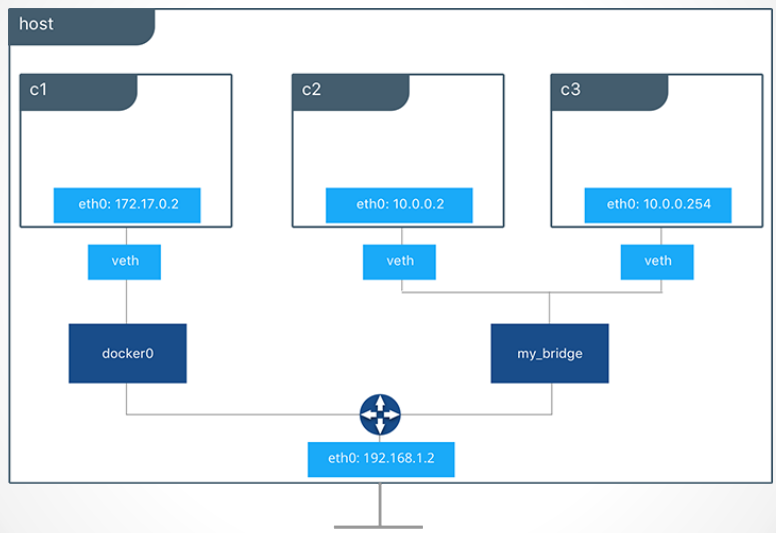
```
Ex: docker network rm netweb
```

- สามารถเพิ่มเติม option ในการสร้าง virtual switch เพิ่มเติม
  - -d macvlan -o parent = กำหนด vlan tagging
  - --subnet = xx (ระบุ ip address ของ virtual switch (Ex: 192.168.100.0/24))
  - --ip-range = xx (ระบุ ip address ที่จะส่งให้ container ทำงาน) (Ex: 192.168.100.128/25)
  - --gateway = xx (ระบุ ip address gateway) (Ex: 192.168.100.5)
  - --opt = custom option
    - --opt="com.docker.network.mtu"="1500"
    - --opt="com.docker.network.bridge.host_binding_ipv4"=x.x.x.x

Docker: The Next-Gen of Virtualization

135

Network



Docker: The Next-Gen of Virtualization

136

Network

- การเพิ่ม network ใน container

```
docker network connect <network> <container>
```

```
Ex: docker network connect webnet web1
```

- การลด network ใน container

```
docker network disconnect <network> <container>
```

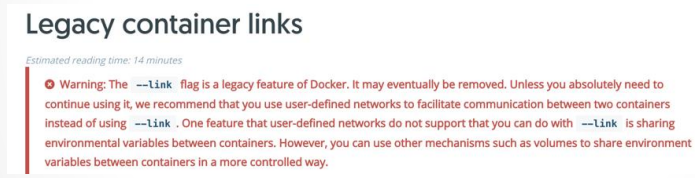
```
Ex: docker network disconnect webnet web1
```


Network

- Link container (add on /etc/hosts) (Legacy)

```
docker –dt --name web1 labdocker/alpineweb sh
```

```
docker –dt --name web2 --link web1:webmaster \
labdocker/alpineweb sh
```



Legacy container links

Estimated reading time: 14 minutes

Warning: The `--link` flag is a legacy feature of Docker. It may eventually be removed. Unless you absolutely need to continue using it, we recommend that you use user-defined networks to facilitate communication between two containers instead of using `--link`. One feature that user-defined networks do not support that you can do with `--link` is sharing environmental variables between containers. However, you can use other mechanisms such as volumes to share environment variables between containers in a more controlled way.

- DNS resolve on docker network (Recommend for Production)

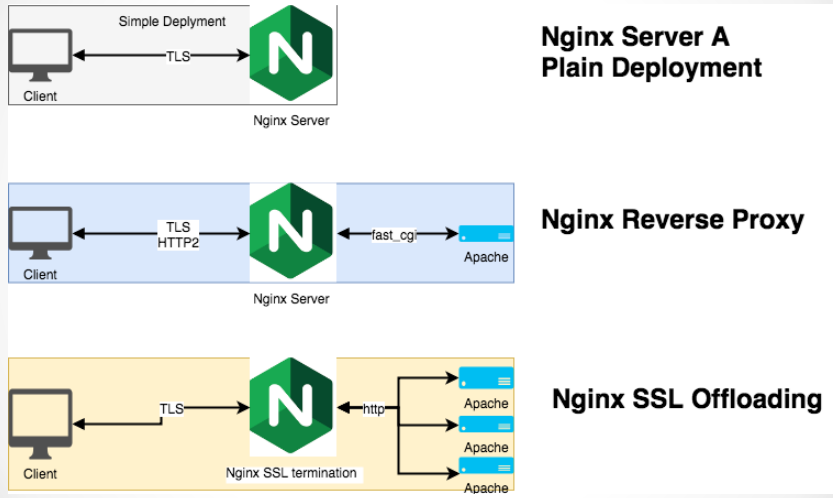
Workshop: Network Configure

- Part 1: Reverse Proxy Network (DNS)
- Purpose: ทำการ Deploy nodejs webserver ด้วย solution proxy ของ nginx (load balance / reverse proxy)

- **public network** เพื่อให้บุคคลภายนอกเข้าใช้งานผ่าน nginx server (reverse proxy)
  - IP Address: 192.168.100.0/24
  - Range Address: 192.168.100.128 – 192.168.100.256
  - MTU: 1500
- **private network** เพื่อให้ nginx server เข้าเรียกใช้งาน nodejs web server
  - IP Address: 192.168.101.0/24
  - Range Address: 192.168.101.128 – 192.168.101.256
  - MTU: 9000

Workshop: Network Configure

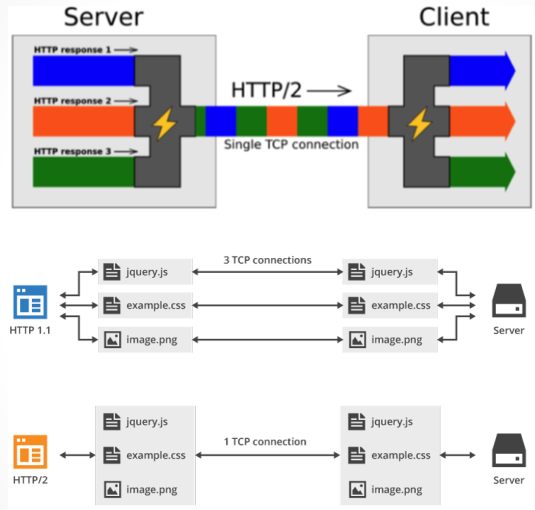
Workshop: Network Configure



Docker: The Next-Gen of Virtualization

141

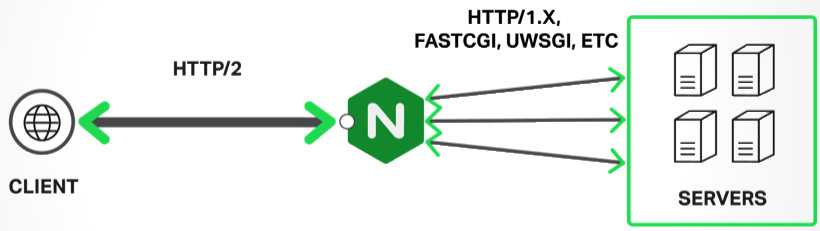
Workshop: Network Configure



Docker: The Next-Gen of Virtualization

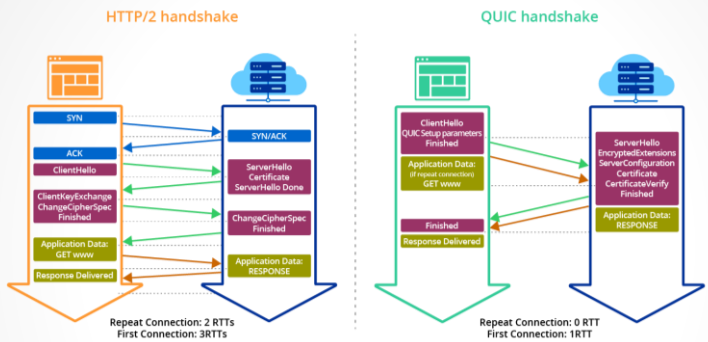
142

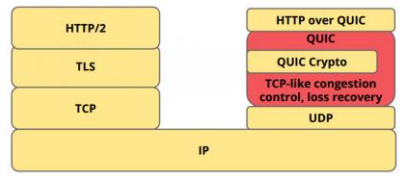
Workshop: Network Configure



Docker: The Next-Gen of Virtualization

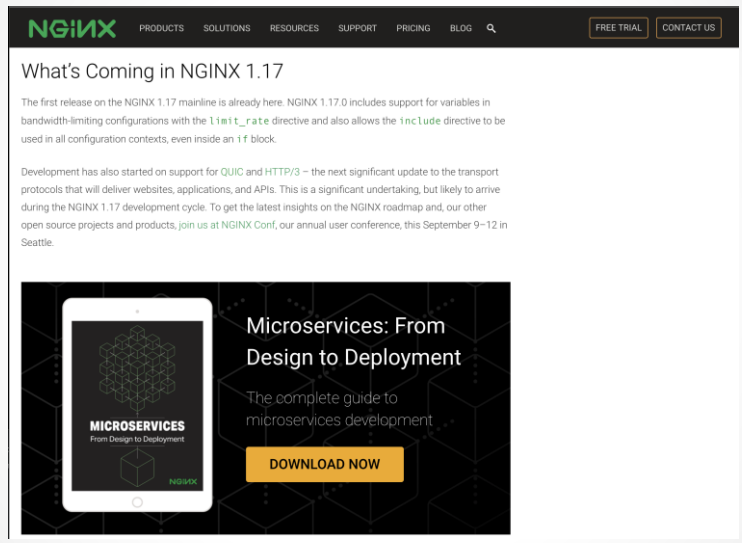
Workshop: Network Configure





Docker: The Next-Gen of Virtualization

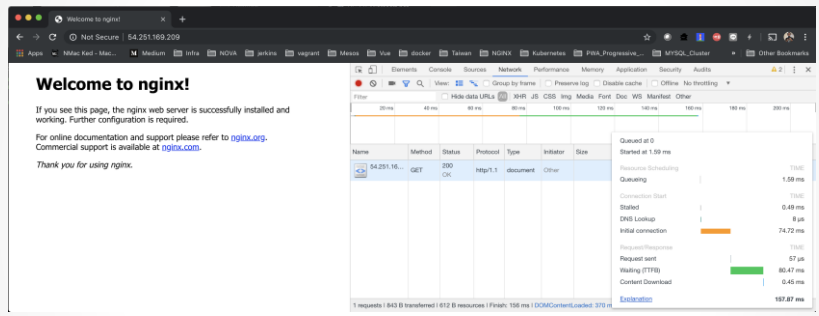
Workshop: Network Configure



https://www.nginx.com/blog/nginx-1-16-1-17-released/

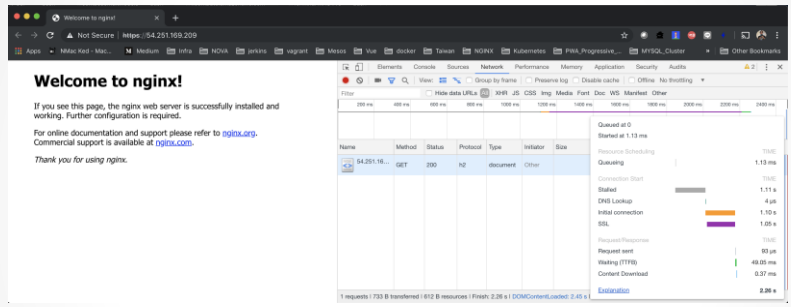
Workshop: Network Configure

- Normal HTTP/1.1



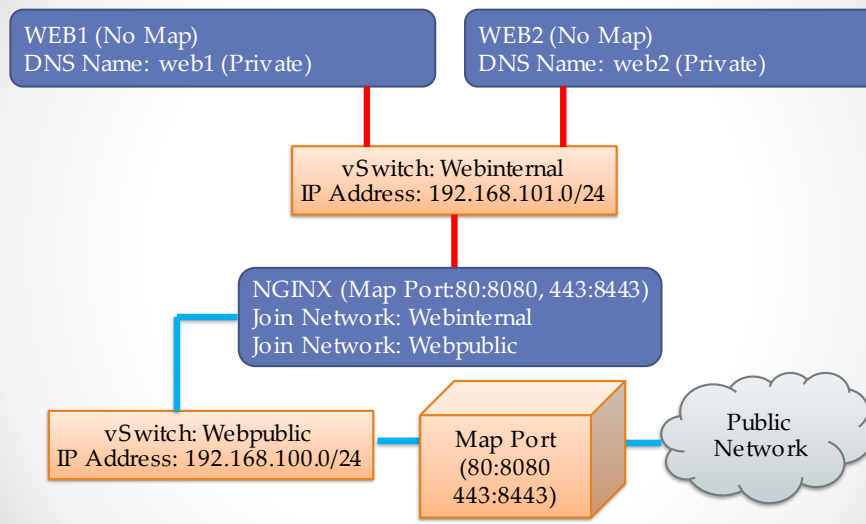
Workshop: Network Configure

- HTTP/2 HTTPS (Old word: SPDY)



Docker: The Next-Gen of Virtualization

Workshop: Network Configure



Docker: The Next-Gen of Virtualization

Workshop: Network Configure

- ทำการสร้าง Switch สำหรับเชื่อมต่อ Private / Public Network
  - docker network create --driver bridge \
    --subnet=192.168.100.0/24 --ip-range=192.168.100.128/25 \
    --gateway=192.168.100.5 --opt="com.docker.network.mtu"="1500"
    webpublic
  - docker network create --driver bridge \
    --subnet=192.168.101.0/24 --ip-range=192.168.101.128/25 \
    --gateway=192.168.101.5 --opt="com.docker.network.mtu"="9000"
    webinternalCreate Server

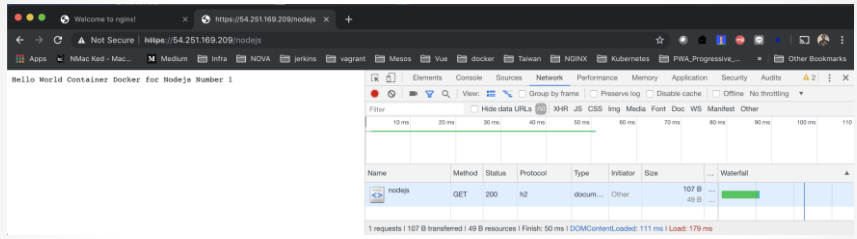
Workshop: Network Configure

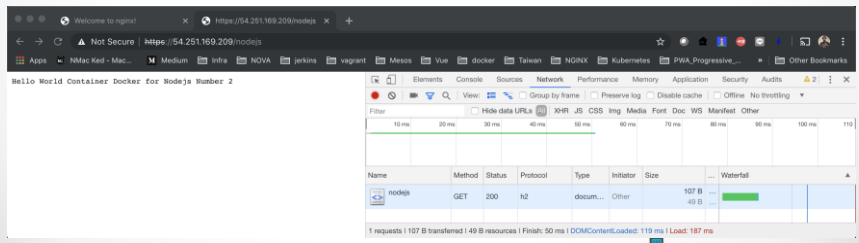
- สร้างเครื่อง Webserver (nodejs) และ Nginx
  - **Web1**
  - docker run -dt --name web1 --net webinternal \
    --net-alias web1 labdocker/alpineweb:web1 node hello.js
  - **Web2**
  - docker run -dt --name web2 --net webinternal \
    --net-alias web2 labdocker/alpineweb:web2 node hello.js
  - **NGINX**
  - docker run -dt --name nginx --net webinternal \
    -p 80:8080 –p 443:8443 labdocker/nginx:labnetworkhttp2

  docker network connect webpublic nginx

Workshop: Network Configure

- url: http://<Public IP>/nodejs





Workshop: Network Configure

- curl result:

```
...ntu@ip-10-0-1-55: ~ — -bash ...   ...composemultinodejs — -bash
ubuntu@ip-10-0-1-55:~/temp$ docker container exec -it nginx sh
/usr/sbin # curl http://web1:3000
Hello World Container Docker for Nodejs Number 1
/usr/sbin # curl http://web1:3000 -I
HTTP/1.1 200 OK
Content-Type: text/plain
Date: Sat, 22 Jun 2019 02:50:39 GMT
Connection: keep-alive

/usr/sbin # curl http://web2:3000
Hello World Container Docker for Nodejs Number 2
/usr/sbin # curl http://web2:3000 -I
HTTP/1.1 200 OK
Content-Type: text/plain
Date: Sat, 22 Jun 2019 02:50:40 GMT
Connection: keep-alive

/usr/sbin #
```

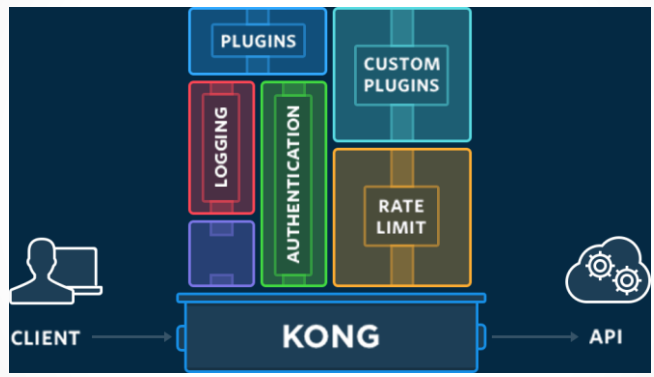
Workshop: Network Configure

- nginx.conf

```
upstream nodejs_web {
    server web1:3000;
    server web2:3000;
}

server {
        listen 8080 default_server;
        location /nodejs{
        proxy_pass http://nodejs_web;
        proxy_http_version 1.1;
        proxy_set_header Upgrade $http_upgrade;
        proxy_set_header Connection 'upgrade';
        proxy_set_header Host $host;
        proxy_cache_bypass $http_upgrade;
        }
}

server {
        listen 8443 ssl http2;
        ssl_certificate         labdocker.com.crt;
        ssl_certificate_key     labdocker.com.key;
        location /nodejs{
        proxy_pass http://nodejs_web;
        proxy_http_version 1.1;
        proxy_set_header Upgrade $http_upgrade;
        proxy_set_header Connection 'upgrade';
        proxy_set_header Host $host;
        proxy_cache_bypass $http_upgrade;
        }
}
```

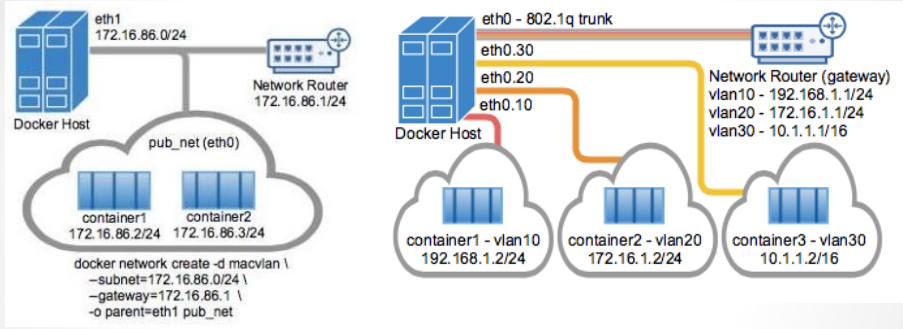

Workshop: Network Configure

- Bonus: Kong API Gateway the basic



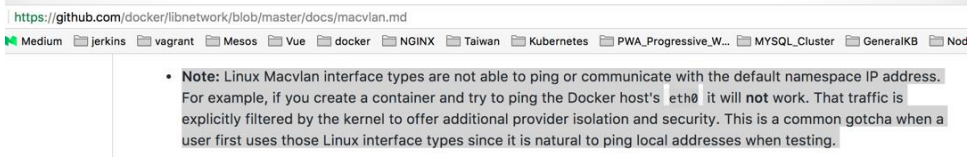
Network

- 802.1q Tagging (MACVLAN)

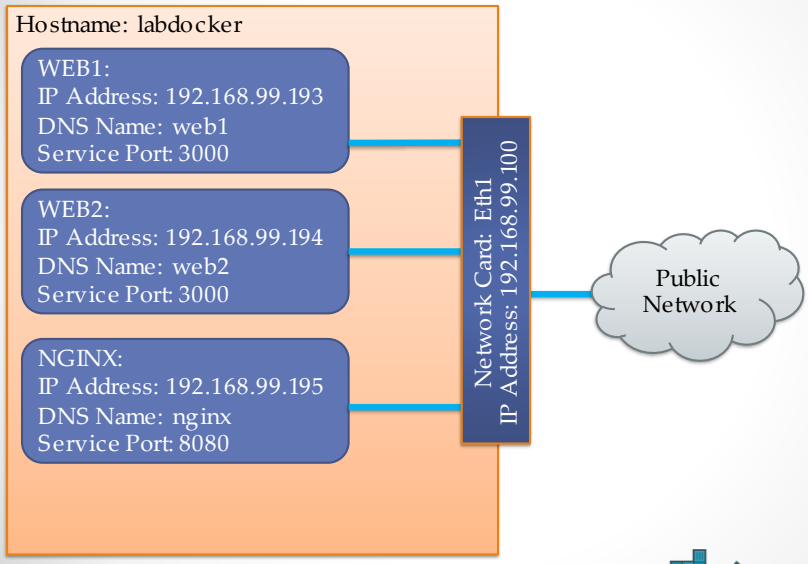


Demo: MACVLAN

- Reverse Proxy Network (MACVLAN) (This need docker-machine)
- Purpose: ทำการ Deploy nodejs webserver ด้วย solution proxy ของ nginx ผ่าน Macvlan
- **Macvlan:**
  - Interface: eth1
  - IP Address: 192.168.99.0/24
  - Gateway: 192.168.99.1 ➔ Your Machine
  - Labdocker: 192.168.99.100 ➔ Default
  - Range Address: 192.168.99.192/28
    - 192.168.99.193 – 192.168.99.206



Demo: MACVLAN



Docker: The Next-Gen of Virtualization

157

Demo: MACVLAN

- ทำการสร้าง Switch สำหรับเชื่อมต่อ Macvlan
  - docker network create -d macvlan \
    --subnet=192.168.99.0/24 \
    --ip-range=192.168.99.192/28 \
    --gateway=192.168.99.1 \
    -o parent=eth1 macvlanlab

- ในกรณีต้องการทำ Tag VLAN (802.1q) จาก Switch/Router เข้าสู่ Docker Host และทำการสร้าง Sub Interface สามารถทำได้ดังนี้
  - docker network create -d macvlan \
    --subnet=192.168.99.0/24 \
    --ip-range=192.168.99.192/28 \
    --gateway=192.168.99.1 \
    -o parent=eth1.<vlan id> macvlanlab

Docker: The Next-Gen of Virtualization

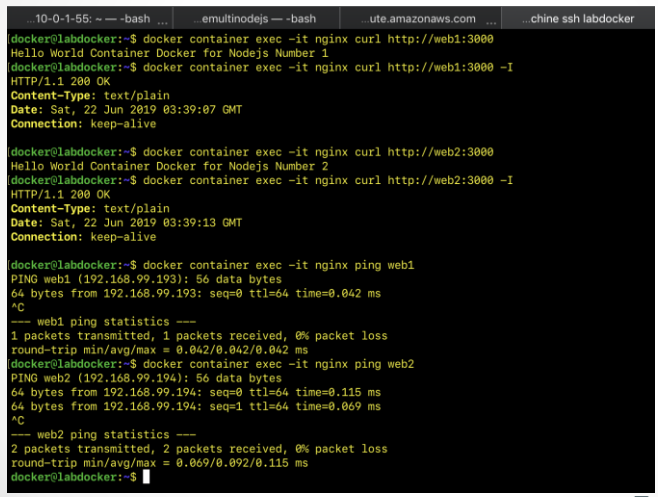
158

Demo: MACVLAN

- สร้างเครื่อง Webserver (nodejs) และ Nginx
  - **Web1**
  - docker run -dt --name web1 --net macvlanlab \
    --net-alias web1 labdocker/alpineweb:web1 node hello.js
  - **Web2**
  - docker run -dt --name web2 --net macvlanlab \
    --net-alias web2 labdocker/alpineweb:web2 node hello.js
  - **NGINX**
  - docker run -dt --name nginx --net macvlanlab \
    labdocker/nginx:labnetworkhttp2

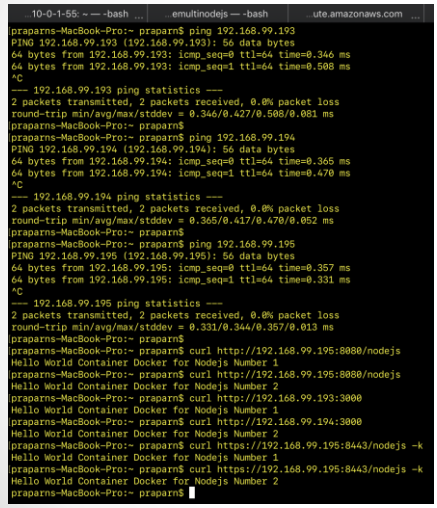
Demo: MACVLAN

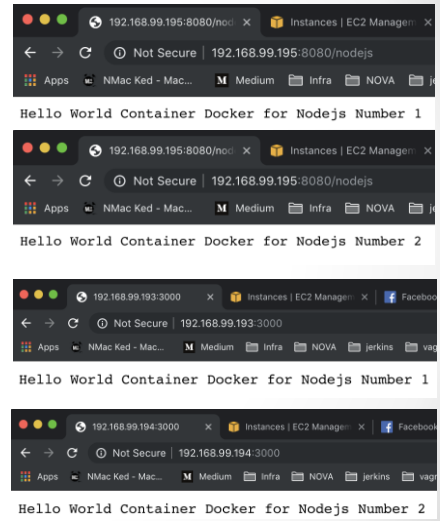
- Internal test:



Demo: MACVLAN

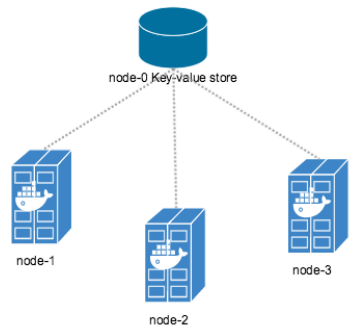
- External Test:





Network

- Network across host (Overlay Network)



Network

- 3rd Party Network Plugin

Plugin	Description
Contiv Networking	An open source network plugin to provide infrastructure and security policies for a multi-tenant micro services deployment, while providing an integration to physical network for non-container workload. Contiv Networking implements the remote driver and IPAM APIs available in Docker 1.9 onwards.
Kuryr Network Plugin	A network plugin is developed as part of the OpenStack Kuryr project and implements the Docker networking (libnetwork) remote driver API by utilizing Neutron, the OpenStack networking service. It includes an IPAM driver as well.
Weave Network Plugin	A network plugin that creates a virtual network that connects your Docker containers - across multiple hosts or clouds and enables automatic discovery of applications. Weave networks are resilient, partition tolerant, secure and work in partially connected networks, and other adverse environments - all configured with delightful simplicity.

Volume

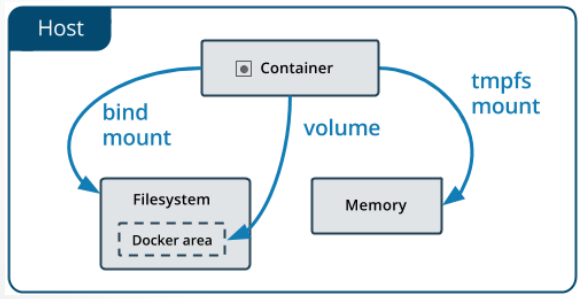
• • •

Volume

- ตามปกติแล้ว docker จะเก็บข้อมูลทุกอย่างเอาไว้ภายใน container
  - /var/log
  - /sys/data
  - /etc/nagios/
  - /etc/mysql
  - Etc.
- สำหรับการใช้งาน container ใน production environment docker ได้สร้าง tool สำหรับอำนวยความสะดวกในการใช้งานข้อมูลร่วมกันในหลายๆกรณี อาทิเช่น
  - การ share ข้อมูลร่วมกันระหว่าง container
  - การ share ข้อมูลร่วมกันระหว่าง container / host
  - จัดเก็บ configuration / log / data ของทุกๆ container ไว้ที่ศูนย์กลาง
  - data migration
  - backup / restore

Volume

- รูปแบบการใช้งาน Volume บน Docker
  - Bind Mount (Map path with Host Directly)
  - Volumes Mount (Local, Special Driver)
  - Tmpfs Mount (Memory Only)
- พารามิเตอร์ในการใช้งาน (--mount), (-v (Obsolete))



Volume

- 1. Bind Mount: map volume ระหว่าง host directory และ container directory

```
-v /volume-host:/volume-container:(ro/rw)
```

```
--mount type=bind,source=/volume-host
,target=/volume-container, (readonly)
```

```
Ex: docker container run –dt -v /etc/nginx.conf:/etc/nginx.conf:ro
```

```
Ex:docker container run -dt --mount type=bind, \
source=/etc/nginx.conf,target=/etc/nginx.conf,readonly
```

- ตรวจสอบการคอนฟิกบน container (inspect)

```
"HostConfig": {
        "Binds": [
          "/var/log:/var/log:ro"],
```


Volume

- 2. Volumes สร้าง volume กลางเพื่อใช้ในการจัดเก็บข้อมูล หรือ share volume ระหว่าง host/container/container (local: /var/lib/docker/volumes,driver: 3rd Party)
  - สร้าง Volume สำหรับใช้เก็บข้อมูล

```
docker volume create --driver <xxx> --opt <xxx> <name>
```

```
Ex: docker volume create --driver local datavol
```

```
Ex: docker volume create --driver local \
    --opt type=nfs --opt o=addr=192.168.99.100,rw \
    --opt device=:/nfs_share datavol
```


Volume

- การใช้ Volumes (-v option is not allow for service level (Swarm/Compose))

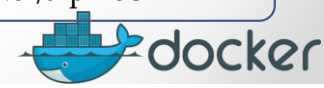
```
Ex: docker volume create --driver local datavol
```

```
Ex: docker container run –dt --name web1 \
-v datavol:/data labdocker/alpine sh
```

```
Ex: docker container run –dt --name web2 \
-v datavol:/data labdocker/alpine sh
```

```
Ex: docker container run –dt --name web1 \
--mount source=datavol,target=/data labdocker/alpine sh
```

```
Ex: docker container run –dt --name web2 \
--mount source=datavol,target=/data labdocker/alpine sh
```

Volume

- การลบ volume ทิ้งจาก container ให้ใช้คำสั่ง docker volume rm เพื่อลบ volume

```
docker volume rm <volume name>
```

- Third Party Volume Plugin (Since 1.8)

```
docker volume create --driver=<third party> <volume name>
```

```
Ex: docker volume create --driver=gce --name gce-disk \
-o SizeGb=90
```

```
Ex: docker run –dt -v gce-disk:/store/database alpine sh
```


Volume

Plugin	Description
Azure File Storage plugin	Lets you mount Microsoft Azure File Storage shares to Docker containers as volumes using the SMB 3.0 protocol. Learn more.
BeeGFS Volume Plugin	An open source volume plugin to create persistent volumes in a BeeGFS parallel file system.
Blockbridge plugin	A volume plugin that provides access to an extensible set of container-based persistent storage options. It supports single and multi-host Docker environments with features that include tenant isolation, automated provisioning, encryption, secure deletion, snapshots and QoS.
Contiv Volume Plugin	An open source volume plugin that provides multi-tenant, persistent, distributed storage with intent based consumption. It has support for Ceph and NFS.
Convoy plugin	A volume plugin for a variety of storage back-ends including device mapper and NFS. It's a simple standalone executable written in Go and provides the framework to support vendor-specific extensions such as snapshots, backups and restore.
DigitalOcean Block Storage plugin	Integrates DigitalOcean's block storage solution into the Docker ecosystem by automatically attaching a given block storage volume to a DigitalOcean droplet and making the contents of the volume available to Docker containers running on that droplet.
DRBD plugin	A volume plugin that provides highly available storage replicated by DRBD. Data written to the docker volume is replicated in a cluster of DRBD nodes.
Flocker plugin	A volume plugin that provides multi-host portable volumes for Docker, enabling you to run databases and other stateful containers and move them around across a cluster of machines.
Fuxi Volume Plugin	A volume plugin that is developed as part of the OpenStack Kuryr project and implements the Docker volume plugin API by utilizing Cinder, the OpenStack block storage service.
gce-docker plugin	A volume plugin able to attach, format and mount Google Compute persistent disks.
GlusterFS plugin	A volume plugin that provides multi-host volumes management for Docker using GlusterFS.
Horcrux Volume Plugin	A volume plugin that allows on-demand, version controlled access to your data. Horcrux is an open-source plugin, written in Go, and supports SCP, Minio and Amazon S3.
HPE 3Par Volume Plugin	A volume plugin that supports HPE 3Par and StoreVirtual iSCSI storage arrays.
IPFS Volume Plugin	An open source volume plugin that allows using an ipfs filesystem as a volume.
Keywhiz plugin	A plugin that provides credentials and secret management using Keywhiz as a central repository.
local Persist Plugin	A volume plugin that extends the default local driver's functionality by allowing you specify a mountpoint anywhere on the host, which enables the files to *always persist*, even if the volume is removed via docker volume rm.
NetApp Plugin(nDVP)	A volume plugin that provides direct integration with the Docker ecosystem for the NetApp storage portfolio. The nDVP package supports the provisioning and management of storage resources from the storage platform to Docker hosts, with a robust framework for adding additional platforms in the future.
Netshare plugin	A volume plugin that provides volume management for NFS 3/4, AWS EFS and CIFS file systems.
Nimble Storage Volume Plugin	A volume plug-in that integrates with Nimble Storage Unified Flash Fabric arrays. The plug-in abstracts array volume capabilities to the Docker administrator to allow self-provisioning of secure multi-tenant volumes and clones.
OpenStorage Plugin	A cluster-aware volume plugin that provides volume management for file and block storage solutions. It implements a vendor neutral specification for implementing extensions such as CoS, encryption, and snapshots. It has example drivers based on FUSE, NFS, NBD and EBS to name a few.
Portworx Volume Plugin	A volume plugin that turns any server into a scale-out converged compute/storage node, providing container granular storage and highly available volumes across any node, using a shared-nothing storage backend that works with any docker scheduler.
Quobyte Volume Plugin	A volume plugin that connects Docker to Quobyte's data center file system, a general-purpose scalable and fault-tolerant storage platform.
REX-Ray plugin	A volume plugin which is written in Go and provides advanced storage functionality for many platforms including VirtualBox, EC2, Google Compute Engine, OpenStack, and EMC.
Virtuozzo Storage and Ploop plugin	A volume plugin with support for Virtuozzo Storage distributed cloud file system as well as ploop devices.
VMware vSphere Storage Plugin	Docker Volume Driver for vSphere enables customers to address persistent storage requirements for Docker containers in vSphere environmen

Volume

- การ backup volume จาก container

Ex:
```
docker container run -it --rm --mount source=datavol,target=/data \
--mount type=bind,source=$(pwd) ,target=/backup \
tar cvf /backup/vol001.tar /data
```

- การ restore volume จาก container

Ex:
```
docker container run  -it --rm --mount source=datavol,target=/data \
--mount type=bind,source=$(pwd) ,target=/backup \
bash -c "cd /data && tar xvf /backup/vol001.tar --strip 1"
```


Volume

- 3. tmpfs mount ใช้เพื่อจัดเก็บข้อมูลใน memory ไว้บน non-persistency space โดย tmpfs ไม่สามารถ Share ระหว่าง container และไม่สามารถใช้งานบน Windows ได้

```
docker volume create --driver <xxx> --opt <xxx> <name>
```

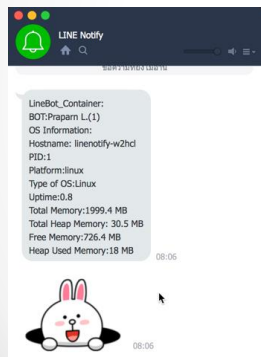
```
Ex: docker volume create --driver local --opt type=tmpfs \    --
opt device=tmpfs  --opt o=size=100m,uid=1000 tmptest
```

```
Ex: docker container run -dt --name tmptest –mount
type=tmpfs,destination=/app nginx:latest
```

```
Ex: docker container run -dt --name tmptest --tmpfs /app \
nginx:latest
```

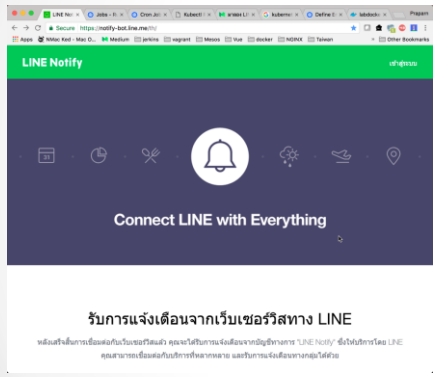

Workshop: Share Volume

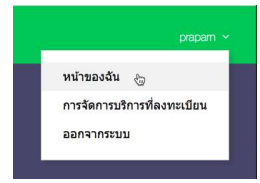
- Part 1: Host Path debug program
- Purpose: ทำการ Map volume เพื่อนำ source code เข้าไปทำการ debug/run บน container
- Example on WorkShop: "Monitor and LINE notify container"



Workshop: Share Volume

- Generate LINE Token
  - https://notify-bot.line.me

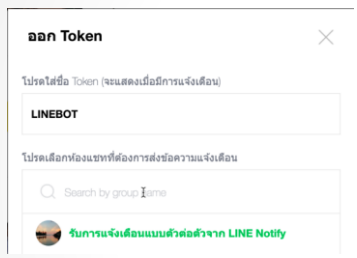


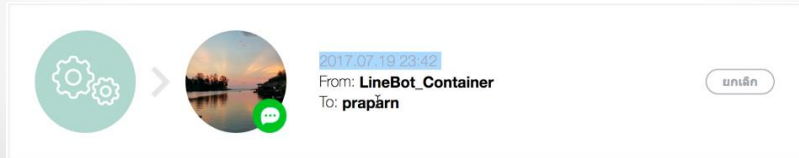


Docker: The Next-Gen of Virtualization

Workshop: Share Volume

- Generate LINE Token
  - https://notify-bot.line.me





Docker: The Next-Gen of Virtualization

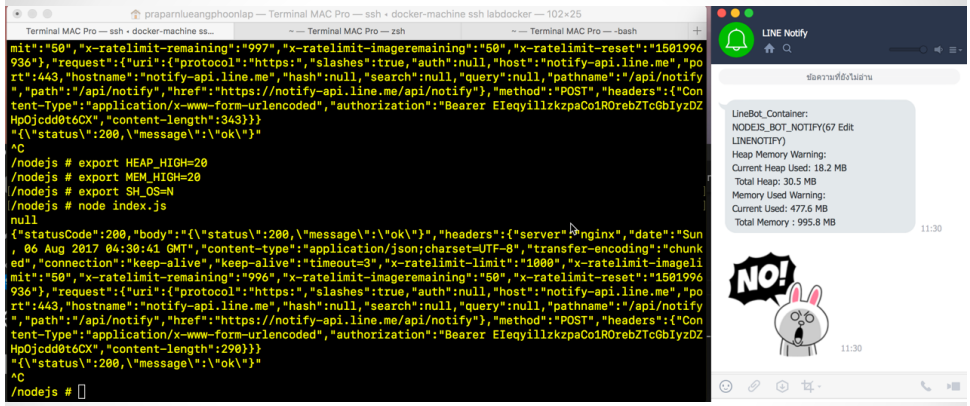
Workshop: Share Volume

```
const Monitor = require('monitor');
const request = require('request');
const TITLE=process.env.TITLE;
const INTERVAL=process.env.INTERVAL;
const HEAP_HIGH =process.env.HEAP_HIGH;
const MEM_HIGH =process.env.MEM_HIGH;
const SH_OS =process.env.SH_OS;
const TOKEN = process.env.TOKEN;
const critical_StickerPkg = 2;
const critical_StickerId = 39;
const information_StickerPkg = 2;
const information_StickerId = 34;
var options = {
  probeClass: 'Process',
  initParams: {
    pollInterval: INTERVAL
  }
}
var processMonitor = new Monitor(options);
var stickerPkg=0; //stickerPackageId
var stickerId=0; //stickerId
processMonitor.on('change', () => {
  var sendNotify="N" //final decision to send notify
  var heapWarning="N" //flag for heap memory warning
  var memoryWarning="N" //flag for memory warning
```

```
var processMonitor = new Monitor(options);
var stickerPkg=0; //stickerPackageId
var stickerId=0; //stickerId
processMonitor.on('change', () => {
  var sendNotify="N" //final decision to send notify
  var heapWarning="N" //flag for heap memory warning
  var memoryWarning="N" //flag for memory warning
  //collect OS information
  var hostName = processMonitor.get('hostname');
  var pID = processMonitor.get('pid');
  var platForm = processMonitor.get('platform');
  var upTime = processMonitor.get('uptime');
  var type = processMonitor.get('type');
  var totalMem = processMonitor.get('totalmem');
  totalMem=Number(((totalMem/1024)/1024).toFixed(1)); //Convert to MB
  var heapTotal = processMonitor.get('heapTotal');
  heapTotal=Number(((heapTotal/1024)/1024).toFixed(1)); //Convert to MB
  var titleMSG="\n"+TITLE+"("+pID+")"
  var osMSG="";
  var warnMSG="";
  //collect OS information
  //collect memory information
  var heapUsed = processMonitor.get('heapUsed');
  heapUsed=Number(((heapUsed/1024)/1024).toFixed(1)); //Convert to MB
  if(HEAP_HIGH<((heapUsed/heapTotal)*100)){heapWarning="Y";}
  var freeMem = processMonitor.get('freemem');
  freeMem=Number(((freeMem/1024)/1024).toFixed(1));
  var usedMem = totalMem-freeMem;
  usedMem=Number(usedMem.toFixed(1)); //Convert to MB
  if(MEM_HIGH<((usedMem/totalMem)*100)){memoryWarning="Y";}
  //collect memory information
```


177

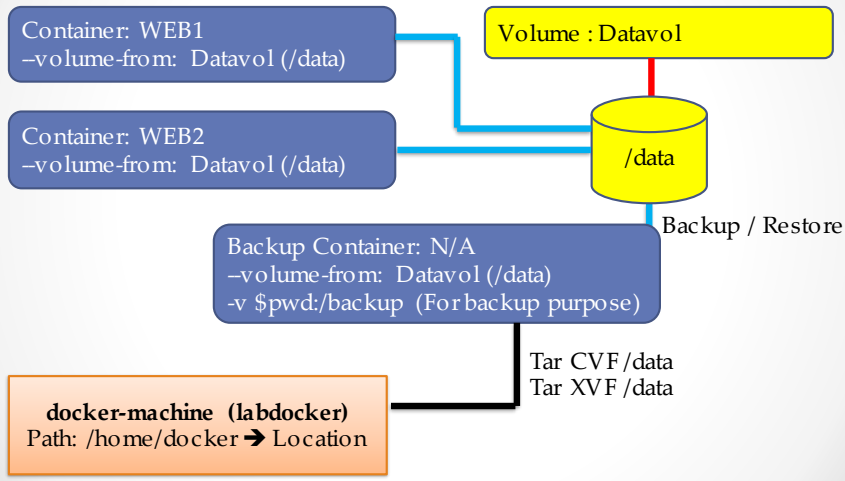
Workshop: Share Volume



178

Workshop: Share Volume

- Part 2: Container Volume



Log and Inspect

• • •

Log

- เพื่อตรวจสอบ log การทำงานบน container อย่างต่อเนื่อง docker ได้เตรียม tool ในการตรวจสอบ log การทำงาน

```
docker container logs <options> <container name>
```

- options ในการดูล็อกไฟล์
  - -f, --follow เพื่อตรวจสอบล็อกไฟล์ใหม่ตลอดเวลา
  - -t,--timestamps กำหนดให้ใส่วันและเวลาในล็อกไฟล์
  - --since= <unix timestamps> กำหนดเวลาเริ่มตรวจสอบล็อกไฟล์ หรือกำหนด yyyy-mm-dd
  - --tail = "all" / number of line
  - --until แสดง log ก่อนเวลาที่กำหนด (Ex: 20180619220001) หรือ Relative (Ex: 42m = 42 minute before)
  - --details แสดงรายละเอียดเพิ่มเติมของล็อกเช่น Env variable, labels โดยจะเป็นรายละเอียดเพิ่มเติมจากการใส่ option --log-opt ตอนสร้าง container

Log

- Server side. Big problem will come with logging !!!
- All container log will keep on "/var/lib/docker/containers/<container id>/<container-id>-json.log"and it take mega size on this path until full
- We have 2 option for manage this
- Global Configuration
  - Add daemon.json on path /etc/docker/daemon.json for global apply (need to restart docker daemon for take effect)

Workshop-1-8-Inspect-Logs ▸ {} daemon.json ▸ ...

```
{
  "log-driver": "json-file",
  "log-opts": {
    "max-size": "10m",
    "max-file": "10"
  }
}
```


Log

Driver	Description
`none`	No logs are available for the container and `docker logs` does not return any output.
`local`	Logs are stored in a custom format designed for minimal overhead.
`json-file`	The logs are formatted as JSON. The default logging driver for Docker.
`syslog`	Writes logging messages to the `syslog` facility. The `syslog` daemon must be running on the host machine.
`journald`	Writes log messages to `journald`. The `journald` daemon must be running on the host machine.
`gelf`	Writes log messages to a Graylog Extended Log Format (GELF) endpoint such as Graylog or Logstash.
`fluentd`	Writes log messages to `fluentd` (forward input). The `fluentd` daemon must be running on the host machine.
`awslogs`	Writes log messages to Amazon CloudWatch Logs.
`splunk`	Writes log messages to `splunk` using the HTTP Event Collector.
`etwlogs`	Writes log messages as Event Tracing for Windows (ETW) events. Only available on Windows platforms.
`gcplogs`	Writes log messages to Google Cloud Platform (GCP) Logging.
`logentries`	Writes log messages to Rapid7 Logentries.

Ref https://docs.docker.com/config/containers/logging/configure/

Log

- Container Configuration
  - Specific on run command of docker container
    - --log-driver json-file (default)
    - --log-opt max-size=10m
    - --log-opt max-file=10

```
ubuntu@ip-10-0-1-55:~$ docker container run -dt --name nginx -p 80:80 \
> --log-driver json-file \
> --log-opt max-size=10m \
> --log-opt max-file=10 \
> labdocker/nginx:badversion
07af88d6368bdfd8a74608882963a50052e5c887fc32da812369d78068643e51
ubuntu@ip-10-0-1-55:~$
```


Inspect

- การตรวจสอบค่าคอนฟิกของ container / network / volume etc

```
docker inspect <container >
```

```
docker network inspect
```

```
docker volume inspect
```


Workshop: Log & Inspect

- ทดสอบสร้าง container nginx และ map port 80 ดังนี้

```
docker container run -dt –name nginx \
–p 80:8080 labdocker/nginx: badversion
```

- ตรวจสอบค่าคอนฟิกภายใน container ด้วยคำสั่ง inspect

```
docker container inspect nginx
```

- ตรวจสอบล็อกการทำงานภายใน container ด้วยคำสั่ง logs

```
docker container logs nginx
```


Commit

• • •

Commit

- เมื่อต้องการเก็บ container ที่ทำการรันเรียบร้อยเป็น snap image เป็น generation สามารถทำได้ผ่านคำสั่ง "commit"

```
docker container commit <options> <container><image name:tag>
```

- options
  - -a, --author=" " ระบุผู้จัดทำ image
  - -c, --change = [ ] เพิ่มเติม command พิเศษที่จะจัดเก็บภายใน image
  - -m, --message = " " ระบุ comment ใน image ที่จัดเก็บ
  - -p, --pause=true กำหนดให้หยุดการใช้งาน container ชั่วคราวในระหว่างทำการ commit

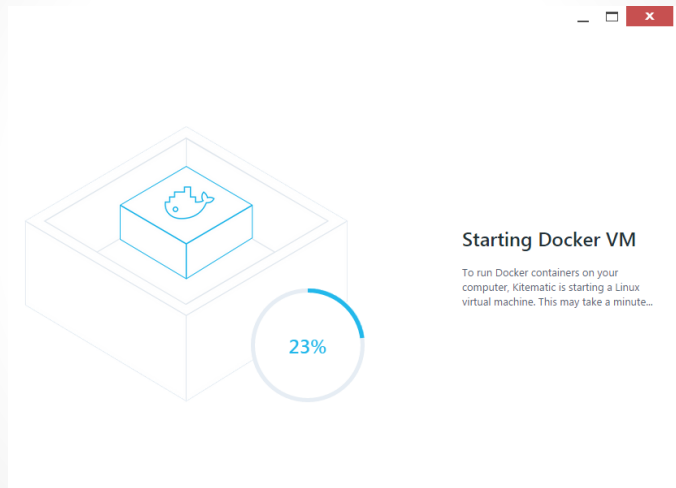
Kitematic

• • •

189

Kitematic

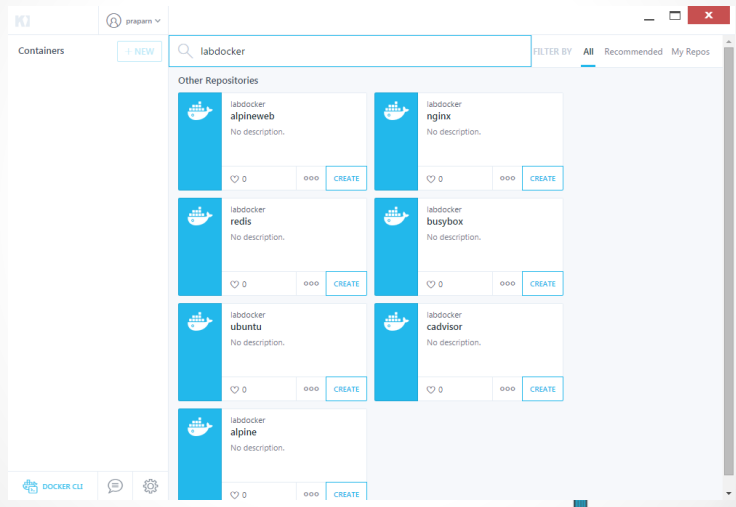
- GUI tool for operate docker



190

Kitematic

- GUI tool for operate docker



Recapture for Day 1

- Docker principle
- Docker machine
- Image, Repository & Tag, container
- CPU, Memory and I/O
- Network
- Volume
- Inspect and Log
- Commit
- Kitematic

Q&A for Day 1

193

194

Outline Day 2

- Dockerfile and Build
- Compose
- Docker Security
- Registry
- Swarm Mode
  - Conceptual of Swarm
  - Swarm Mode Architecture
  - Swarm init/join cluster system
  - Swarm service
  - Orchestrator Assignment
  - Config and Secret
  - Network Overlay and Ingress
  - HA Manager Role
  - Docker Stack Deploy (Compose Swarm Mode)
- Portainer for Docker
- Q&A

Dockerfile and Build

Dockerfile

- docker file คือการคำสั่งที่ใช้สร้าง image ขึ้นเพื่อใช้งานโดยเฉพาะ และสามารถกำหนดเป็นมาตรฐานสำหรับการทำงานในองค์กรโดยสร้าง text file ตาม syntax ที่ทาง docker กำหนดไว้
  - FROM
  - MAINTAINER
  - RUN (shell), ["exec", "parameter1","parameter2","etc"]
  - CMD (shell),["exec","parameter1","parameter2","etc"]
  - EXPOSE
  - ARGS
  - ENV
  - COPY /ADD (source) (Destination), [(source) (destination)]
  - ENTRYPOINT
  - WORKDIR
  - Etc(https://docs.docker.com/engine/reference/builder)
- เมื่อสร้าง dockerfile เสร็จแล้วสามารถสั่ง image ผ่านคำสั่ง build

```
docker build <option> <path of dockerfile>
```


Dockerfile

- **Best practice ในการสร้าง dockerfile**
- simple is the best
- 1 container / 1 service
- เลือก source image จาก official owner
- สร้าง dockerfile โดยพยายามให้มี footprint ต่ำที่สุด
  - สร้าง dockerfile บน path ที่สร้างขึ้นเฉพาะงาน
  - วางเฉพาะไฟล์ที่จำเป็นต้องใช้งานบน path
  - install component เท่าที่จำเป็นต้องใช้งานบน container
- คำสั่ง run เพื่อติดตั้ง software รวบยอดใน 1 ชุดคำสั่ง
- ควรมีการลบ temp ที่เกิดขึ้นจากการติดตั้ง software เพื่อลดขนาดของ image
- จัดเรียง dockerfile ให้อ่านง่าย
  - apt-update && apt-install –y \
  - curl \
  - automake \
- ควรระบุ EXPOSE port ที่ออกแบบให้ใช้งานไว้ในทุกๆครั้ง

Dockerfile

```
RUN apt-get update && apt-get install -y \
    aufs-tools \
    automake \
    build-essential \
    curl \
    dpkg-sig \
    libcap-dev \
    libsqlite3-dev \
    mercurial \
    reprepro \
    ruby1.9.1 \
    ruby1.9.1-dev \
    s3cmd=1.1.* \
 && rm -rf /var/lib/apt/lists/*
```

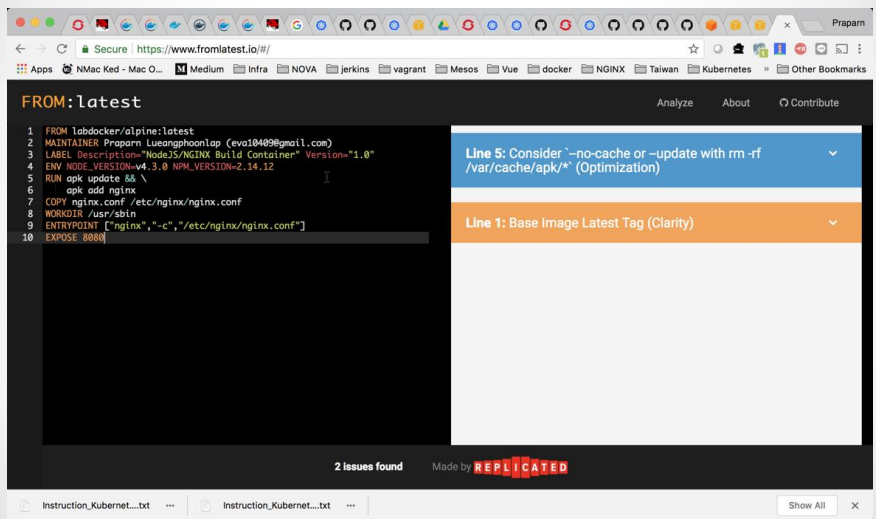

Dockerfile

```
FROM php:5.6-apache
MAINTAINER Volker Wiegand <volker.wiegand@cvw.de>

RUN a2enmod rewrite

RUN apt-get update && apt-get install -y \
        libpng12-dev \
        libjpeg-dev \
        libpq-dev \
        libxml2-dev \
        vim-tiny \
        && docker-php-ext-configure gd --with-png-dir=/usr --with-jpeg
        && docker-php-ext-install gd mbstring mysql mysqli pgsql soap
        && rm -rf /var/lib/apt/lists/* /var/www/html/index.html

ENV MANTIS_VER 1.3.2
ENV MANTIS_MD5 f30acb6d41ba757b7c09f922a0f68b06
ENV MANTIS_URL https://sourceforge.net/projects/mantisbt/files/mantis-
ENV MANTIS_FILE mantisbt.tar.gz

RUN mkdir -p /var/lib/mantisbt && cd /var/lib/mantisbt \
        && curl -fSL ${MANTIS_URL} -o ${MANTIS_FILE} \
        && echo "${MANTIS_MD5}  ${MANTIS_FILE}" | md5sum -c \
        && tar -xz --strip-components=1 -f ${MANTIS_FILE} \
        && rm ${MANTIS_FILE} \
        && chown -R www-data:www-data .
```


Dockerfile

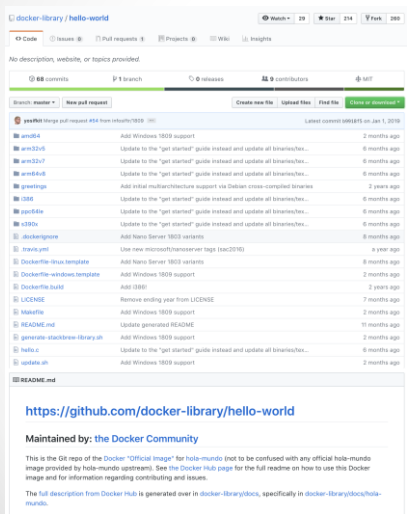
- ควรระบุ WORKDIR เพื่อกำหนด path เริ่มต้นในการทำงานทุกครั้ง (before ENTRYPOINT, RUN, CMD, COPY etc)
- ADD/COPY operation
  - COPY เป็น basic transfer simple file
  - ADD ใช้ในกรณี remote file URL, self extract (.tar) (Not recommend)
- ENV PATH ควรระบุ path ของ executable ที่จำเป็นต้องใช้งาน
- พิจารณาการใช้ cache ของ image layer โดยเราสามารถ ignore cache ด้วย option "--no-cache=true"
  - ตามปกติ docker จะเปรียบเทียบ instruction ที่กำหนดไว้กับ image layer ที่
  - Consider: instruction, base image

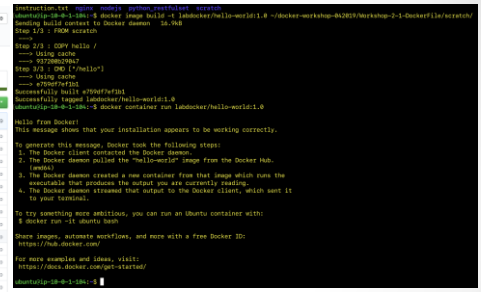
How can check dockerfile ?



Workshop: DockerFile

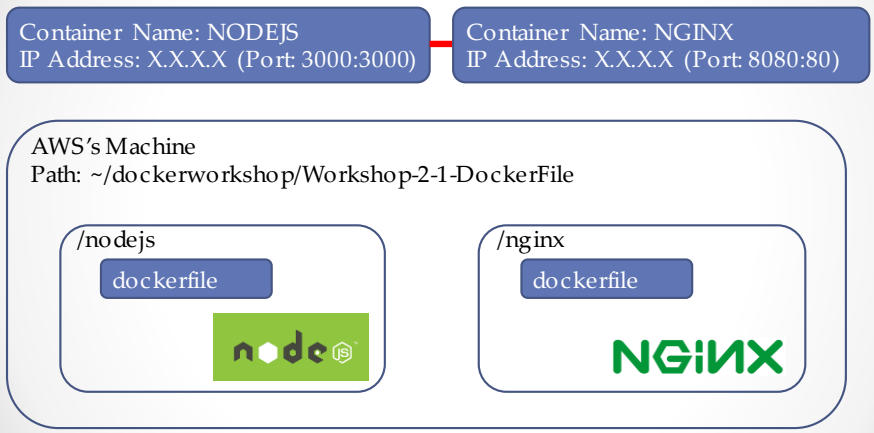
- Part1: SCRATCH





Workshop: DockerFile

- Part2: NGINX/NODEJS



Workshop: DockerFile

- ตรวจสอบ dockerfile ตามตัวอย่างด้านล่าง

```
FROM labdocker/alpine:latest
MAINTAINER Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="NodeJS/NGINX Build Container" Version="1.0"
ENV NODE_VERSION=v4.3.0 NPM_VERSION=2.14.12
RUN apk update && \
    apk add nodejs
RUN mkdir /nodejs
COPY hello.js /nodejs/
WORKDIR /nodejs
ENTRYPOINT ["node","hello.js"]
EXPOSE 3000
```

```
docker image build -t labdocker/node:1.0 ~/docker-workshop-072019/Workshop-2-1-DockerFile/nodejs
```


Workshop: DockerFile

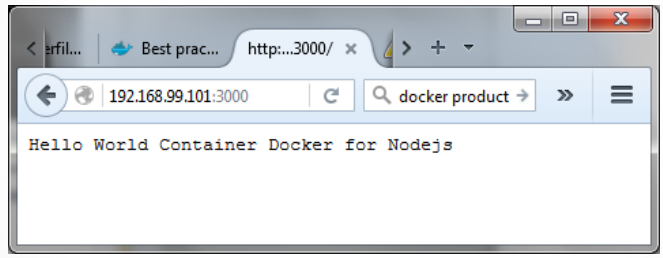
- Output

```
Sending build context to Docker daemon 3.072 kB
Step 1 : FROM labdocker/alpine:latest
 ---> 14f89d0e6257
Step 2 : MAINTAINER Praparn Lueangphoonlap (eva10409@gmail.com)
 ---> Using cache
 ---> 10f80fb4997d
Step 3 : LABEL Description "NodeJS/NGINX Build Container" Version "1.0"
 ---> Using cache
 ---> 59bc5a927e19
Step 4 : ENV NODE_VERSION v4.3.0 NPM_VERSION 2.14.12
 ---> Using cache
 ---> ce23d23959b7
Step 5 : RUN apk update &&     apk add nodejs
 ---> Running in b12c752ef6a0
fetch http://dl-4.alpinelinux.org/alpine/v3.3/main/x86_64/APKINDEX.tar.gz
fetch http://dl-4.alpinelinux.org/alpine/v3.3/community/x86_64/APKINDEX.tar.gz
v3.3.1-99-gc7d905f [http://dl-4.alpinelinux.org/alpine/v3.3/main]
v3.3.1-59-g48b0368 [http://dl-4.alpinelinux.org/alpine/v3.3/community]
OK: 5857 distinct packages available
(1/4) Installing libgcc (5.3.0-r0)
(2/4) Installing libstdc++ (5.3.0-r0)
(3/4) Installing libuv (1.7.5-r0)
(4/4) Installing nodejs (4.3.0-r0)
Executing busybox-1.24.1-r7.trigger
OK: 29 MiB in 15 packages
 ---> 8f2bf208ab86
Removing intermediate container b12c752ef6a0
Step 6 : RUN mkdir /nodejs
 ---> Running in 2ee51d1af642
 ---> d3edf2c2f511
Removing intermediate container 2ee51d1af642
Step 7 : COPY hello.js /nodejs/
 ---> f703ccbc7dd4
Removing intermediate container 952935d69cce
Step 8 : CMD nginx -c /etc/nginx/nginx.conf
 ---> Running in 67940385f5ac
 ---> edfbe608e20a
```


Workshop: DockerFile

- Test run

```
docker container run -dt --name NODEJS \
-p 3000:3000 labdocker/node:1.0
```



Workshop: DockerFile

- ตรวจสอบ dockerfile ตามตัวอย่างด้านล่าง

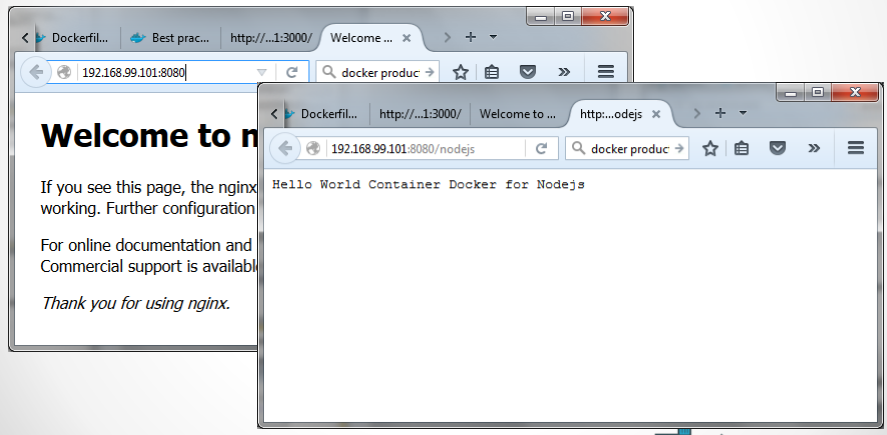
```
FROM labdocker/alpine:latest
MAINTAINER Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="NodeJS/NGINX Build Container" Version="1.0"
ENV NODE_VERSION=v4.3.0 NPM_VERSION=2.14.12
RUN mkdir -p /run/nginx
RUN apk update && \
   apk add nginx && \
   rm /etc/nginx/conf.d/default.conf
COPY nginx.conf /etc/nginx/nginx.conf
WORKDIR /usr/sbin
ENTRYPOINT ["nginx","-c","/etc/nginx/nginx.conf"]
EXPOSE 8080
```

```
docker build -t labdocker/web:1.0 ~/docker-workshop-
072019/Workshop-2-1-DockerFile/nginx
```


Workshop: DockerFile

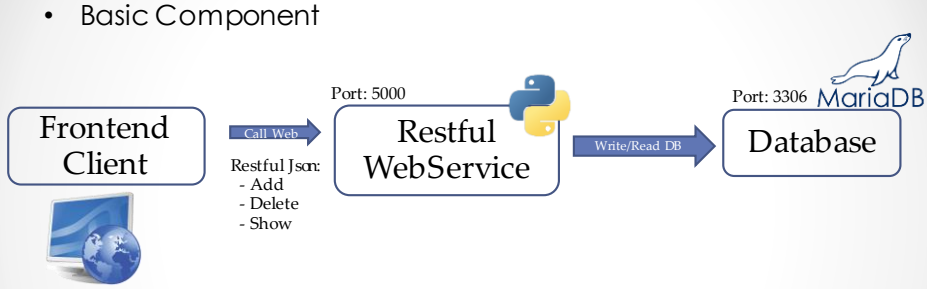
- Test run

```
docker container run -dt --name NGINX -p 8080:8080 -p
8443:8443 labdocker/web:1.0
```



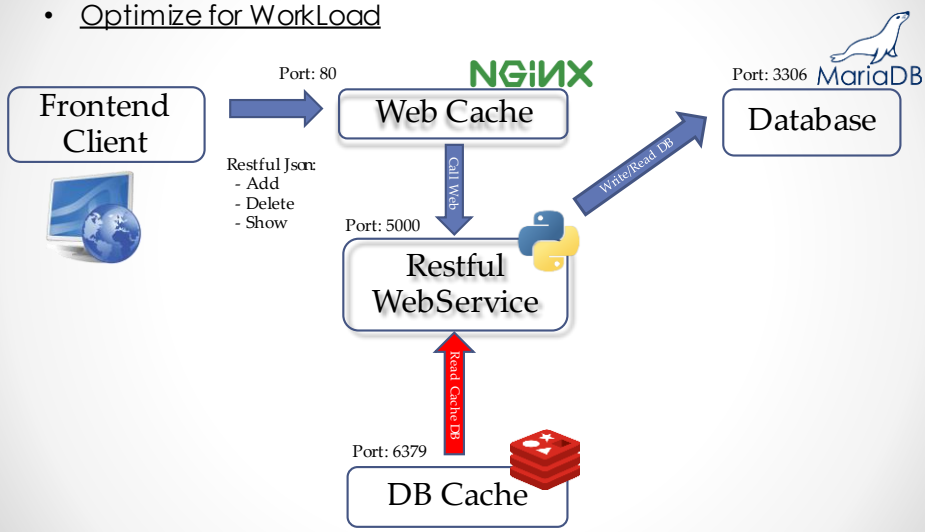
Workshop: DockerFile

- Part3: Python RESTFUL
- Basic Component



Workshop: DockerFile

- Optimize for WorkLoad



Workshop: DockerFile

- Restful WebService
  - /init

```
@app.route('/init')
def init():
    MAIN_DB.execute("DROP DATABASE IF EXISTS ACCTABLE")
    MAIN_DB.execute("CREATE DATABASE ACCTABLE")
    MAIN_DB.execute("USE ACCTABLE")
    sql = """CREATE TABLE users (
         ID int,
         USER char(30),
         DESCRIPE char(250)
      )"""
    MAIN_DB.execute(sql)
    db.commit()
    return "##########   Database Create New Account Table Done  ##########"
```

  - /insertuser

```
@app.route("/users/insertuser", methods=['POST'])
def add_users():
    req_json = request.get_json()
    MAIN_DB.execute("INSERT INTO ACCTABLE.users (ID, USER, DESCRIPE) VALUES (%s,%s,%s)", (req_json['uid'], req_json['user'], req_json['descripe']))
    #curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "1", "user":"Praparn Luangphoonlap", "descripe":"System Engineer"}' http://<IP
    db.commit()
    return Response("########## Record was added ##########", status=200, mimetype='application/json')
```

Workshop: DockerFile

- Restful WebService
  - /removeuser/<uid>

```
@app.route('/users/removeuser/<uid>')
def remove_users(uid):
    hash = hashlib.sha224(str(uid)).hexdigest()
    key = "sql_cache:" + hash
    MAIN_DB.execute("DELETE FROM ACCTABLE.users WHERE ID =" + str(uid))
    db.commit()
    #curl http://<IP Host>:<Port>/users/removeuser/<uid>
    if (CACHE_DB.get(key)):
        CACHE_DB.delete(key)
        return Response("########## Record was deleted (Both Database Cache) ##########", status=200, mimetype='application/json')
    else:
        return Response("########## Record was deleted ##########", status=200, mimetype='application/json')
```


Workshop: DockerFile

- Restful WebService
  - /users/<uid>

```
@app.route('/users/<uid>')
def get_users(uid):
    hash = hashlib.sha224(str(uid)).hexdigest()
    key = "sql_cache:" + hash
    #curl http://<IP Host>:<Port>/users/<uid>
    if (CACHE_DB.get(key)):
        return CACHE_DB.get(key) + "(Database Cache)"
    else:
        MAIN_DB.execute("select USER from ACCTABLE.users where ID=" + str(uid))
        data = MAIN_DB.fetchone()
        if data:
            CACHE_DB.set(key,data[0])
            CACHE_DB.expire(key, 36);
            return CACHE_DB.get(key)
        else:
            return "########## Record not found ##########"
```


Workshop: DockerFile

- Web Cache (NGINX)

```
http {
    client_max_body_size 500M;
    client_body_timeout 3000s;
    include /etc/nginx/mime.types;
    default_type application/octet-stream;
    log_format main '$remote_addr - $remote_user [$time_local] "$request" '
    '$status $body_bytes_sent "$http_referer" '
    '"$http_user_agent" "$http_x_forwarded_for"';

    access_log /var/log/nginx/access.log main;
    tcp_nopush on;

    keepalive_timeout 65;

    gzip on;

    include /etc/nginx/conf.d/*.conf;
server {
        listen 80;
        client_body_buffer_size 50M;
        index index.html        index.htm;
        location / {
        proxy_pass http://webservice:5000;
        proxy_next_upstream error timeout invalid_header http_500 http_502 http_503 http_504;
        proxy_redirect off;
        proxy_buffering off;
        proxy_set_header        Host            $host;
        proxy_set_header        X-Real-IP       $remote_addr;
        proxy_set_header        X-Forwarded-For $proxy_add_x_forwarded_for;
        }
        }
```


Workshop: DockerFile

- Database / Database Cache

```
maindb:
  image: labdocker/mysql:latest
  container_name: maindb
  environment:
      MYSQL_ROOT_PASSWORD: password

cachedb:
  image: labdocker/redis:latest
  container_name: cachedb

webservice:
  build: .
  dockerfile: dockerfile_python
  container_name: webservice
  ports:
   - "5000:5000"
  links:
   - cachedb:cachedb
   - maindb:maindb

webcache:
  build: .
  dockerfile: dockerfile_nginx
  container_name: webcache
  ports:
   - "80:80"
  links:
   - webservice:webservice
```

Maria Database

Redis Key-Value Database

Workshop: DockerFile

- Dockerfile: WebService

```
FROM labdocker/alpinepython:2.7-onbuild
MAINTAINER Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="Python Special Build for Alpine (On Build)" Version="1.0"
EXPOSE 5000
CMD [ "python", "main.py" ]
```

```
docker build -t labdocker/webservice:1.0 \
-f dockerfile_python Path: ~/dockerworkshop/Workshop-2-1-DockerFile/python_restfulset/
```


Workshop: DockerFile

- Dockerfile: Webcache

```
FROM labdocker/alpine:latest
MAINTAINER Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="NGINX Build Container" Version="1.0"
RUN apk update && \
apk add nginx
COPY nginx.conf /etc/nginx/nginx.conf
WORKDIR /usr/sbin
ENTRYPOINT ["nginx","-c","/etc/nginx/nginx.conf"]
EXPOSE 8080
```

```
docker build -t labdocker/webcache:1.0 \
-f dockerfile_nginx ~/dockerworkshop/Workshop-2-1-DockerFile/python_restfulset/
```


Workshop: DockerFile

- Test run container

```
praparns-MacBook-Pro:python_restfulset praparn$ docker container ps
CONTAINER ID        IMAGE                          COMMAND                  CREATED             STATUS              PORTS                    NAMES
0c8e81f04982        labdocker/webcache:1.0         "nginx -c /etc/nginx…"   5 seconds ago       Up 3 seconds        0.0.0.0:80->8080/tcp     webcache
702b554adb42        labdocker/webservice:1.0       "python main.py"         10 seconds ago      Up 9 seconds        0.0.0.0:5000->5000/tcp   webservice
f259cf6fe88a        labdocker/redis:latest         "docker-entrypoint.s…"   22 seconds ago      Up 20 seconds       6379/tcp                 cachedb
b0dbab1856d6        labdocker/mariadb:latest       "/docker-entrypoint.…"   48 seconds ago      Up 47 seconds       3306/tcp                 maindb
praparns-MacBook-Pro:python_restfulset praparn$
```

```
praparns-MacBook-Pro:python_restfulset praparn$  export Server_IP=127.0.0.1
praparns-MacBook-Pro:python_restfulset praparn$ export Server_Port=80
praparns-MacBook-Pro:python_restfulset praparn$ curl http://$Server_IP:$Server_Port/
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Sun Oct 21 09:36:04 2018
praparns-MacBook-Pro:python_restfulset praparn$
```

127.0.0.1

Welcome Page from Container Python Lab

Checkpoint Date/Time: Sun Oct 21 09:36:18 2018

Workshop: DockerFile

- Init / Insert Data

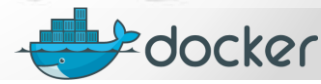
```
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/init
##########  Database Create New Account Table Done  ##########
praparns-MacBook-Pro% curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "1", "user":"Praparn Luangphoonlap", "descripe":"Slave"}' http://$Server_IP:$Server_Port/users/inse
rtuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "2", "user":"Somchai Sunsukwan", "descripe":"Security Guard"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "3", "user":"Sanyachan Panrudee", "descripe":"House Keeping"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "4", "user":"Sakkan Yanyicharoen", "descripe":"Messenger"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "5", "user":"Chatchai Moungang", "descripe":"Programmer"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "6", "user":"Anusit Kannaphat", "descripe":"DevOps Manager"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "7", "user":"Meelarp Maisanuk", "descripe":"System Engineer"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "8", "user":"Panaa Bunsong", "descripe":"Security Guard"}' http://$Server_IP:$Server_Port/users/insertuser
      curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "9", "user":"Wiphanee Wongsaisawan", "descripe":"Administrator"}' http://$Server_IP:$Server_Port/users/insertuser

HTTP/1.1 200 OK
Server: nginx/1.8.1
Date: Sun, 06 Aug 2017 16:06:09 GMT
Content-Type: application/json
Content-Length: 41
Connection: keep-alive

########## Record was added ##########
HTTP/1.1 200 OK
Server: nginx/1.8.1
Date: Sun, 06 Aug 2017 16:06:09 GMT
Content-Type: application/json
Content-Length: 41
Connection: keep-alive

########## Record was added ##########
HTTP/1.1 200 OK
Server: nginx/1.8.1
Date: Sun, 06 Aug 2017 16:06:09 GMT
Content-Type: application/json
Content-Length: 41
Connection: keep-alive

########## Record was added ##########
HTTP/1.1 200 OK
Server: nginx/1.8.1
Date: Sun, 06 Aug 2017 16:06:09 GMT
Content-Type: application/json
Content-Length: 41
Connection: keep-alive
```


Workshop: DockerFile

- Get Data (Direct/Cache) and Delete Data

```
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/1
Praparn Luangphoonlap(Database Direct)
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/1
Praparn Luangphoonlap(Database Cache)
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/4
Sakkan Yanyicharoen(Database Direct)
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/4
Sakkan Yanyicharoen(Database Cache)
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/removeuser/1
########## Record was deleted (Both Database Cache) ##########
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/removeuser/2
########## Record was deleted ##########
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/removeuser/3
########## Record was deleted ##########
praparns-MacBook-Pro% curl http://$Server_IP:$Server_Port/users/removeuser/4
########## Record was deleted (Both Database Cache) ##########
praparns-MacBook-Pro%
```

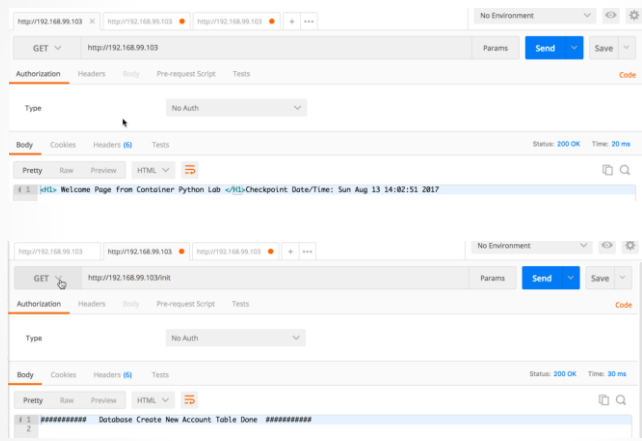
Docker: The Next-Gen of Virtualization



221

Workshop: DockerFile

- Case for POSTMAN

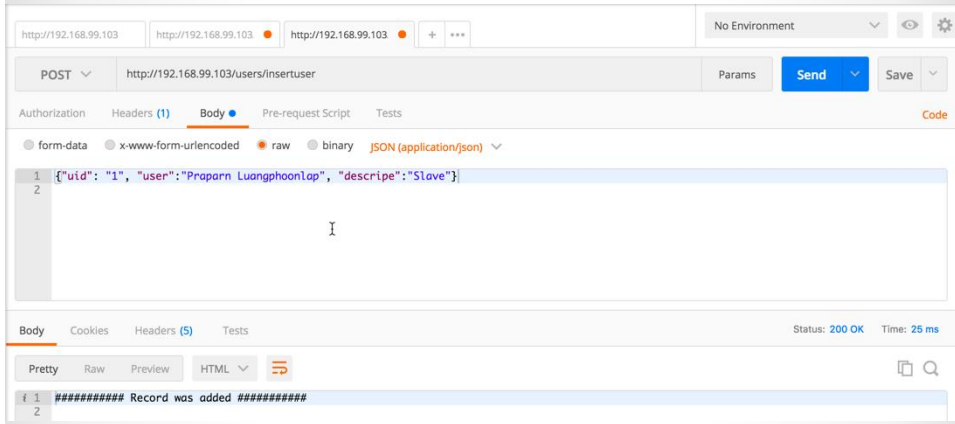


Docker: The Next-Gen of Virtualization

222

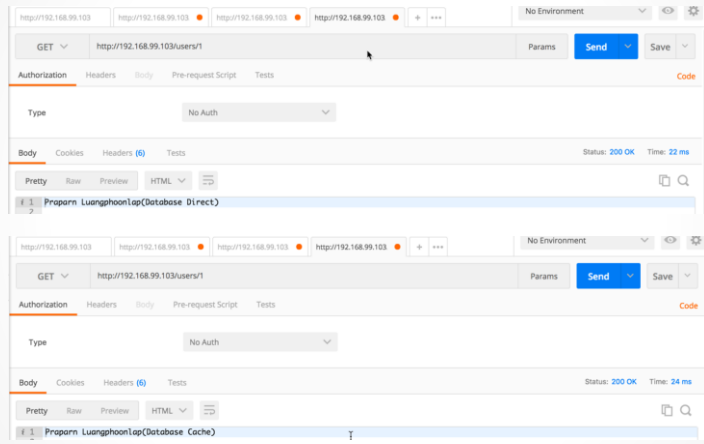
Workshop: DockerFile

- Case for POSTMAN



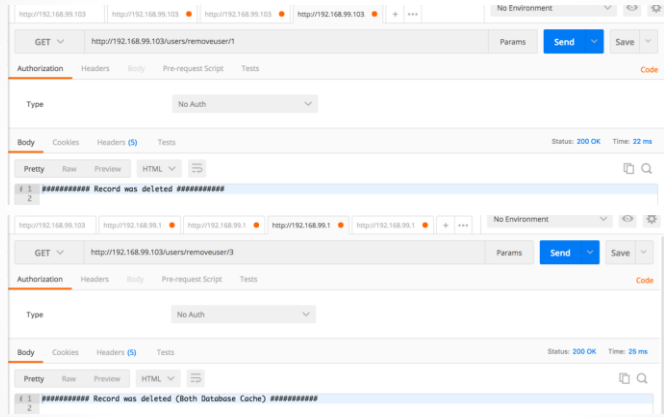
Workshop: DockerFile

- Case for POSTMAN



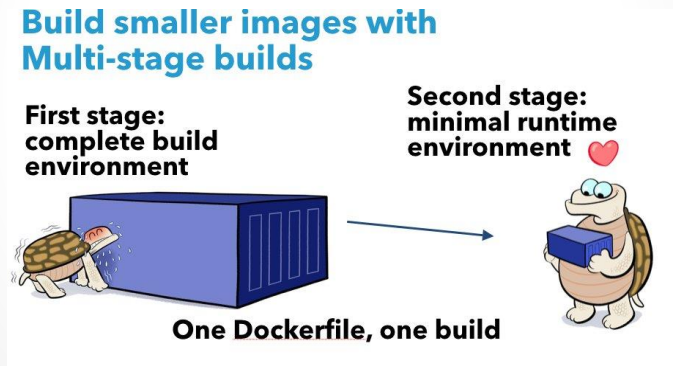
Workshop: DockerFile

- Case for POSTMAN



Dockerfile

- Multi-State was introduced on April 2017(Since 17.06)
- Write multiple "FROM" on same dockerfile
- Reduce duplicate workload by copy "intermediate state" during build to new image



Dockerfile

Multi-state dockerfile:

```
##############################
# STEP 1 build executable binary
##############################
FROM golang:alpine AS builder
# Install git.
# Git is required for fetching the dependencies.
RUN apk update && apk add --no-cache git
WORKDIR $GOPATH/src/mypackage/myapp/
COPY . .
# Fetch dependencies.
# Using go get.
RUN go get -d -v
# Build the binary.
RUN go build -o /go/bin/hello
##############################
# STEP 2 build a small image
##############################
FROM scratch
# Copy our static executable.
COPY --from=builder /go/bin/hello /go/bin/hello
# Run the hello binary.
ENTRYPOINT ["/go/bin/hello"]
```

Output: Final Image 1 Unit

Compose

• • •

Compose

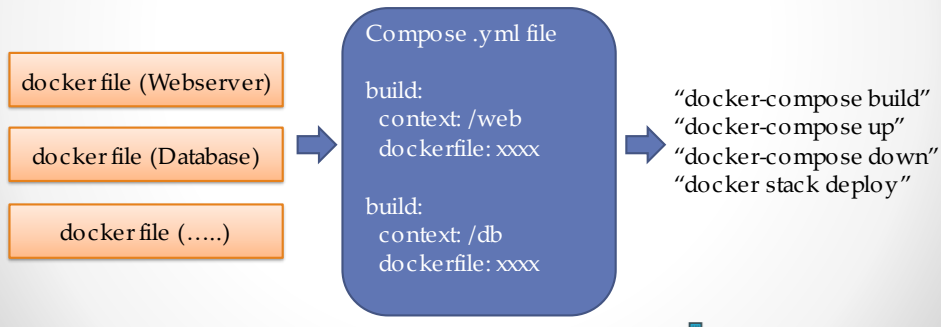
- Compose เป็นเครื่องมือที่ใช้ในการสร้าง system service ที่จะใช้ในการรันระบบงานทั้งระบบ ซึ่งตามปกติจะประกอบไปด้วยหลาย component อาทิเช่น
  - Web component service
  - Application component service
  - Database component service
  - Load balance component service
  - etc
- compose สามารถควบคุมการ start / stop / monitor การทำงานของ service ทั้งระบบเป็น single point
- เหมาะสำหรับการสร้าง development environment / test environment / automatic deploy to production (docker-machine / swam) (build one ➔ ship to everywhere)
- *No Support --ip now

Docker: The Next-Gen of Virtualization

229

Compose

- ขั้นตอนในการสร้าง compose
  - สร้าง docker file สำหรับแต่ละ component
  - กำหนดค่า running parameter ใน .yml/.yaml file ของ compose ซึ่งจะอ้างอิงถึง docker file แต่ละตัว
  - docker-compose up



Docker: The Next-Gen of Virtualization

230

Compose

Compose file format	Docker Engine release
3.7	18.06.0+
3.6	18.02.0+
3.5	17.12.0+
3.4	17.09.0+
3.3	17.06.0+
3.2	17.04.0+
3.1	1.13.1+
3.0	1.13.0+
2.4	17.12.0+
2.3	17.06.0+
2.2	1.13.0+
2.1	1.12.0+
2.0	1.10.0+
1.0	1.9.1.+

Docker Compose release notes

Estimated reading time: 75 minutes

1.24.0

(2019-03-28)

Features

- Added support for connecting to the Docker Engine using the `ssh` protocol.
- Added an `--all` flag to `docker-compose ps` to include stopped one-off containers in the command's output.
- Added bash completion for `ps --all|-a`.
- Added support for credential_spec.
- Added `--parallel` to `docker build`'s options in `bash` and `zsh` completion.

Bug Fixes

- Fixed a bug where some valid credential helpers weren't properly handled by Compose when attempting to pull images from private registries.
- Fixed an issue where the output of `docker-compose start` before containers were created was misleading.
- Compose will no longer accept whitespace in variable names sourced from environment files. This matches the Docker CLI behavior.
- Compose will now report a configuration error if a service attempts to declare duplicate mount points in the volumes section.
- Fixed an issue with the containerized version of Compose that prevented users from writing to stdin during interactive sessions started by `run` or `exec`.
- One-off containers started by `run` no longer adopt the restart policy of the service, and are instead set to never restart.
- Fixed an issue that caused some container events to not appear in the output of the `docker-compose events` command.
- Missing images will no longer stop the execution of `docker-compose down` commands. A warning is now displayed instead.
- Force `virtualenv` version for macOS CI.
- Fixed merging of Compose files when network has `None` config.
- Fixed `CTRL+C` issues by enabling `bootloader_ignore_signals` in `pyinstaller`.
- Bumped `docker-py` version to `3.7.2` to fix SSH and proxy configuration issues.
- Fixed release script and some typos on release documentation.

Compose

- Compose syntax: (docker compose up/down/run)
  - version: x (Current Version 3)
  - services:
    - XXX (service name):
      - image: <image name>
      - build:
        - target: /xxxx (New on Version 3.4)
        - cache_from: (New on Version 3.2)
          - <image name>
        - labels: (New on Version 3.3)
          - <label>: <value>
        - context: ./<path>
        - dockerfile: <file>
      - container_name: <name>
      - args:
        - <xxxx>:<value>
      - dns: x.x.x.x
      - dns_search: xxx.com
      - entrypoint: ["nginx","-c","/etc/nginx/nginx.conf"]
      - env_file: xxxx.xxx (VAR=VAL)
      - Environment:
        - TOKEN: XXXX
      - ports:
        - - "9999:9999"
      - Link:
        - xx:<alias>
      - healthcheck:
        - test: ["CMD-SHELL", "pg_isready"]
        - interval: 30s
        - timeout: 30s
        - retries: 3
        - start_period: 100s (New on Version 3.4)

Compose

- Compose syntax:
  - XXX (service name):
    - depends_on:
      - XXXX
      - XXXX
    - networks:
      - XXXX1
      - XXXX2

Ref:https://docs.docker.com/compose/compose-file/#command

Compose

Control startup and shutdown order in Compose

Estimated reading time: 2 minutes

You can control the order of service startup and shutdown with the depends_on option. Compose always starts and stops containers in dependency order, where dependencies are determined by `depends_on`, `links`, `volumes_from`, and `network_mode: "service:..."`.

However, for startup Compose does not wait until a container is "ready" (whatever that means for your particular application) - only until it's running. There's a good reason for this.

The problem of waiting for a database (for example) to be ready is really just a subset of a much larger problem of distributed systems. In production, your database could become unavailable or move hosts at any time. Your application needs to be resilient to these types of failures.

To handle this, design your application to attempt to re-establish a connection to the database after a failure. If the application retries the connection, it can eventually connect to the database.

The best solution is to perform this check in your application code, both at startup and whenever a connection is lost for any reason. However, if you don't need this level of resilience, you can work around the problem with a wrapper script:

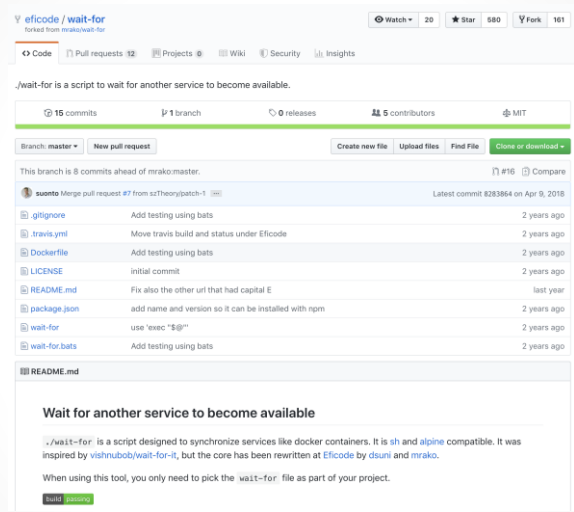
- Use a tool such as wait-for-it, dockerize, or sh-compatible wait-for. These are small wrapper scripts which you can include in your application's image to poll a given host and port until it's accepting TCP connections.

  For example, to use `wait-for-it.sh` or `wait-for` to wrap your service's command:

```
version: "2"
services:
  web:
    build: .
    ports:
      - "80:8000"
    depends_on:
      - "db"
    command: ["./wait-for-it.sh", "db:5432", "--", "python", "app.py"]
  db:
    image: postgres
```

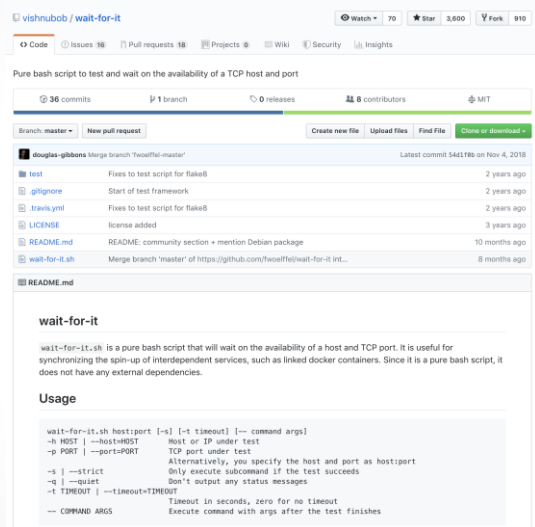
Ref: https://docs.docker.com/compose/startup-order/

Compose



Ref: https://github.com/Eficode/wait-for

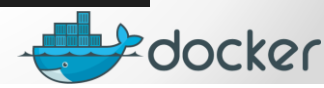
Compose



Ref: https://github.com/vishnubob/wait-for-it

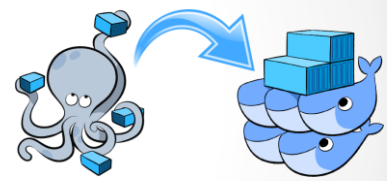
Compose

```
Workshop-2-1-DockerFile ▸ python_restfulset ▸ main.py
1  from flask import Flask
2  from flask import Response
3  from flask import request
4  from redis import Redis
5  from datetime import datetime
6  import MySQLdb
7  import sys
8  import redis
9  import time
10 import hashlib
11 import os
12 import json
13 flagloop= 0
14 app = Flask(__name__)
15 startTime = datetime.now()
16 while flagloop == 0:
17     try:
18         db = MySQLdb.connect("maindb","root","password")
19     except:
20         time.sleep(2)
21         continue
22     else:
23         flagloop= 1
24
25 CACHE_DB = redis.Redis(host=os.environ.get('REDIS_HOST', 'cachedb'), port=6379)
26 MAIN_DB = db.cursor()
27 @app.route('/')
28 def hello():
29     return '<H1> Welcome Page from Container Python Lab </H1><Checkpoint Date/Time: ' + time.strftime("%c") +'\n'
30 @app.route('/init')
31 def init():
32     MAIN_DB.execute("DROP DATABASE IF EXISTS ACCTABLE")
33     MAIN_DB.execute("CREATE DATABASE ACCTABLE")
34     MAIN_DB.execute("USE ACCTABLE")
35     sql = """CREATE TABLE users (
36         ID int,
37         USER char(30),
38         DESCRIPE char(250)
39     )"""
40     MAIN_DB.execute(sql)
41     db.commit()
42     return "##########   Database Create New Account Table Done  ##########\n"
```

Compose

- Compose syntax: (docker stack deploy)
  - services:
    - XXX (service name):
      - image: <image name>
      - **deploy: <SWARM>**
        - mode:
          - global
          - replicated
        - resource:
          - limits:
            - cpus: '0.5'
            - memory: 100M
          - reservations:
            - cpus: '0.1'
            - memory: 20M
        - restart_policy:
          - condition: on-failure
          - delay: 5s
          - max_attempts: 3
        - update_config:
          - parallelism: 2
          - delay: 10s
          - failure_action: 10ms
          - max_failure_ratio: X
          - order: (stop-first,start-first) <New on Version 3.4>

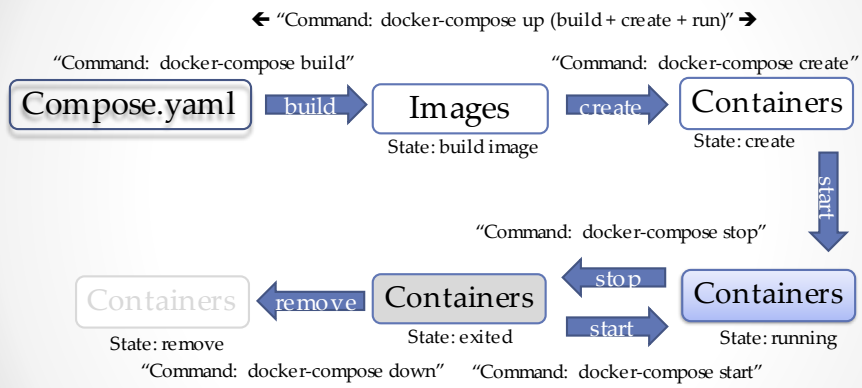


Compose

- DOCKER STACK DEPLOY
  - Not Supported
    - build
    - cgroup_parent
    - container_name
    - devices
    - dns
    - dns_search
    - external_links
    - links
    - network_mode
    - security_opt
    - stop_signal
    - sysctls
    - userns_mode

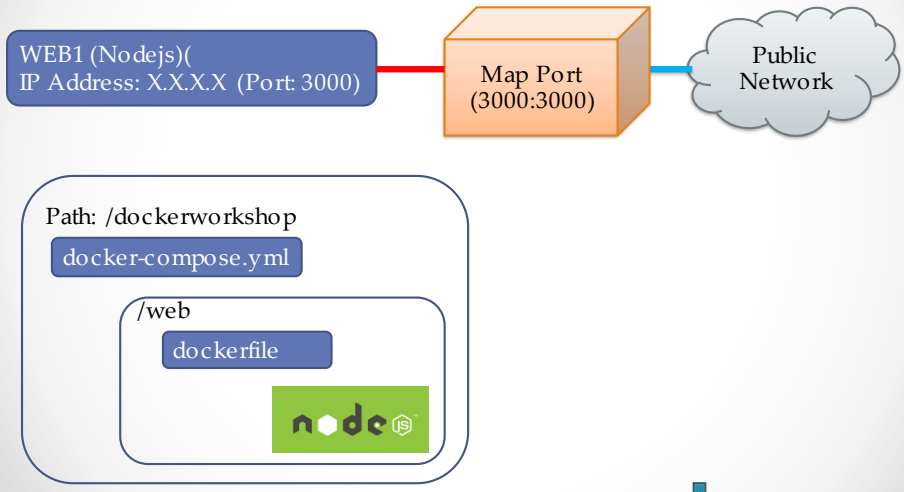
Compose

- Compose State:



Workshop: Compose

- Part1: composenodejs



Docker: The Next-Gen of Virtualization

Workshop: Compose

- dockerfile

```
FROM labdocker/alpine:latest
MAINTAINER Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="NodeJS/NGINX Build Container" Version="1.0"
ENV NODE_VERSION=v4.3.0 NPM_VERSION=2.14.12
RUN apk update && \
   apk add nodejs
RUN mkdir /nodejs
COPY hello.js /nodejs/
WORKDIR /nodejs
ENTRYPOINT ["node","hello.js"]
EXPOSE 3000
```

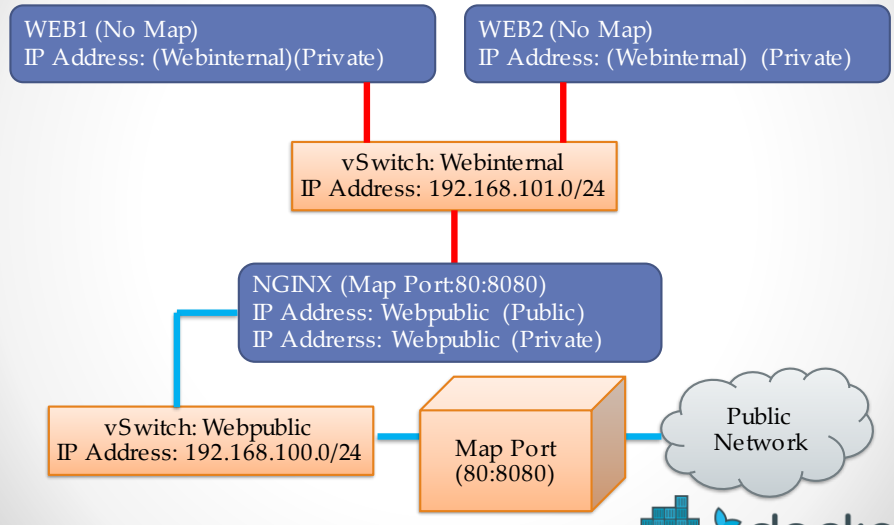
- docker-compose.yml

```
version: "3.4"
services:
  web:
     build:
        context: ./web
        dockerfile: dockerfile                  # optional for specific dockerfile
     container_name: nodejs                     # optional for specific container name
     command: ["node","hello.js"]               # optional for override command on dockerfile
     ports:
       - 3000:3000
```

Docker: The Next-Gen of Virtualization

Workshop: Compose

- Part 2: composemultinodejs

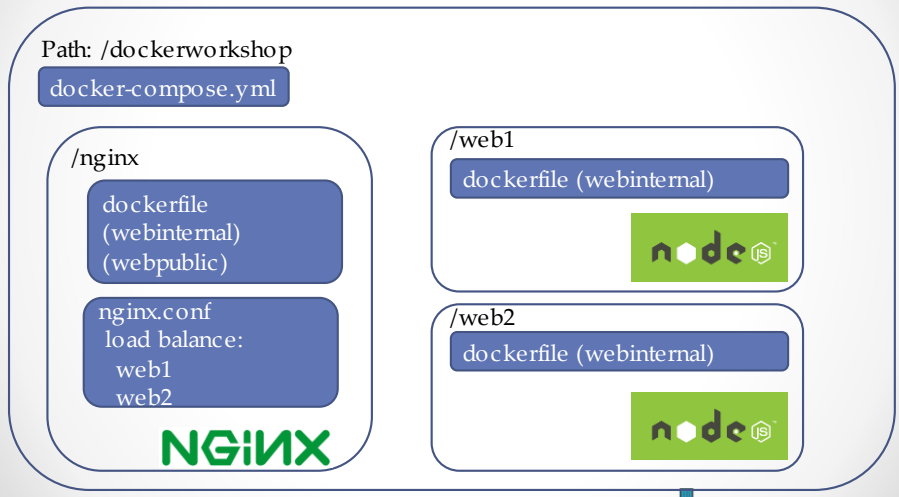


Docker: The Next-Gen of Virtualization

243

Workshop: Compose

- Use case: multinodejs with nginx



Docker: The Next-Gen of Virtualization

244

Workshop: Compose

- nginx: dockerfile

```
FROM labdocker/alpine:latest
MAINTAINER  Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="NodeJS/NGINX Build Container" Version="1.0"
ENV NODE_VERSION=v10.14.2-r0 NPM_VERSION=v10.14.2-r0
RUN mkdir -p /run/nginx
RUN apk update && \
apk add nginx curl && \
rm /etc/nginx/conf.d/default.conf
COPY nginx.conf /etc/nginx/nginx.conf
COPY labdocker.com.crt /etc/nginx/labdocker.com.crt
COPY labdocker.com.key /etc/nginx/labdocker.com.key
WORKDIR /usr/sbin
ENTRYPOINT ["nginx","-c","/etc/nginx/nginx.conf"]
EXPOSE 8080 8443
```


Workshop: Compose

- Web1 & Web 2: dockerfile

```
FROM labdocker/alpine:latest
MAINTAINER  Praparn Lueangphoonlap (eva10409@gmail.com)
LABEL Description="NodeJS/NGINX Build Container" Version="1.0"
ENV NODE_VERSION=v4.3.0 NPM_VERSION=2.14.12
RUN apk update && \
   apk add nodejs
RUN mkdir /nodejs
COPY hello.js /nodejs/
WORKDIR /nodejs
ENTRYPOINT ["node","hello.js"]
EXPOSE 3000
```


Workshop: Compose

- Web1: Hello.js

```
var http = require('http');
http.createServer(function (req, res)
{res.writeHead(200, {'Content-Type': 'text/plain'});
res.end('Hello World Container Docker for Nodejs Node 1\n');}).listen(3000,
'0.0.0.0');
console.log('Server running at http://0.0.0.0:3000/');
```

- Web2: Hello.js

```
var http = require('http');
http.createServer(function (req, res)
{res.writeHead(200, {'Content-Type': 'text/plain'});
res.end('Hello World Container Docker for Nodejs Node 2\n');}).listen(3000,
'0.0.0.0');
console.log('Server running at http://0.0.0.0:3000/');
```


Workshop: Compose

- docker-compose.yml

```yaml
version: '3.4'
services:
  nginx:
    build:
      context: ./nginx
      dockerfile: dockerfile          # optional for specific dockerfile
      cache_from:
        - alpine:latest
    container_name: nginx
    depends_on:
      - web1
      - web2
    healthcheck:
      test: ["CMD", "curl", "-f", "http://localhost:80"]  # option for health check and send curl for check http://localhost:3000
      interval: 30s                                       # interval health check
      timeout: 10s                                        # timeout for check
      retries: 3                                          # maximum retries
      start_period: 30s                                   # start period <news on 3.4>
    networks:
      webpublic:
        aliases:
        - nginx
      webinternal:
        aliases:
        - nginx
    ports:
      - "80:8080"
```


Workshop: Compose

- docker-compose.yml

```yaml
web1:
  build:
    context: ./web1
    dockerfile: dockerfile          # optional for specific dockerfile
    cache_from:
      - labdocker/alpineweb:latest
  container_name: web1
  healthcheck:
    test: ["CMD", "curl", "-f", "http://localhost:3000"]  # option for health check and send curl for check http://localhost:3000
    interval: 30s                                         # interval health check
    timeout: 10s                                          # timeout for check
    retries: 3                                            # maximum retries
    start_period: 30s                                     # start period <news on 3.4>
  networks:
    webinternal:
      aliases:
      - web1

web2:
  build:
    context: ./web2
    dockerfile: dockerfile          # optional for specific dockerfile
    cache_from:
      - labdocker/alpineweb:latest
  container_name: web2
  healthcheck:
    test: ["CMD", "curl", "-f", "http://localhost:3000"]  # option for health check and send curl for check http://localhost:3000
    interval: 30s                                         # interval health check
    timeout: 10s                                          # timeout for check
    retries: 3                                            # maximum retries
    start_period: 30s                                     # start period <news on 3.4>
  networks:
    webinternal:
      aliases:
      - web2
```


Workshop: Compose

- docker-compose.yml

```yaml
networks:
    webpublic:
      driver: bridge
      ipam:
        driver: default
        config:
        - subnet: 192.168.100.0/24
    webinternal:
      driver: bridge
      ipam:
        driver: default
        config:
        - subnet: 192.168.101.0/24
```


Docker Security

Docker Security

- เพื่อให้การรันงานบน docker container มีความปลอดภัยสูง docker มีการพิจารณาเรื่อง security ในการทำงานแบ่งออกได้ดังนี้
- Control Group (CG Group) / Name Space
  - Docker container run in separate namespace (Process independence, Not release / touch with other container)
  - Separate network stack
  - CG group will create for separate resource (CPU, Memory, I/O) and limit for protect single container run process and make host fail (denied-of-service)
- Docker daemon operation (root privilege)
  - Beaware for allow user who operate with docker daemon
  - Some operation quite risk for security (docker pull, docker run –v with share host path etc)
  - Docker API should be aware for RESTFUL connection with secure method

Docker Security

- Secure enhancement by limit capability of container inside
  - Normally user will be "root" inside container
  - Almost container job (web server, restful server, database server) don't need high privilege as "root" for operate
  - Control user inside container with limit capability
  - Some activity should be prohibited on container
    - Mount disk operation
    - Access system path (/bin, /usr/bin, /proc etc)
    - Create network socket
    - Execute shell
    - etc

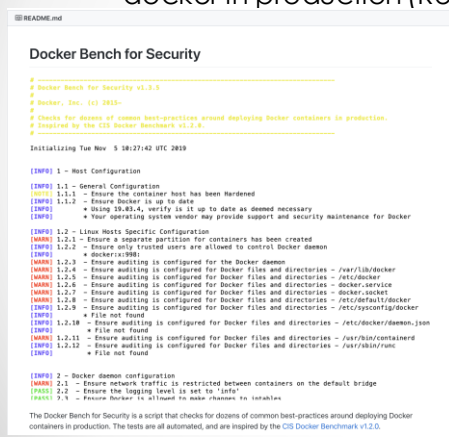
Docker Security

- Docker Image Scanning
  - How can you make sure that your image is not vulnerability

Ref: https://docs.anchore.com/current/

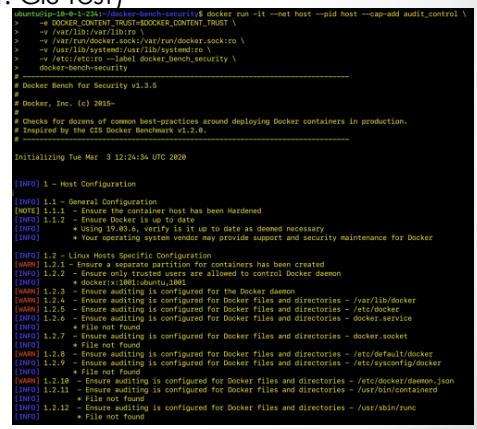
Docker Security

- Docker Bench for Security
  - Docker container / script for check best practice to use docker in production (Ref: CIS Test)


README.md

Docker Bench for Security

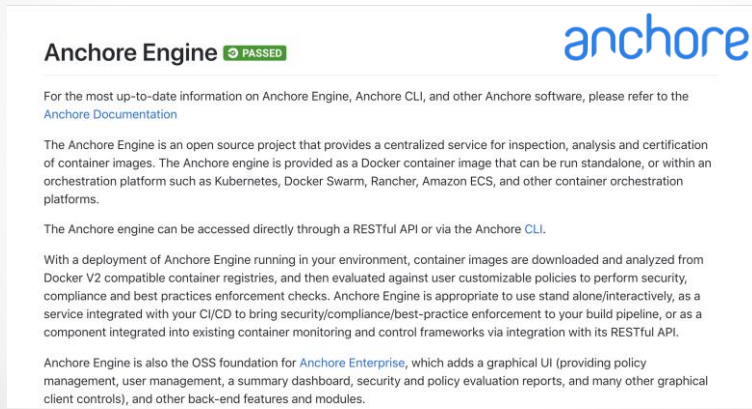
```
# ------------------------------------------------------------------------------
# Docker Bench for Security v1.3.5
#
# Docker, Inc. (c) 2015-
#
# Checks for dozens of common best-practices around deploying Docker containers in production.
# Inspired by the CIS Docker Benchmark v1.2.0.
# ------------------------------------------------------------------------------

Initializing Tue Nov  5 10:27:42 UTC 2019

[INFO] 1 - Host Configuration

[INFO] 1.1 - General Configuration
[NOTE] 1.1.1  - Ensure the container host has been Hardened
[INFO] 1.1.2  - Ensure Docker is up to date
[INFO]        * Using 19.03.4, verify is it up to date as deemed necessary
[INFO]        * Your operating system vendor may provide support and security maintenance for Docker

[INFO] 1.2 - Linux Hosts Specific Configuration
[WARN] 1.2.1  - Ensure a separate partition for containers has been created
[INFO] 1.2.2  - Ensure only trusted users are allowed to control Docker daemon
[INFO]        * docker:x:998:
[WARN] 1.2.3  - Ensure auditing is configured for the Docker daemon
[WARN] 1.2.4  - Ensure auditing is configured for Docker files and directories - /var/lib/docker
[WARN] 1.2.5  - Ensure auditing is configured for Docker files and directories - /etc/docker
[WARN] 1.2.6  - Ensure auditing is configured for Docker files and directories - docker.service
[WARN] 1.2.7  - Ensure auditing is configured for Docker files and directories - docker.socket
[WARN] 1.2.8  - Ensure auditing is configured for Docker files and directories - /etc/default/docker
[INFO] 1.2.9  - Ensure auditing is configured for Docker files and directories - /etc/sysconfig/docker
[INFO]        * File not found
[INFO] 1.2.10 - Ensure auditing is configured for Docker files and directories - /etc/docker/daemon.json
[INFO]        * File not found
[WARN] 1.2.11 - Ensure auditing is configured for Docker files and directories - /usr/bin/containerd
[INFO] 1.2.12 - Ensure auditing is configured for Docker files and directories - /usr/sbin/runc
[INFO]        * File not found


[INFO] 2 - Docker daemon configuration
[WARN] 2.1  - Ensure network traffic is restricted between containers on the default bridge
[PASS] 2.2  - Ensure the logging level is set to 'info'
[PASS] 2.3  - Ensure Docker is allowed to make changes to iptables

The Docker Bench for Security is a script that checks for dozens of common best-practices around deploying Docker containers in production. The tests are all automated, and are inspired by the CIS Docker Benchmark v1.2.0.
```



Ref: https://github.com/docker/docker-bench-security

Docker Security

- Anchore for docker image scanning
  - Scan in each layer of docker image and compare with know vulnerability


Anchore Engine PASSED

anchore

For the most up-to-date information on Anchore Engine, Anchore CLI, and other Anchore software, please refer to the Anchore Documentation

The Anchore Engine is an open source project that provides a centralized service for inspection, analysis and certification of container images. The Anchore engine is provided as a Docker container image that can be run standalone, or within an orchestration platform such as Kubernetes, Docker Swarm, Rancher, Amazon ECS, and other container orchestration platforms.

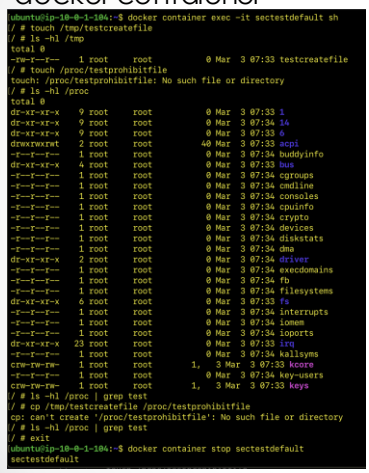
The Anchore engine can be accessed directly through a RESTful API or via the Anchore CLI.

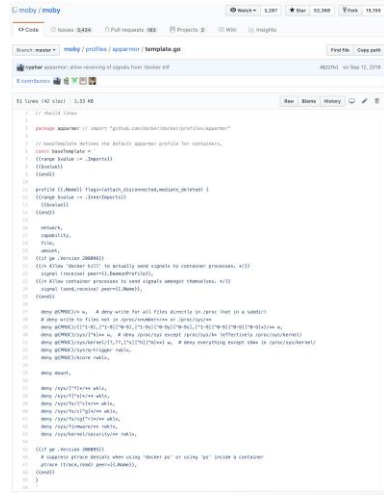
With a deployment of Anchore Engine running in your environment, container images are downloaded and analyzed from Docker V2 compatible container registries, and then evaluated against user customizable policies to perform security, compliance and best practices enforcement checks. Anchore Engine is appropriate to use stand alone/interactively, as a service integrated with your CI/CD to bring security/compliance/best-practice enforcement to your build pipeline, or as a component integrated into existing container monitoring and control frameworks via integration with its RESTful API.

Anchore Engine is also the OSS foundation for Anchore Enterprise, which adds a graphical UI (providing policy management, user management, a summary dashboard, security and policy evaluation reports, and many other graphical client controls), and other back-end features and modules.

Docker Security

- Default apparmor in docker (1.13.0 and above) apply on all docker contaiener

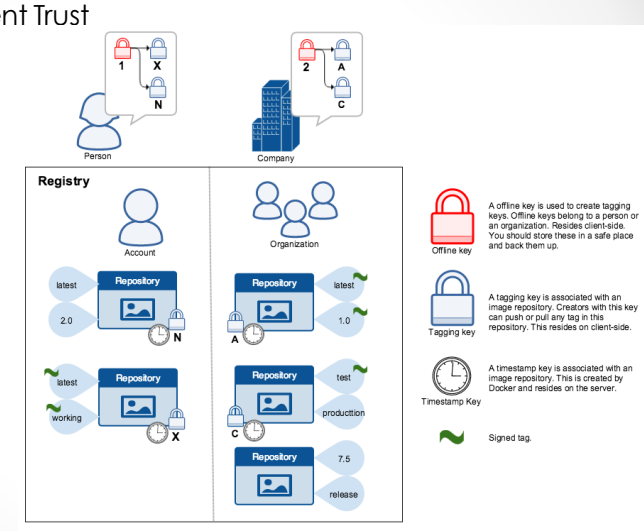




Ref: https://github.com/moby/moby/blob/master/profiles/apparmor/template.go

Docker Security

- Image Content Trust

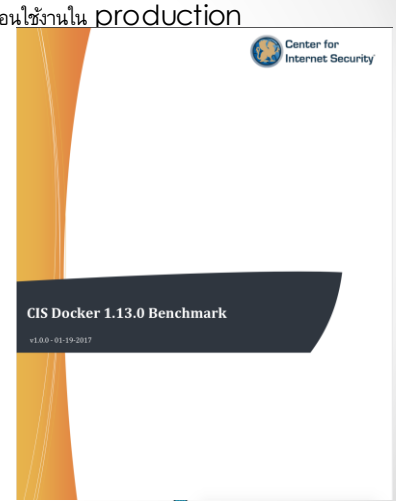


Docker Security

- Recommendation for enhance docker security
  - ระวังการจัดการ user ที่มีหน้าที่ทำงานกับ docker daemon และ privilege คำสั่งบน docker command
  - ใช้ non-root user ในการจัดการ docker daemon operation (docker run etc)
  - จัดการ Image Content Trust (Sign Image) ในการสั่ง pull/push image
  - เปลี่ยนการจัดการ docker daemon socket เป็น HTTP socket (with TLS verify and authentication)
  - จำกัดสิทธิและขอบเขตการทำงานของ user บน container (Secure compute mode (seccomp)

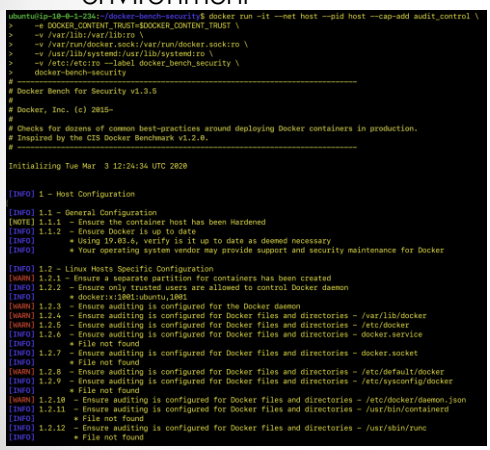
Workshop: Docker Security

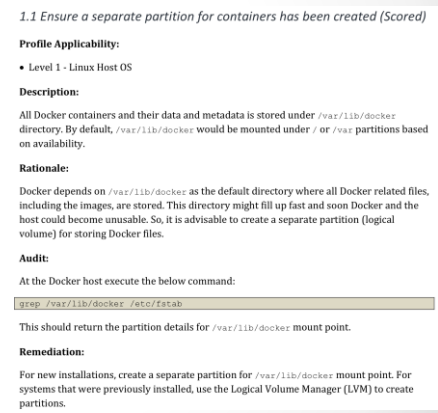
- Docker Bench for Security
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment



Workshop: Docker Security

- Docker Bench for Security
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment





1.1 Ensure a separate partition for containers has been created (Scored)

Profile Applicability:

- Level 1 - Linux Host OS

Description:

All Docker containers and their data and metadata is stored under `/var/lib/docker` directory. By default, `/var/lib/docker` would be mounted under `/` or `/var` partitions based on availability.

Rationale:

Docker depends on `/var/lib/docker` as the default directory where all Docker related files, including the images, are stored. This directory might fill up fast and soon Docker and the host could become unusable. So, it is advisable to create a separate partition (logical volume) for storing Docker files.

Audit:

At the Docker host execute the below command:

```
grep /var/lib/docker /etc/fstab
```

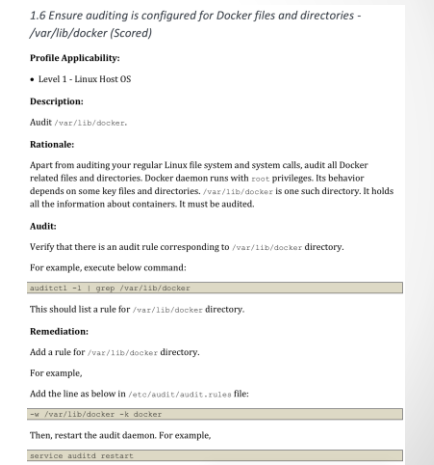
This should return the partition details for `/var/lib/docker` mount point.

Remediation:

For new installations, create a separate partition for `/var/lib/docker` mount point. For systems that were previously installed, use the Logical Volume Manager (LVM) to create partitions.

Workshop: Docker Security

- Docker Bench for Security
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment



1.6 Ensure auditing is configured for Docker files and directories - /var/lib/docker (Scored)

Profile Applicability:

- Level 1 - Linux Host OS

Description:

Audit `/var/lib/docker`.

Rationale:

Apart from auditing your regular Linux file system and system calls, audit all Docker related files and directories. Docker daemon runs with `root` privileges. Its behavior depends on some key files and directories. `/var/lib/docker` is one such directory. It holds all the information about containers. It must be audited.

Audit:

Verify that there is an audit rule corresponding to `/var/lib/docker` directory.

For example, execute below command:

```
auditctl -l | grep /var/lib/docker
```

This should list a rule for `/var/lib/docker` directory.

Remediation:

Add a rule for `/var/lib/docker` directory.

For example,

Add the line as below in `/etc/audit/audit.rules` file:

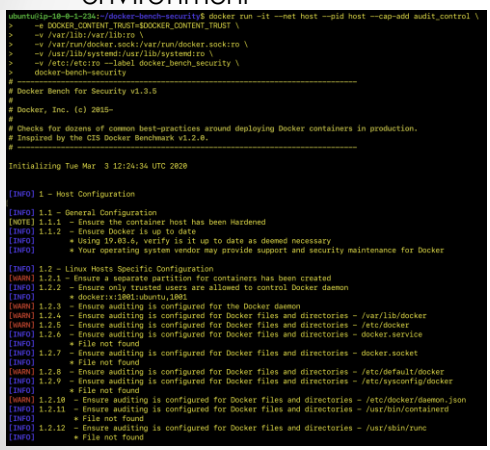
```
-w /var/lib/docker -k docker
```

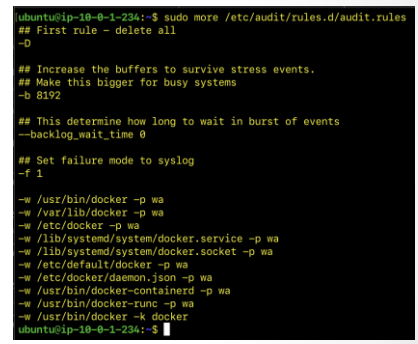
Then, restart the audit daemon. For example,

```
service auditd restart
```


Workshop: Docker Security

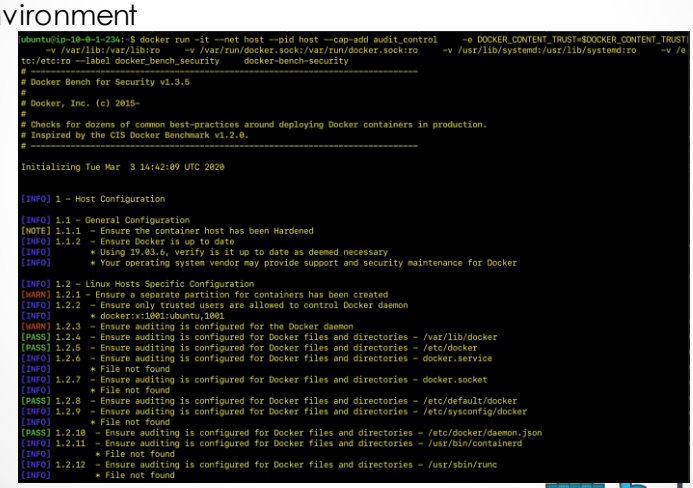
- Docker Bench for Security
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment





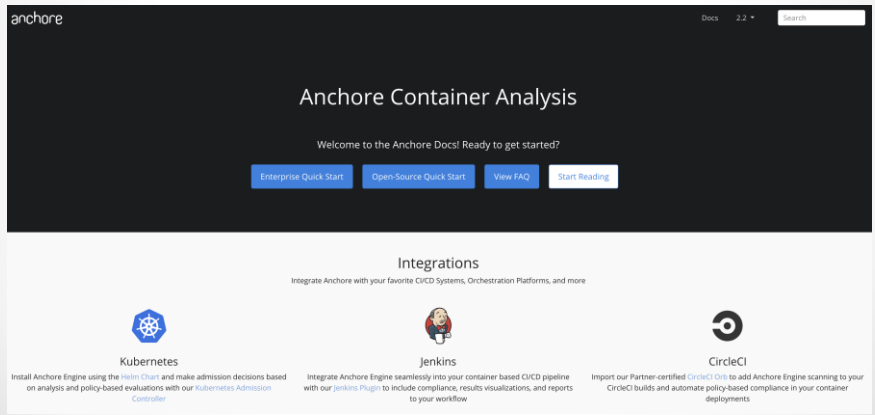
Workshop: Docker Security

- Docker Bench for Security
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment



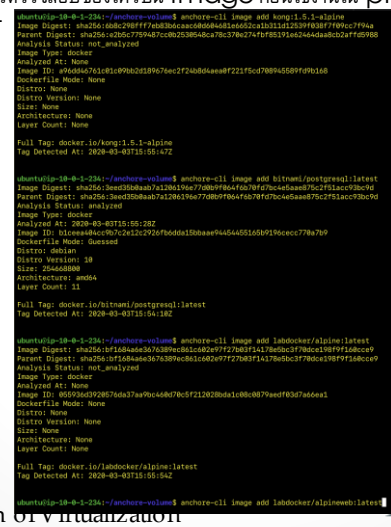
Workshop: Docker Security

- Image Scan with Anchore
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment



Workshop: Docker Security

- Image Scan with Anchore
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment



Workshop: Docker Security

- Image Scan with Anchore
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment

```
ubuntu@ip-10-0-1-234:~/anchore-volume$ anchore-cli image list
Full Tag                                Image Digest                                                                Analysis Status
docker.io/bitnami/postgresql:latest     sha256:3eed35b0aab7a1206196e77d0b9f064f6b70fd7bc4e5aae875c2f51acc93bc9d      analyzed
docker.io/kong:1.5.1-alpine             sha256:6b8c298fff7eb83b6caac60d604681e6652ca1b311d12539f038f7f09cc7f94a      analyzed
docker.io/labdocker/alpine:latest       sha256:bf1684a6e3676389ec861c602e97f27b03f14178e5bc3f70dce198f9f160cce9      analyzed
docker.io/labdocker/alpineweb:latest    sha256:a7aa70c78120ed126487aecbf49db1054f1ff131858516c91137c3accbb4a333      analyzing
ubuntu@ip-10-0-1-234:~/anchore-volume$ anchore-cli image list
Full Tag                                Image Digest                                                                Analysis Status
docker.io/bitnami/postgresql:latest     sha256:3eed35b0aab7a1206196e77d0b9f064f6b70fd7bc4e5aae875c2f51acc93bc9d      analyzed
docker.io/kong:1.5.1-alpine             sha256:6b8c298fff7eb83b6caac60d604681e6652ca1b311d12539f038f7f09cc7f94a      analyzed
docker.io/labdocker/alpine:latest       sha256:bf1684a6e3676389ec861c602e97f27b03f14178e5bc3f70dce198f9f160cce9      analyzed
docker.io/labdocker/alpineweb:latest    sha256:a7aa70c78120ed126487aecbf49db1054f1ff131858516c91137c3accbb4a333      analyzed
ubuntu@ip-10-0-1-234:~/anchore-volume$
```

```
ubuntu@ip-10-0-1-234:~/anchore-volume$ anchore-cli image content labdocker/alpine:latest os
Package                 Version         License
alpine-baselayout       3.1.0           GPL-2.0
alpine-keys             2.1             MIT
apk-tools               2.10.3          GPL2
busybox                 1.29.3          GPL-2.0
ca-certificates-cacert  20190108        MPL-2.0 GPL-2.0-or-later
libc-utils              0.7.1           BSD
libcrypto1.1            1.1.1b          OpenSSL
libssl1.1               1.1.1b          OpenSSL
libtls-standalone       2.7.4           ISC
musl                    1.1.20          MIT
musl-utils              1.1.20          MIT BSD GPL2+
scanelf                 1.2.3           GPL-2.0
ssl_client              1.29.3          GPL-2.0
zlib                    1.2.11          zlib
ubuntu@ip-10-0-1-234:~/anchore-volume$
```


Workshop: Docker Security

- Image Scan with Anchore
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment

```
ubuntu@ip-10-0-1-234:~/anchore-volume$ anchore-cli image vuln kong:1.5.1-alpine all

ubuntu@ip-10-0-1-234:~/anchore-volume$ anchore-cli image vuln bitnami/postgresql:latest all
Vulnerability ID        Package                         Severity        Fix     CVE Refs        Vulnerability URL
CVE-2004-0971           libgssapi-krb5-2-1.17-3         Negligible      None    CVE-2004-0971   https://security-tracker.debian.org/tracker/CVE-2004-0971
CVE-2004-0971           libk5crypto3-1.17-3             Negligible      None    CVE-2004-0971   https://security-tracker.debian.org/tracker/CVE-2004-0971
CVE-2004-0971           libkrb5-3-1.17-3                Negligible      None    CVE-2004-0971   https://security-tracker.debian.org/tracker/CVE-2004-0971
CVE-2004-0971           libkrb5support0-1.17-3          Negligible      None    CVE-2004-0971   https://security-tracker.debian.org/tracker/CVE-2004-0971
CVE-2005-1119           sudo-1.8.27-1+deb10u2           Negligible      None    CVE-2005-1119   https://security-tracker.debian.org/tracker/CVE-2005-1119
CVE-2005-2541           tar-1.30+dfsg-6                 Negligible      None    CVE-2005-2541   https://security-tracker.debian.org/tracker/CVE-2005-2541
CVE-2007-5686           login-1:4.5-1.1                 Negligible      None    CVE-2007-5686   https://security-tracker.debian.org/tracker/CVE-2007-5686
CVE-2007-5686           passwd-1:4.5-1.1                Negligible      None    CVE-2007-5686   https://security-tracker.debian.org/tracker/CVE-2007-5686
CVE-2007-6755           libssl1.1-1.1.1d-0+deb10u2      Negligible      None    CVE-2007-6755   https://security-tracker.debian.org/tracker/CVE-2007-6755
CVE-2007-6755           openssl-1.1.1d-0+deb10u2        Negligible      None    CVE-2007-6755   https://security-tracker.debian.org/tracker/CVE-2007-6755
CVE-2010-0928           libssl1.1-1.1.1d-0+deb10u2      Negligible      None    CVE-2010-0928   https://security-tracker.debian.org/tracker/CVE-2010-0928
CVE-2010-0928           openssl-1.1.1d-0+deb10u2        Negligible      None    CVE-2010-0928   https://security-tracker.debian.org/tracker/CVE-2010-0928
CVE-2010-4051           libc-bin-2.28-10                Negligible      None    CVE-2010-4051   https://security-tracker.debian.org/tracker/CVE-2010-4051
CVE-2010-4051           libc-l10n-2.28-10               Negligible      None    CVE-2010-4051   https://security-tracker.debian.org/tracker/CVE-2010-4051
CVE-2010-4051           libc6-2.28-10                   Negligible      None    CVE-2010-4051   https://security-tracker.debian.org/tracker/CVE-2010-4051
CVE-2010-4051           locales-2.28-10                 Negligible      None    CVE-2010-4051   https://security-tracker.debian.org/tracker/CVE-2010-4051
CVE-2010-4052           libc-bin-2.28-10                Negligible      None    CVE-2010-4052   https://security-tracker.debian.org/tracker/CVE-2010-4052
CVE-2010-4052           libc-l10n-2.28-10               Negligible      None    CVE-2010-4052   https://security-tracker.debian.org/tracker/CVE-2010-4052
CVE-2010-4052           libc6-2.28-10                   Negligible      None    CVE-2010-4052   https://security-tracker.debian.org/tracker/CVE-2010-4052
CVE-2010-4052           locales-2.28-10                 Negligible      None    CVE-2010-4052   https://security-tracker.debian.org/tracker/CVE-2010-4052
CVE-2010-4756           libc-bin-2.28-10                Negligible      None    CVE-2010-4756   https://security-tracker.debian.org/tracker/CVE-2010-4756
CVE-2010-4756           libc-l10n-2.28-10               Negligible      None    CVE-2010-4756   https://security-tracker.debian.org/tracker/CVE-2010-4756
CVE-2010-4756           libc6-2.28-10                   Negligible      None    CVE-2010-4756   https://security-tracker.debian.org/tracker/CVE-2010-4756
CVE-2010-4756           locales-2.28-10                 Negligible      None    CVE-2010-4756   https://security-tracker.debian.org/tracker/CVE-2010-4756
CVE-2011-3374           apt-1.8.2                       Negligible      None    CVE-2011-3374   https://security-tracker.debian.org/tracker/CVE-2011-3374
CVE-2011-3374           libapt-pkg5.0-1.8.2             Negligible      None    CVE-2011-3374   https://security-tracker.debian.org/tracker/CVE-2011-3374
CVE-2011-3389           libgnutls30-3.6.7-4+deb10u2     Negligible      None    CVE-2011-3389   https://security-tracker.debian.org/tracker/CVE-2011-3389
CVE-2011-4116           perl-base-5.28.1-6              Negligible      None    CVE-2011-4116   https://security-tracker.debian.org/tracker/CVE-2011-4116
CVE-2013-4235           login-1:4.5-1.1                 Negligible      None    CVE-2013-4235   https://security-tracker.debian.org/tracker/CVE-2013-4235
CVE-2013-4235           passwd-1:4.5-1.1                Negligible      None    CVE-2013-4235   https://security-tracker.debian.org/tracker/CVE-2013-4235
CVE-2013-4392           libsystemd0-241-7~deb10u3       Negligible      None    CVE-2013-4392   https://security-tracker.debian.org/tracker/CVE-2013-4392
```


Workshop: Docker Security

- Image Scan with Anchore
- Purpose: ทำการตรวจสอบช่องโหว่บน image ก่อนใช้งานใน production environment

README.md

Anchore Policy Hub

The Anchore Policy Hub is a centralized repository of resources that are served and then can be loaded into/consumed by Anchore Engine, via anchore engine clients. This repository serves as the canonical store of source documents (initially, Anchore Policy Bundles), both serving as a location where pre-defined policy bundles can be easily fetched and loaded into Anchore Engine deployments to help with a starting point for creating your own bundles, as well as a location where users of Anchore can submit and share new policy bundles and, moving forward, other Anchore resources as well.

Structure

The structure of this repository is meant to facilitate a straight-forward mechanism for users to contribute new policy documents, or modify existing policy documents, with a light-weight process for translating the source documents into an indexed, static structure that can easily be hosted by any HTTP server. By default, all policy documents stored here are automatically converted into such a static site, hosted publicly, and is made immediately available to any client that can communicate with the public Anchore Policy Hub (initially, the Anchore CLI).

The important items in this repo are as follows:

- source/bundles: location of fully functional anchore policy bundles, ready to l
  For more information on the anchore policy bundle format/capabilities, see th
  guide
- generate.py: script that converts the source documents (bundles in source/b
  document format validation as well as light conversion of some items in the s

```
ubuntu@ip-10-0-1-234:~/anchore-volume$ anchore-cli policy hub list
Name                        Description
anchore_security_only       Single policy, single whitelist bundle for performing
                            security checks, including example blacklist known malicious
                            packages by name.
anchore_default_bundle      Default policy bundle that comes installed with vanilla
                            anchore-engine deployments.  Mixture of light vulnerability
                            checks, dockerfiles checks, and warning triggers for common
                            best practices.
anchore_cis_1.13.0_base     Docker CIS 1.13.0 image content checks, from section 4 and
                            5. NOTE: some parameters (generally are named 'example...')
                            must be modified as they require site-specific settings
ubuntu@ip-10-0-1-234:~/anchore-volume$
```


Workshop: Docker Security

- Apparmor
- Purpose: ระงับการทำงานบางอย่างบน container ที่ไม่จำเป็นเพื่อลดความเสี่ยงในการใช้งานเกินขอบเขตของ application

```
ubuntu@ip-10-0-1-104:~$ docker container run -dt --name sectestrestrict --security-opt "apparmor=restrict-apparmor" labdocker/alpine:latest sh
6db2a1be7b9d1b3f15409e49bc1a0e1a9373cc9b8740a017ff8fb163283b8d1b
ubuntu@ip-10-0-1-104:~$ docker container exec -it sectestdefault sh
Error: No such container: sectestdefault
ubuntu@ip-10-0-1-104:~$ docker container exec -it sectestrestrict sh
/ # ping 1.1.1.1
PING 1.1.1.1 (1.1.1.1): 56 data bytes
ping: can't create raw socket: Permission denied
/ # apk update
ERROR: Unable to lock database: Permission denied
ERROR: Failed to open apk database: Permission denied
/ # apk add curl
ERROR: Unable to lock database: Permission denied
ERROR: Failed to open apk database: Permission denied
/ # curl https://www.google.com
sh: curl: not found
/ # touch /tmp/testcreatefile1
touch: /tmp/testcreatefile1: Permission denied
/ # touch /home/testcreatefile2
touch: /home/testcreatefile2: Permission denied
/ # touch /etc/testcreatefile3
touch: /etc/testcreatefile3: Permission denied
/ # touch /proc/testcreatefile4
touch: /proc/testcreatefile4: No such file or directory
/ # cp /tmp/testcreatefile /proc/testprohibitfile
cp: can't stat '/tmp/testcreatefile': No such file or directory
/ # ls -hl /proc | grep test
/ # exit
ubuntu@ip-10-0-1-104:~$ docker container stop sectestrestrict && docker container rm sectestrestrict
sectestrestrict
sectestrestrict
ubuntu@ip-10-0-1-104:~$
```


Workshop: Docker Security

- Content Trust
- Purpose: ทำการ enable feature "DOCKER_CONTENT_TRUST" และใช้งาน image แบบ sign/unsign

```
root@labdocker:~# docker push praparn/alpine:sign
The push refers to a repository [docker.io/praparn/alpine]
6102f0d2ad33: Layer already exists
sign: digest: sha256:65242e8220a341cec40628caaea77eb4acd2fc252329aa853526fde15a4a1d85 size: 528
Signing and pushing trust metadata
You are about to create a new root signing key passphrase. This passphrase
will be used to protect the most sensitive key in your signing system. Please
choose a long, complex passphrase and be careful to keep the password and the
key file itself secure and backed up. It is highly recommended that you use a
password manager to generate the passphrase and keep it safe. There will be no
way to recover this key. You can find the key in your config directory.
Enter passphrase for new root key with ID ca6ab4b:
Repeat passphrase for new root key with ID ca6ab4b:
Enter passphrase for new repository key with ID 68d88cd (docker.io/praparn/alpine):
Repeat passphrase for new repository key with ID 68d88cd (docker.io/praparn/alpine):
```


Registry

• • •

Registry

- Registry เป็น container แบบหนึ่งที่ใช้สำหรับจัดเก็บ image ที่สร้างขึ้นไว้บน private server โดยไม่จำเป็นต้องผ่าน public internet (hub.docker.com) ทำให้สามารถจัดเก็บ image ภายในองค์กรได้อย่างปลอดภัย
- Registry เป็นพื้นที่สำหรับจัดเก็บ image ที่ถูกสร้างขึ้นโดยแบ่งออกตาม image name และ tag version ที่กำหนดไว้

  Ex: labdocker/alpineweb:latest
- กรณีการใช้งาน registry ระหว่าง Server ด้วยกันสามารถกำหนด TLS security ระหว่างกันได้
- สามารถเลือก storage backend อื่นๆในการจัดเก็บ image ได้เช่น
- Etc: s3 (aws), azure, gcs (google cloud) etc
- มี option gc (garbage collect) ด้วย option
- "bin/registry garbage-collect [--dry-run] config.yml"

Docker: The Next-Gen of Virtualization

Workshop: Registry

- Part1:Registry on single docker-machine
- เริ่มใช้งาน registry โดย download image registry ตามตัวอย่าง

  docker image pull registry:2.6.2 (registry version 2.0)
- Start container เพื่อเริ่มใช้งาน

```
docker container run -d -p 5000:5000 \
--restart=always --name registry \
 -e REGISTRY_STORAGE_DELETE_ENABLED=true \
--mount type=bind,source=/home/docker,target=/var/lib/registry \
registry:2.7.1
```

- ดำเนินการ tag image และทดสอบ push image docker เข้า registry

```
docker image tag labdocker/alpine:latest \
localhost:5000/alpine:latest
```

```
docker push localhost:5000/alpine:latest
```

- *ต้องบันทึก digest image ไว้เพื่อใช้อ้างอิงภายหลัง

Docker: The Next-Gen of Virtualization

Workshop: Registry

- ในการตรวจสอบ registry image file เพื่อให้เกิดความง่ายต่อการใช้งาน docker ได้จัดเตรียม HTTP API สำหรับการเรียกใช้งานบน registry ผ่าน curl/customize application ซึ่งรองรับการใช้งาน อาทิเช่น
- การ List รายการ image ที่จัดเก็บไว้บน

```
curl -X GET http://localhost:5000/v2/_catalog
```

- ตรวจสอบ revision image tag ที่จัดเก็บไว้ในแต่ละ image

```
curl -X GET http://localhost:5000/v2/<name>/tags/list
```

```
curl -X GET http://localhost:5000/v2/alpine/tags/list
```

- สามารถทำการลบ image ที่จัดเก็บไว้โดยอ้างอิงจาก digest

```
curl -X DELETE
http://localhost:5000/v2/alpine/manifests/<digest>
```


Workshop: Registry

- ตรวจสอบ image ทาง physical file จาก docker-machine

```
cd /home/docker
cd /docker/registry/v2
```

- ลบ image file ออกจาก docker-machine

```
docker image rm localhost:5000/alpine:latest
```

- ทำการดึง image ใหม่มาจาก registry

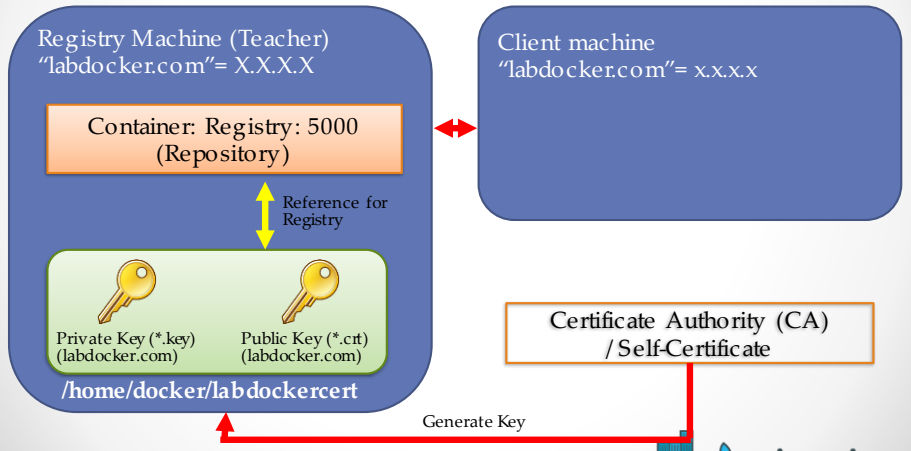
```
docker image pull localhost:5000/alpine:latest
```

- ทำการลบ container registry เพื่อยกเลิกการใช้งาน

```
docker container stop registry
docker container rm registry
```


Registry on difference machine

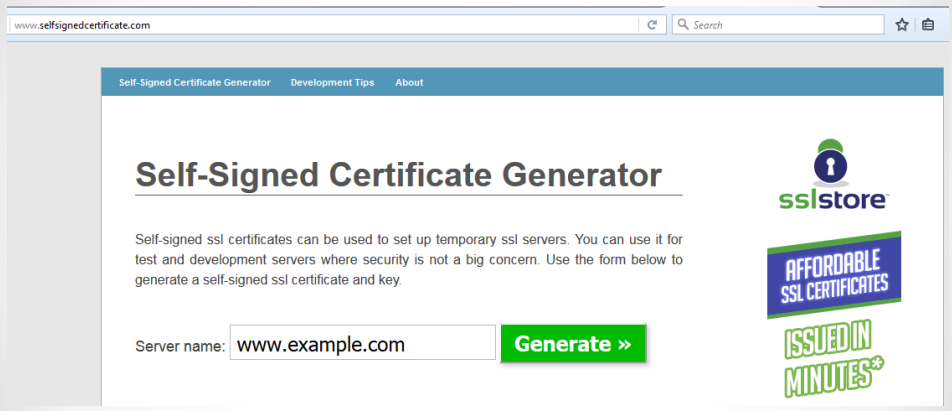
- Part2: Registry on multiple docker-machine
- กรณีที่ต้องใช้งาน registry จาก docker server มากกว่า 1 เครื่อง เราสามารถดึงต้องสร้าง TLS certificate (next generate of SSL) เพื่อ trust registry ระหว่างกัน



277

Registry on difference machine

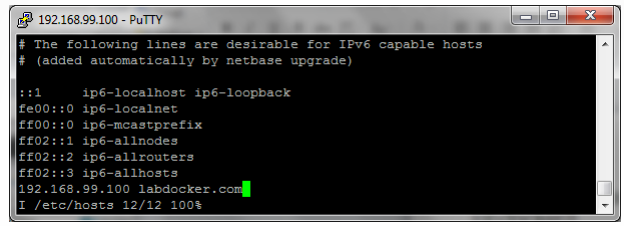
- การสร้าง certificate จาก CA / Self-Signed

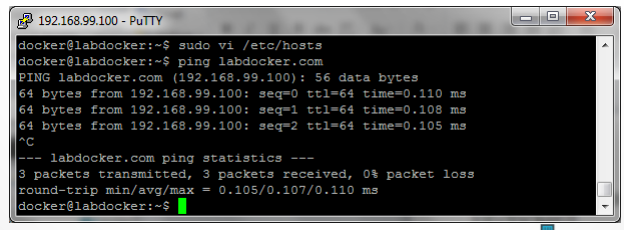


278

Registry on difference machine

- เพิ่ม domain “labdocker.com” ลงใน /etc/hosts (labdocker, labdocker2)

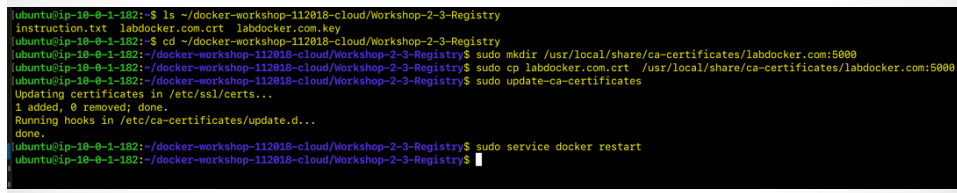




Registry on difference machine

- สำหรับกรณีเครื่อง ubuntu ทั่วไปที่ใช้งาน self-certificate ให้ทำการ trust root ca ดังนี้

```
sudo mkdir /usr/local/share/ca-certificates/labdocker.com:5000
sudo cp labdocker.com.crt  /usr/local/share/ca-certificates/labdocker.com:5000
sudo update-ca-certificates
sudo service docker restart
```



Registry on difference machine

- เริ่มใช้งาน registry โดย start container ดังนี้ (labdocker)

```
docker container run -d -p 5000:5000 \
        --restart=always --name registrylab \
        --mount type=bind,source=$(pwd),target=/var/lib/registry \
        --mount type=bind,source=$(pwd),target=/certs \
        --mount type=bind,source=$(pwd),target=/auth\
        -e "REGISTRY_AUTH=htpasswd" \
        -e "REGISTRY_AUTH_HTPASSWD_REALM=Registry Realm" \
        -e REGISTRY_AUTH_HTPASSWD_PATH=/auth/htpasswd \
        -e REGISTRY_STORAGE_DELETE_ENABLED=true \
        -e REGISTRY_HTTP_TLS_CERTIFICATE=/certs/labdocker.com.crt \
        -e REGISTRY_HTTP_TLS_KEY=/certs/labdocker.com.key \
        registry:2.7.1
```

- ดำเนินการ tag image,login และทดสอบ push image docker เข้า registry

```
docker image tag labdocker/alpine:latest labdocker.com:5000/alpine:1.0
docker login -u <username> -p <password>
docker image push labdocker.com:5000/alpine:1.0
```


Registry on difference machine

- ในการตรวจสอบ registry image file สำหรับ registry ที่มีการ enable TLS เรียบบร้อย แล้วต้องเพิ่มพารามิเตอร์ “--cacert “ เพื่อระบุ certificate สำหรับการใช้งานและเปลี่ยน protocol เป็น https

- การ List รายการ image ที่จัดเก็บไว้บน

```
curl –u <username:password>  --cacert /Share_DockerToolbox/labdocker.com.crt  -X
GET https://labdocker.com:5000/v2/_catalog
```

- ตรวจสอบ revision image tag ที่จัดเก็บไว้ในแต่ละ image

```
curl –u <username:password>  --cacert /home/docker/labdockercert/labdocker.com.crt  -
X GET https://labdocker.com:5000/v2/alpine/tags/list
```

- สามารถทำการลบ image ที่จัดเก็บไว้โดยอ้างอิงจาก digest

```
curl –u <username:password>  --cacert /home/docker/labdockercert/labdocker.com.crt
-X DELETE https://labdocker.com:5000/v2/alpine/manifests
```


Registry on difference machine

- ดึง image ผ่าน labdocker 2

```
ubuntu@ip-10-0-1-239:~/docker-workshop-112018-cloud/Workshop-2-3-Registry$ docker login labdocker.com:5000
Username: docker
Password:
WARNING! Your password will be stored unencrypted in /home/ubuntu/.docker/config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
ubuntu@ip-10-0-1-239:~/docker-workshop-112018-cloud/Workshop-2-3-Registry$ docker image pull labdocker.com:5000/alpine:1.0
1.0: Pulling from alpine
Digest: sha256:028928264601a9d18f0ea01f8a2f35d328ef039db4e1edcc45c630314a0457d5b
Status: Downloaded newer image for labdocker.com:5000/alpine:1.0
ubuntu@ip-10-0-1-239:~/docker-workshop-112018-cloud/Workshop-2-3-Registry$
```

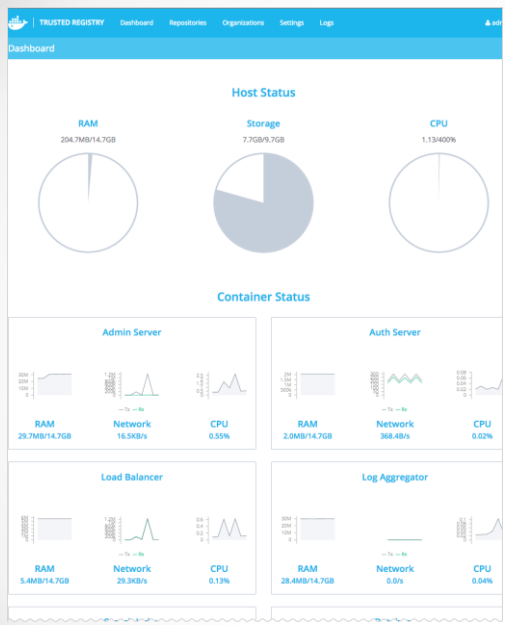
- Optional: สำหรับเพิ่มรันเว็บเพื่อตรวจสอบ Container

```
-v `pwd`/auth:/auth \
 -e "REGISTRY_AUTH=htpasswd" \
 -e "REGISTRY_AUTH_HTPASSWD_REALM=Registry
Realm" \
```

- ทำการลบ container registry เพื่อยกเลิกการใช้งาน

```
docker container stop registry
docker container rm -v registry
```

Ref: https://docs.docker.com/registry/deploying/

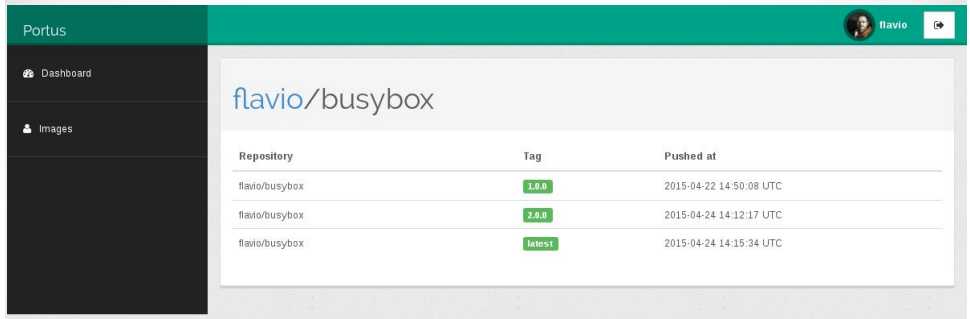


Docker Trust Registry (DTR)

- Commercial support
- GUI for manage ev erything
- Integrated LDAP authentication
- GC schedule av ailable

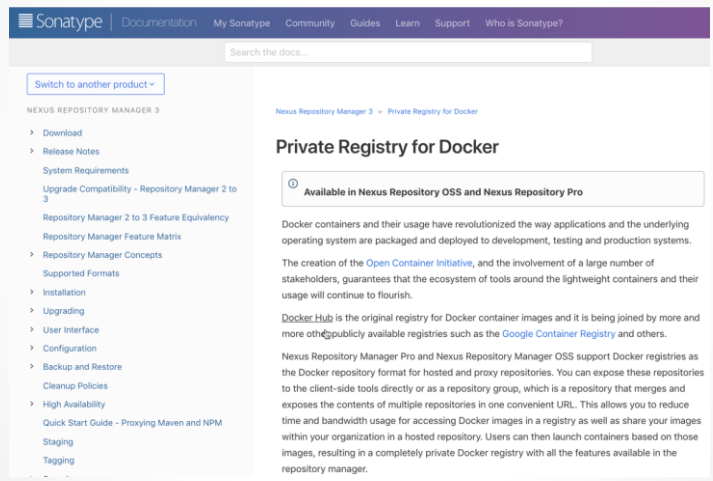
Open Source Registry (Experiment)

- http://port.us.org



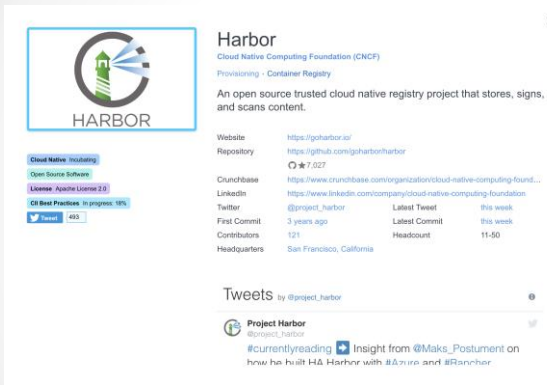
Artifact Registry

- Sonatype



Artifact Registry

- Harbor CNCF Registry (Incubator)

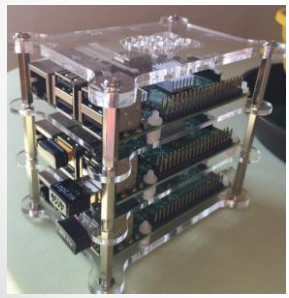


Swarm

• • •

Swarm: Conceptual

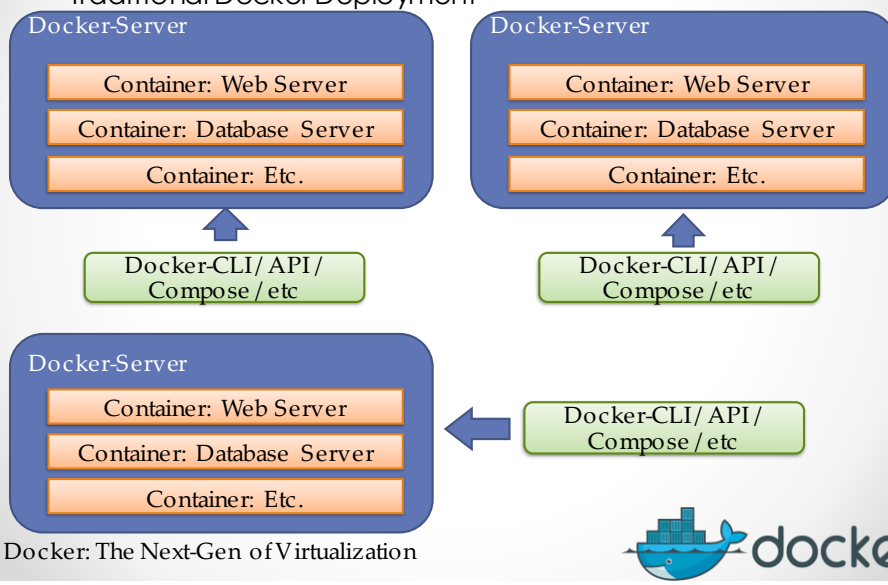
- Swarm ถือเป็น native tool ในการจัดการ docker-engine หลายๆเครื่องให้รวมเป็น resource pool เดียวกัน เพื่อให้ง่ายต่อการบริหารจัดการ
- เพิ่มขีดความสามารถในการทำงานร่วมกันของ docker-engine
- Hybrid Swan Cluster (Windows / Linux)
- Fail Over / High Availability (HA)
- Micro Service



Docker: The Next-Gen of Virtualization

Swarm: Conceptual

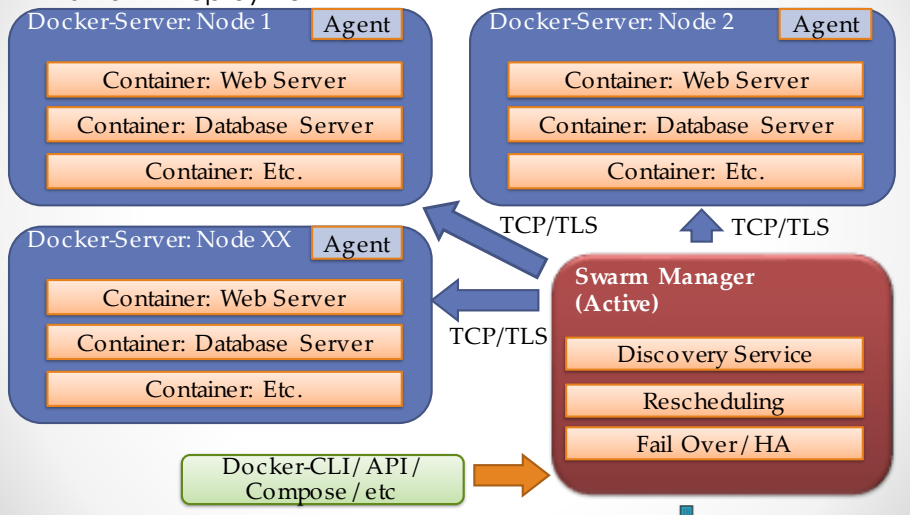
- Traditional Docker Deployment



Docker: The Next-Gen of Virtualization

Swarm: Conceptual

- Swarm Deployment

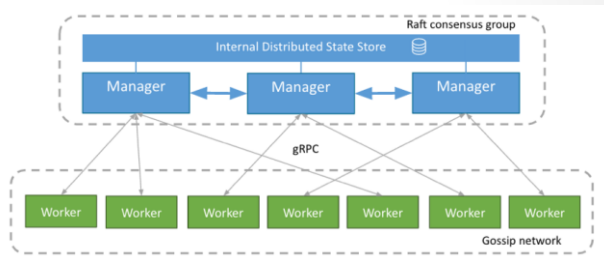


Docker: The Next-Gen of Virtualization

Swarm Mode Architecture

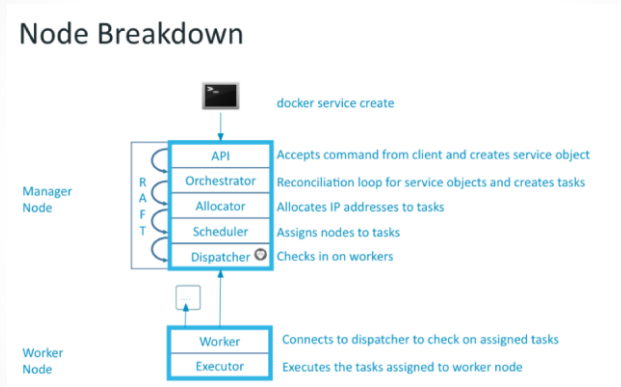
- Swarm Mode (build-in swarm) เป็นฟังก์ชั่นที่มาพร้อมdocker-engine ตั้งแต่แรก และสามารถบริหารจัดการ swarm ได้ด้วยตัวเองรวมถึง build-in TLS certificate เพื่อใช้ทำงานระหว่าง node ทันที (Security On the Box)

- Swarm Role
  - Manager Node
  - Worker Node

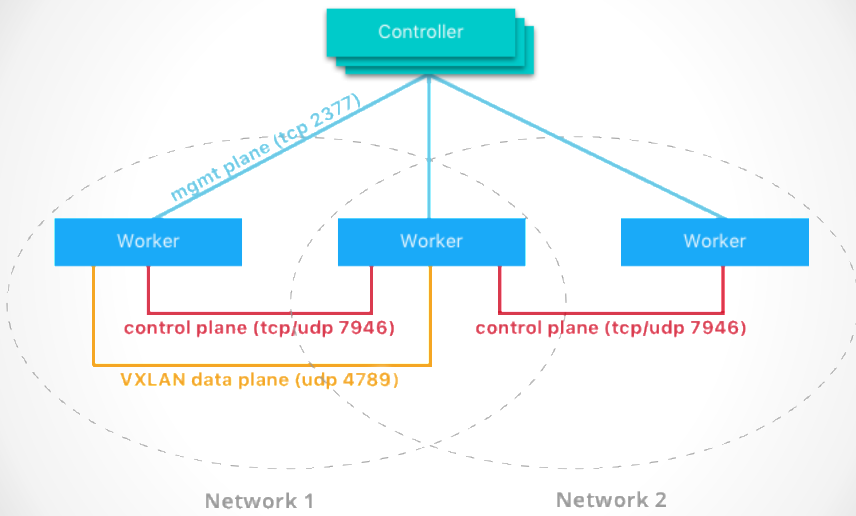


Docker: The Next-Gen of Virtualization

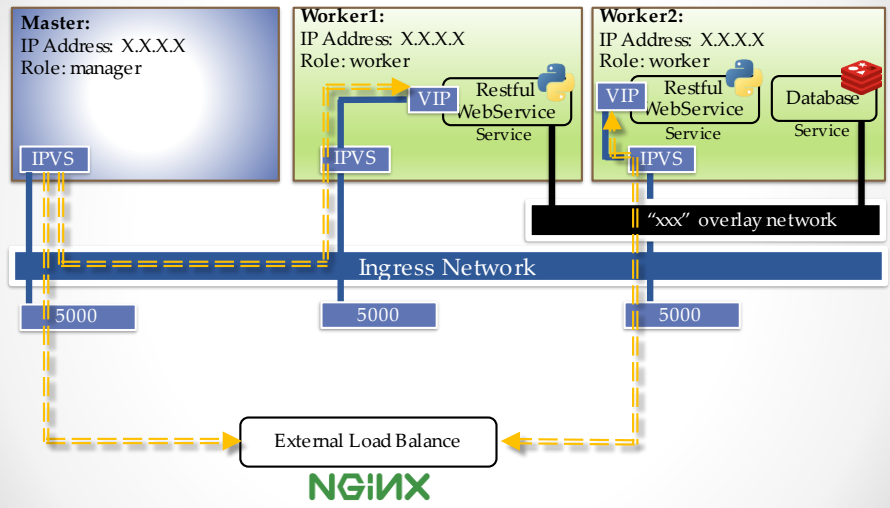
Swarm Mode Architecture



Swarm Mode Architecture



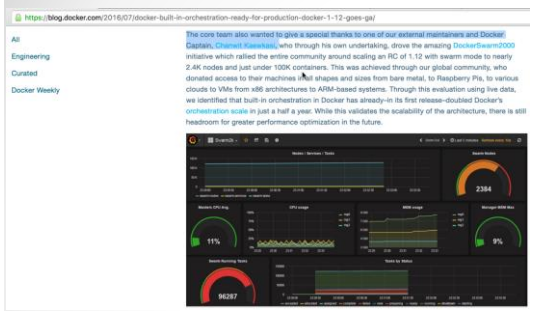
Swarm Mode Architecture



Docker: The Next-Gen of Virtualization

295

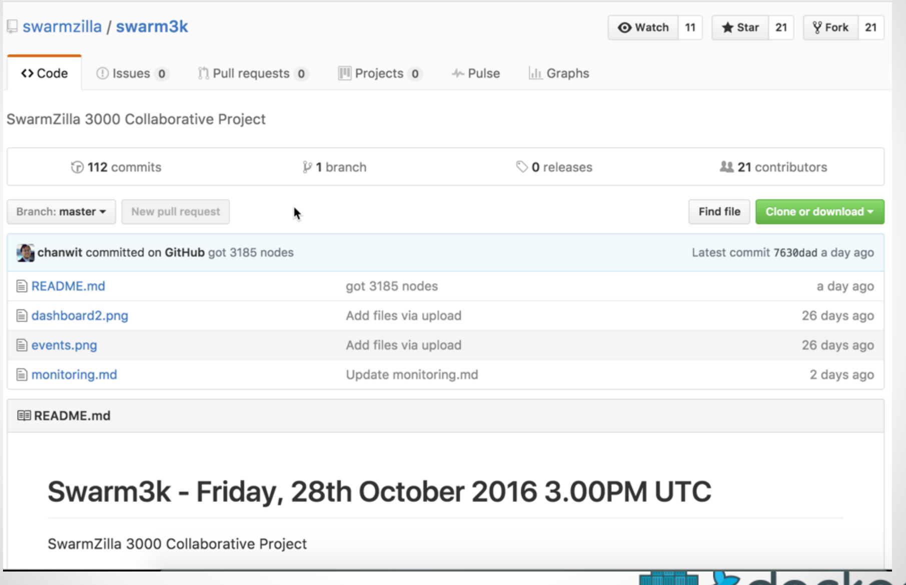
Swarm Mode Architecture



Docker: The Next-Gen of Virtualization

296

Swarm Mode Architecture

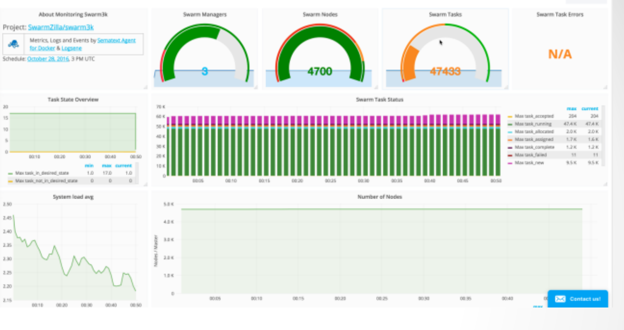


Docker: The Next-Gen of Virtualization

297

Swarm Mode Architecture

Name	Company	Number of Nodes Expected to Contribute
@chanwit	~~Suranaree University~~	100
@FlorianHeigl	my own boss	10
@jmaitrehenry	PetalMD	50
@everett_toews	Rackspace	100
@InetCloudArch	~~Internet Thailand~~	500
@squeaky_pl	n/a	10
@neverlock	Neverlock	10
@demonware	Demonware	1000
@sujaypillai	Jabil	50
@pilgrimstack	OVH	500
@ajeetsraina	Collabnix	10
@AorJoa	Aiyara Cluster	10
@f_soppelsa	Personal	20
@GroupSprint3r	SPRINT3r	630
@toughIQ	Personal	30
@mrnonaki	N/A	10
@zinuzoid	HotelQuickly	200
@_EthanHunt_	N/A	25
@packethost	Packet	100
@ContainerizeT	ContainerizeThis: The Conference	10
@_pascalandy	FirePress	10
@lucjuggery	TRAXxs	10
@alexellisuk	Personal	10
@svega	Huli	10
@BretFisher	Myself :)	20
@voodootikigod	Emerging Technology Advisors	100
@AlexPostID	Personal	20
@gianarb	ThumpFlow	50
@Rucknar	Personal	10
@lherrerabenitez	Personal	10
@abhisak	~~Nipa Technology~~	100
@djalal	NexwayGroup	30



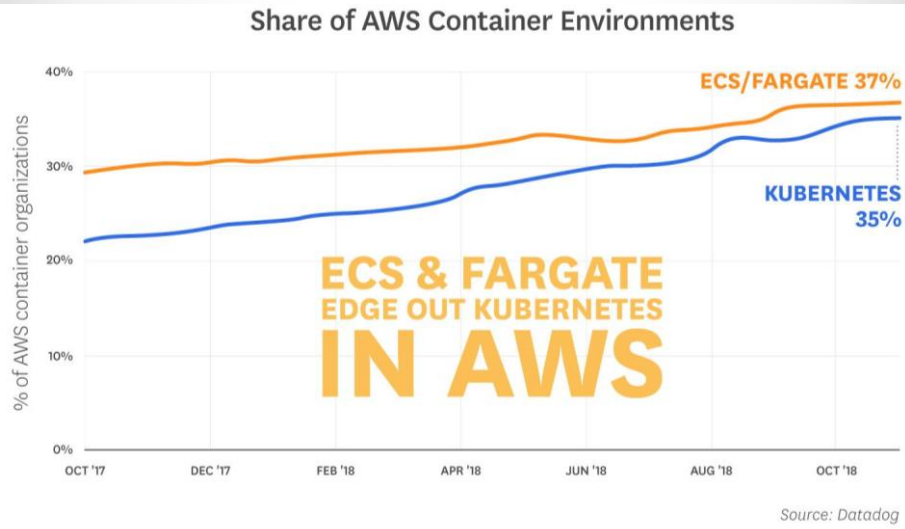
Docker: The Next-Gen of Virtualization

298

K8S vs Docker what is the difference ?

Topic	K8S	Docker/Swarm
Architecture	Open-system (Base on cluster manager "Borg" for support complex workload)	**Swarm**: Proprietary of Docker product, "Easy to use", "Extend capability of Docker in cluster"
Operation command	Almost operate by "YMAL" file (Declarative Command)	Almost operate by "command" (Imperative Command)
Unit of Work	Pods (Pods >= Container)	Container
How to Identify Work	"Label operation"	**Docker**: By container name **Swarm**: By service/stack name
Level of workload management	Service Level: (Simple) Replication Level: (Auto healing) Deployment Level: (Auto healing + Roll Update)	**Docker**: N/A **Swarm**: Service Level (Snag with service/stack)
Auto scaling	HPA (Horizontal Pods Scaling) base on CPU	No
Health check	Liveness & Readiness (Multi option to check application health)	Service health only

K8S vs Docker what is the difference ?

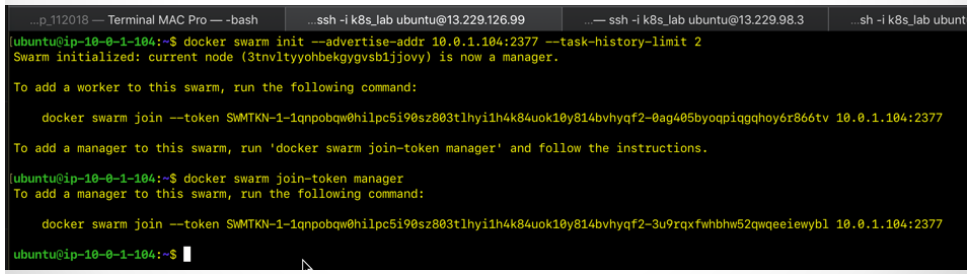


Swarm Init/Join

- เริ่มการสร้าง swarm ด้วยคำสั่ง docker swarm init [OPTIONS] เพื่อให้ docker เริ่มทำงานใน swarm mode

```
docker swarm init --listen-addr <ip address>:<port>
```

```
docker swarm init --advertise-addr 10.0.1.104:2377 --task-history-limit 2
```



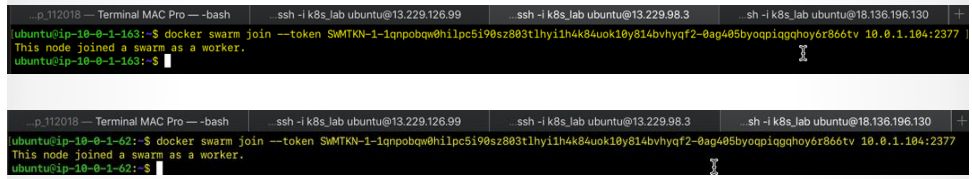
Swarm Init/Join

- Option:
  - --cert-expiry duration: กำหนดระยะเวลาในการ expire certificate (default: 2160 hours = 90 Days)
  - --dispatcher-heartbeat duration: กำหนดช่วงเวลาในการ check heartbeat ภายใน swarm (Default: 5 seconds)
  - --external-ca value: กำหนดให้ใช้งาน CA certificate ภายนอกเพื่อทำ trust node ภายใน swarm
  - --force-new-cluster: บังคับการสร้าง swarm cluster ใหม่
  - --advertise-addr value: ระบุ ip address ที่ใช้คุยระหว่าง swarm node (default: 0.0.0.0:2377)
  - --task-history-limit <int>: กำหนดการจัดเก็บ history task ย้อนหลังบน swarm (default: 10)
  - --availability: <"active"/"pause"/"drain">
  - Etc.

Swarm Init/Join

- ทำการ join node เข้าไปยัง swarm cluster ด้วยคำสั่ง

```
docker swarm join --token <token> <ip of swarm manager: port>
```



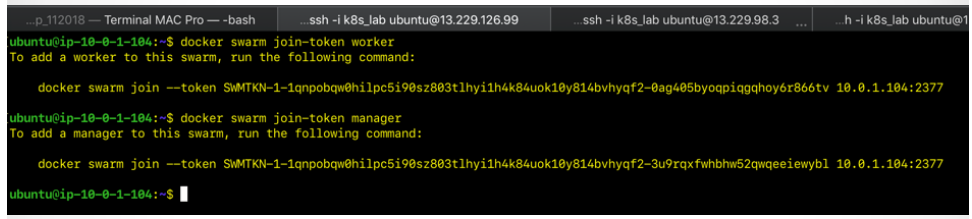
Swarm Init/Join

- Option:
  - --token <value>: กำหนด token เพื่อใช้ในการ trust swarm cluster ร่วมกัน
  - --listen-addr value: ระบุ ip address ที่ใช้คุยระหว่าง swarm node (default: 0.0.0.0:2377)
  - --advertise-addr value: ระบุ ip address ที่ประกาศให้ผู้อื่นมาคุยในกรณีเป็น swarm-manager
  - --availability: <"active"/"pause"/"drain">
  - Etc.

Swarm Init/Join

- ตรวจสอบ Token ที่ใช้ในการ Join Swarm (Worker/Manager)

```
docker swarm join-token <option><worker/manager>
```



- Option:
  - -q, --q : แสดงเฉพาะ token เท่านั้น
  - --rotate: ทำการเปลี่ยน token ใหม่

Swarm Init/Join

- ตรวจสอบ node ที่ทำงานภายใต้ swarm cluster ด้วยคำสั่ง docker node ls

```
docker node ls
```

Swarm Init/Join

- Option:
  - promote <ID>: ทำการ promote node จาก worker กลายเป็น manager
  - demote <ID>: ทำการ demote node จาก manager กลายเป็น worker ปกติ
  - Inspect <ID>: ตรวจสอบค่าคอนฟิกกูเรชั่นของ node
  - ls: แสดง node ทั้งหมดภายใต้ docker swarm cluster
  - ps <ID>: แสดงงานทั้งหมดที่รันอยู่ภายใต้ node
  - rm <ID>: ลบ node ออกจาก swarm cluster
  - update <ID>: ทำการ update node information
    - --availability <status>: อัพเดตสถานะของ node (active/pause/drain)
    - --label-add <value>: สร้าง custom label เพื่อใช้อ้างอิงให้กับ node สำหรับการรัน service
    - --label-remove <value>: ลบ custom label
    - --role <role>: role of node (worker/manager)

Workshop: Swarm Mode

- ทำการตรวจสอบเครื่องใน LAB ที่ได้รับมอบหมายแต่ละกลุ่มซึ่ง

```
Name: Training_DockerZerotoHero_StudentG1_1
(IP: 10.0.1.X), Role: Master
Name: Training_DockerZerotoHero_StudentG1_2
(IP: 10.0.1.X), Role: Worker1
Name: Training_DockerZerotoHero_StudentG1_3
(IP: 10.0.1.X), Role: Worker2
```

- เริ่ม initial swarm ที่เครื่อง Master

```
docker swarm init --secret labdocker --listen-addr <private ip of Master>:2377
```

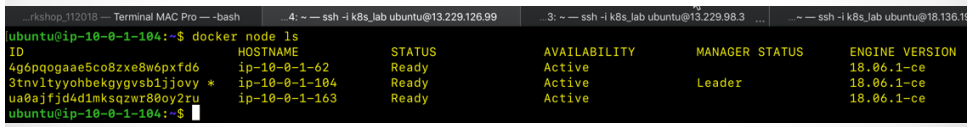

Workshop: Swarm Mode

- ทำการ Join swarm-node1, swarm-node2 เข้าสู่ swarm cluster

```
docker swarm join --token SWMTKN-1-
1qnpobqw0hilpc5i90sz803tlhyi1h4k84uok10y814bvhyqf2-
0ag405byoqpiqgqhoy6r866tv 10.0.1.104:2377
```

- ตรวจสอบสถานะของ swarm หลังจาก join node เข้าไปเรียบร้อยแล้ว

```
docker node ls
```

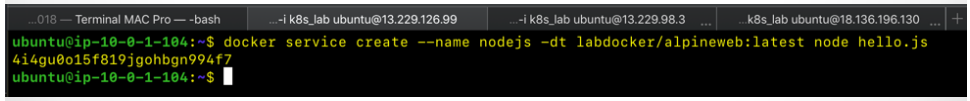


Swarm Service

- สำหรับการสั่งรัน container บน swarm ได้มีการเปลี่ยนแปลงรูปแบบใหม่เช่นกัน โดยกำหนดการรัน container ถูกนิยามใหม่ในรูปแบบของคำสั่ง “docker service” เพื่อนิยามแทนการรันกลุ่มของ container แทนคำสั่ง "docker run" โดยเราสามารถกำหนดค่าพารามิเตอร์ได้เช่นกัน

```
docker service <action> (create/inspect/tasks/scale/ls/rm/update)
```

```
Ex: docker service create -dt --name nodejs \
labdocker/alpineweb:latest node hello.js
```



Swarm Service

```
Options:
      --config config                      Specify configurations to expose to the service
      --constraint list                    Placement constraints
      --container-label list               Container labels
      --credential-spec credential-spec    Credential spec for managed service account (Windows only)
  -d, --detach                             Exit immediately instead of waiting for the service to converge (default true)
      --dns list                           Set custom DNS servers
      --dns-option list                    Set DNS options
      --dns-search list                    Set custom DNS search domains
      --endpoint-mode string               Endpoint mode (vip or dnsrr) (default "vip")
      --entrypoint command                 Overwrite the default ENTRYPOINT of the image
  -e, --env list                           Set environment variables
      --env-file list                      Read in a file of environment variables
      --group list                         Set one or more supplementary user groups for the container
      --health-cmd string                  Command to run to check health
      --health-interval duration           Time between running the check (ms|s|m|h)
      --health-retries int                 Consecutive failures needed to report unhealthy
      --health-start-period duration       Start period for the container to initialize before counting retries towards unstable (ms|s|m|h)
      --health-timeout duration            Maximum time to allow one check to run (ms|s|m|h)
      --help                               Print usage
      --host list                          Set one or more custom host-to-IP mappings (host:ip)
      --hostname string                    Container hostname
  -l, --label list                         Service labels
      --limit-cpu decimal                  Limit CPUs
      --limit-memory bytes                 Limit Memory
      --log-driver string                  Logging driver for service
      --log-opt list                       Logging driver options
      --mode string                        Service mode (replicated or global) (default "replicated")
      --mount mount                        Attach a filesystem mount to the service
      --name string                        Service name
```

- Reference: https://docs.docker.com/engine/reference/commandline/service_create/

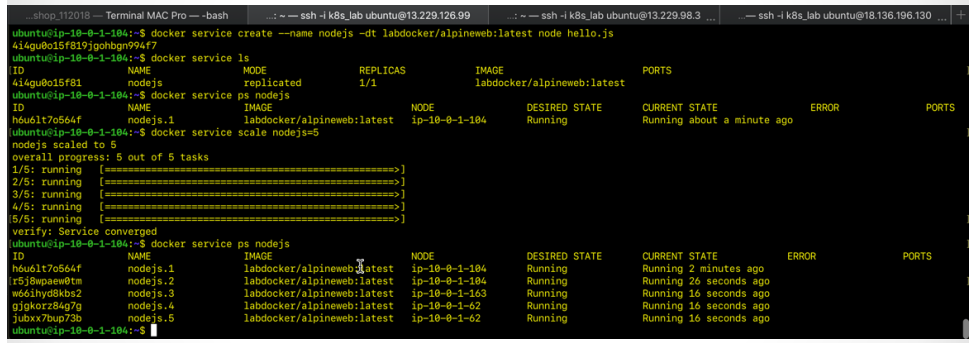
Swarm Service

```
      --name string                        Service name
      --network network                    Network attachments
      --no-healthcheck                     Disable any container-specified HEALTHCHECK
      --no-resolve-image                   Do not query the registry to resolve image digest and supported platforms
      --placement-pref pref                Add a placement preference
  -p, --publish port                       Publish a port as a node port
  -q, --quiet                              Suppress progress output
      --read-only                          Mount the container's root filesystem as read only
      --replicas uint                      Number of tasks
      --reserve-cpu decimal                Reserve CPUs
      --reserve-memory bytes               Reserve Memory
      --restart-condition string           Restart when condition is met ("none"|"on-failure"|"any") (default "any")
      --restart-delay duration             Delay between restart attempts (ns|us|ms|s|m|h) (default 5s)
      --restart-max-attempts uint          Maximum number of restarts before giving up
      --restart-window duration            Window used to evaluate the restart policy (ns|us|ms|s|m|h)
      --rollback-delay duration            Delay between task rollbacks (ns|us|ms|s|m|h) (default 0s)
      --rollback-failure-action string     Action on rollback failure ("pause"|"continue") (default "pause")
      --rollback-max-failure-ratio float   Failure rate to tolerate during a rollback (default 0)
      --rollback-monitor duration          Duration after each task rollback to monitor for failure (ns|us|ms|s|m|h) (default 5s)
      --rollback-order string              Rollback order ("start-first"|"stop-first") (default "stop-first")
      --rollback-parallelism uint          Maximum number of tasks rolled back simultaneously (0 to roll back all at once) (default 1)
      --secret secret                      Specify secrets to expose to the service
      --stop-grace-period duration         Time to wait before force killing a container (ns|us|ms|s|m|h) (default 10s)
      --stop-signal string                 Signal to stop the container
  -t, --tty                                Allocate a pseudo-TTY
      --update-delay duration              Delay between updates (ns|us|ms|s|m|h) (default 0s)
      --update-failure-action string       Action on update failure ("pause"|"continue"|"rollback") (default "pause")
      --update-max-failure-ratio float     Failure rate to tolerate during an update (default 0)
      --update-monitor duration            Duration after each task update to monitor for failure (ns|us|ms|s|m|h) (default 5s)
      --update-order string                Update order ("start-first"|"stop-first") (default "stop-first")
      --update-parallelism uint            Maximum number of tasks updated simultaneously (0 to update all at once) (default 1)
  -u, --user string                        Username or UID (format: <name|uid>[:<group|gid>])
      --with-registry-auth                 Send registry authentication details to swarm agents
  -w, --workdir string                     Working directory inside the container
```

- Reference: https://docs.docker.com/engine/reference/commandline/service_create/

Swarm Service

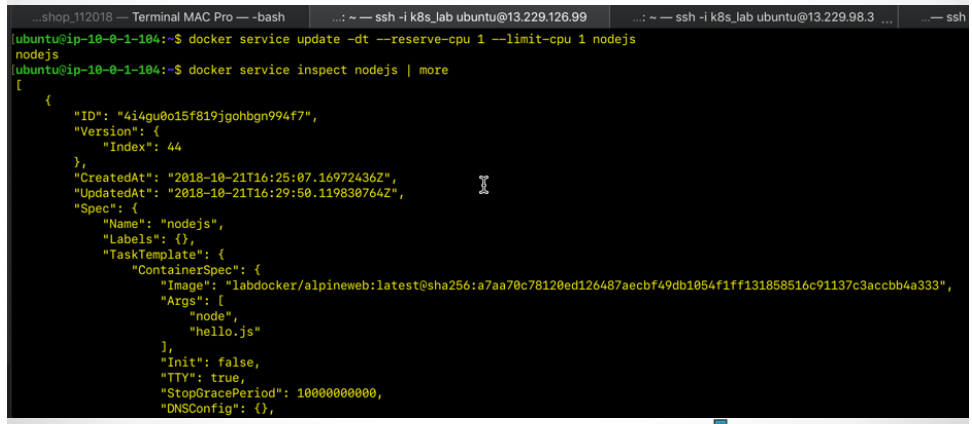
docker service scale nodejs=5



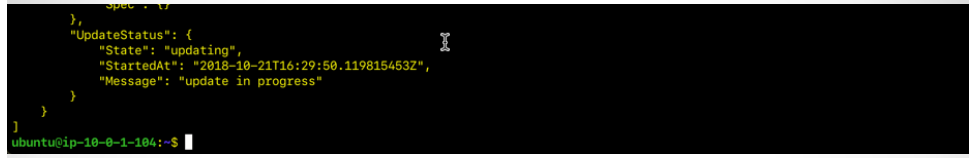
Swarm Service

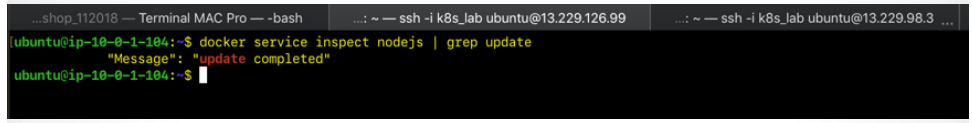
docker service update -dt --reserve-cpu 1 --limit-cpu 1 nodejs

docker service inspect nodejs | more



Swarm Service

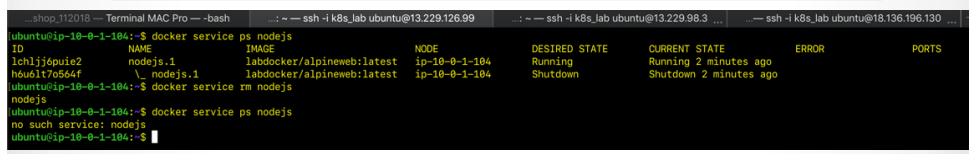




Swarm Service

docker service ps nodejs

docker service rm nodejs



Swarm Service

```
Usage:  docker service update [OPTIONS] SERVICE

Update a service

Options:
      --args command                     Service command args
      --config-add config                Add or update a config file on a service
      --config-rm list                   Remove a configuration file
      --constraint-add list              Add or update a placement constraint
      --constraint-rm list               Remove a constraint
      --container-label-add list         Add or update a container label
      --container-label-rm list          Remove a container label by its key
      --credential-spec credential-spec  Credential spec for managed service account (Windows only)
  -d, --detach                           Exit immediately instead of waiting for the service to converge (default true)
      --dns-add list                     Add or update a custom DNS server
      --dns-option-add list              Add or update a DNS option
      --dns-option-rm list               Remove a DNS option
      --dns-rm list                      Remove a custom DNS server
      --dns-search-add list              Add or update a custom DNS search domain
      --dns-search-rm list               Remove a DNS search domain
      --endpoint-mode string             Endpoint mode (vip or dnsrr)
      --entrypoint command               Overwrite the default ENTRYPOINT of the image
      --env-add list                     Add or update an environment variable
      --env-rm list                      Remove an environment variable
      --force                            Force update even if no changes require it
      --group-add list                   Add an additional supplementary user group to the container
      --group-rm list                    Remove a previously added supplementary user group from the container
      --health-cmd string                Command to run to check health
```

- Reference: https://docs.docker.com/engine/reference/commandline/service_update/

Swarm Service

```
      --health-interval duration         Time between running the check (ms|s|m|h)
      --health-retries int               Consecutive failures needed to report unhealthy
      --health-start-period duration     Start period for the container to initialize before counting retries towards unstable (ms|s|m|h)
      --health-timeout duration          Maximum time to allow one check to run (ms|s|m|h)
      --help                             Print usage
      --host-add list                    Add or update a custom host-to-IP mapping (host:ip)
      --host-rm list                     Remove a custom host-to-IP mapping (host:ip)
      --hostname string                  Container hostname
      --image string                     Service image tag
      --label-add list                   Add or update a service label
      --label-rm list                    Remove a label by its key
      --limit-cpu decimal                Limit CPUs
      --limit-memory bytes               Limit Memory
      --log-driver string                Logging driver for service
      --log-opt list                     Logging driver options
      --mount-add mount                  Add or update a mount on a service
      --mount-rm list                    Remove a mount by its target path
      --network-add network              Add a network
      --network-rm list                  Remove a network
      --no-healthcheck                   Disable any container-specified HEALTHCHECK
      --no-resolve-image                 Do not query the registry to resolve image digest and supported platforms
      --placement-pref-add pref          Add a placement preference
      --placement-pref-rm pref           Remove a placement preference
      --publish-add port                 Add or update a published port
      --publish-rm port                  Remove a published port by its target port
  -q, --quiet                            Suppress progress output
      --read-only                        Mount the container's root filesystem as read only
      --replicas uint                    Number of tasks
      --reserve-cpu decimal              Reserve CPUs
      --reserve-memory bytes             Reserve Memory
```

- Reference: https://docs.docker.com/engine/reference/commandline/service_update/

Swarm Service

```
    --read-only                         Mount the container's root filesystem as read only
    --replicas uint                     Number of tasks
    --reserve-cpu decimal               Reserve CPUs
    --reserve-memory bytes              Reserve Memory
    --restart-condition string          Restart when condition is met ("none"|"on-failure"|"any")
    --restart-delay duration            Delay between restart attempts (ns|us|ms|s|m|h)
    --restart-max-attempts uint         Maximum number of restarts before giving up
    --restart-window duration           Window used to evaluate the restart policy (ns|us|ms|s|m|h)
    --rollback                          Rollback to previous specification
    --rollback-delay duration           Delay between task rollbacks (ns|us|ms|s|m|h)
    --rollback-failure-action string    Action on rollback failure ("pause"|"continue")
    --rollback-max-failure-ratio float  Failure rate to tolerate during a rollback
    --rollback-monitor duration         Duration after each task rollback to monitor for failure (ns|us|ms|s|m|h)
    --rollback-order string             Rollback order ("start-first"|"stop-first")
    --rollback-parallelism uint         Maximum number of tasks rolled back simultaneously (0 to roll back all at once)
    --secret-add secret                 Add or update a secret on a service
    --secret-rm list                    Remove a secret
    --stop-grace-period duration        Time to wait before force killing a container (ns|us|ms|s|m|h)
    --stop-signal string                Signal to stop the container
-t, --tty                               Allocate a pseudo-TTY
    --update-delay duration             Delay between updates (ns|us|ms|s|m|h)
    --update-failure-action string      Action on update failure ("pause"|"continue"|"rollback")
    --update-max-failure-ratio float    Failure rate to tolerate during an update
    --update-monitor duration           Duration after each task update to monitor for failure (ns|us|ms|s|m|h)
    --update-order string               Update order ("start-first"|"stop-first")
    --update-parallelism uint           Maximum number of tasks updated simultaneously (0 to update all at once)
-u, --user string                       Username or UID (format: <name|uid>[:<group|gid>])
    --with-registry-auth                Send registry authentication details to swarm agents
-w, --workdir string                    Working directory inside the container
```

- Reference: https://docs.docker.com/engine/reference/commandline/service_update/

Workshop: Swarm Service

- สร้าง service nodejs เพื่อเริ่มทำงานบน swarm

```
docker service create -dt --name nodejs \
labdocker/alpineweb:latest node hello.js
```

- ตรวจสอบสถานะของ service หลังจากการสร้าง

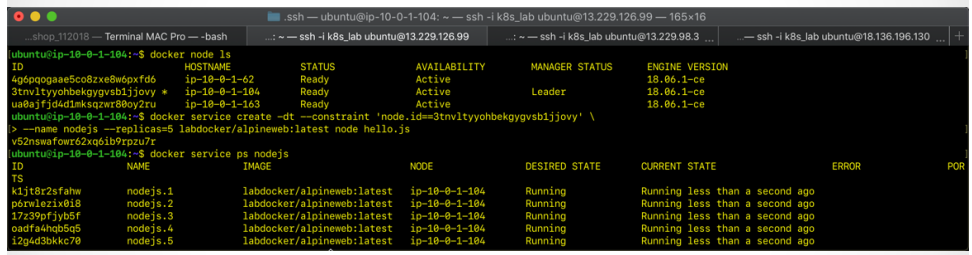
```
docker service ls
docker service ps nodejs
```

Orchestrator Assignment

- Swarm สามารถควบคุมการจ่ายงานให้จาก manager ไปยัง workerได้หลากหลายเทคนิค เพื่อตอบสนองความต้องการของผู้ใช้งาน
- Docker stack deploy (Compose version 3.4)
  - Replicated (Specific number of container by manual)
  - Global (1 container per node in swarm)
- Assign by default node constrain (--constrain)
  - node.id
  - node.hostname
  - node.role
  - node.labels (user define label)
  - engine.labels
- Assign by service placement preference (--placement-pref)
  - Spread on node.label (user define label)

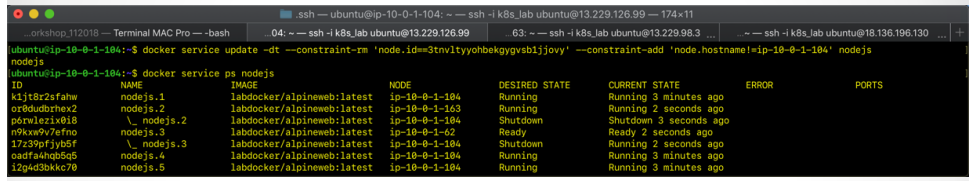
Orchestrator Assignment

- node constrain
  - Running with constrain with node
  - node.id



Orchestrator Assignment

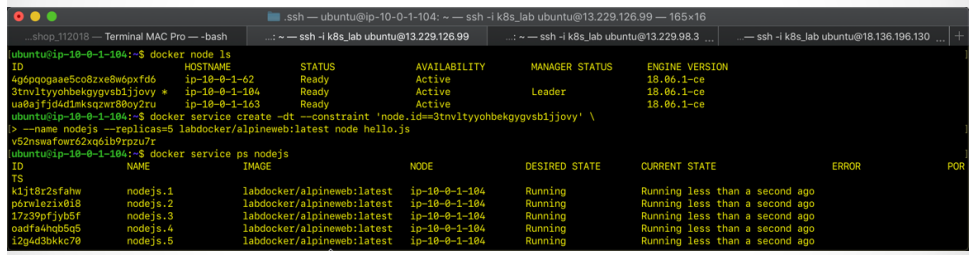
- Remove constrain/Add constrain
  - node.hostname



Workshop: node constrain

- สร้าง service nodejs เพื่อเริ่มทำงานบน swarm

```
docker service create -dt --constraint
'node.id==6bei4mbj5pd7yduyhp375b7z4' --name nodejs --
replicas=5 labdocker/alpineweb:latest node hello.js
```

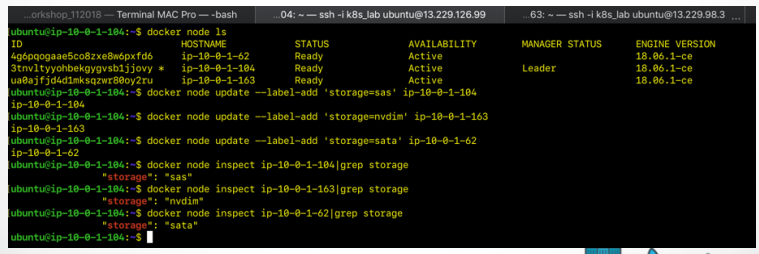


Orchestrator Assignment

- node constrain (custom label)

```
docker node update --label-add 'storage=sas' swarm-mng
docker node update --label-add 'storage=nvdimm' swarm-node1
docker node update --label-add 'storage=sata' swarm-node2
```

```
docker node inspect swarm-mng|grep storage
docker node inspect swarm-node1|grep storage
docker node inspect swarm-node2|grep storage
```

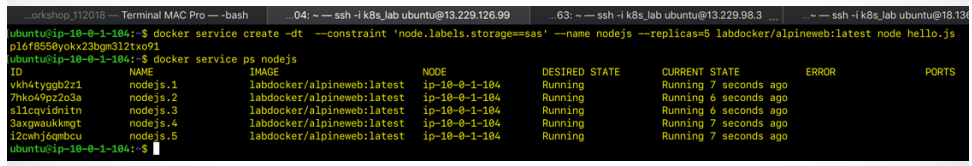


Orchestrator Assignment

- custom label

```
docker service create --name xxx --add-label 'xxx=xxx'
```

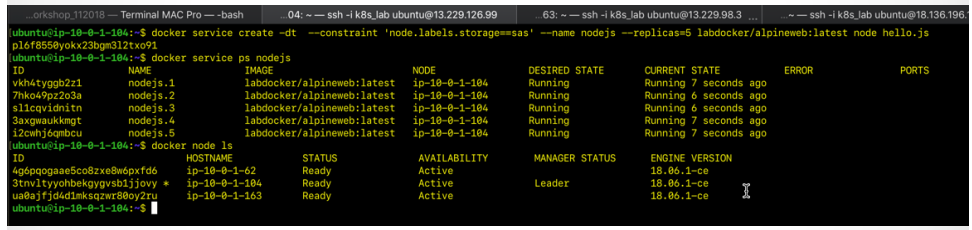
```
docker service create -dt --constraint 'node.labels.storage==sas' --
name nodejs --replicas=5 labdocker/alpineweb:latest node hello.js
```



Workshop: custom label

- สร้าง docker service โดยระบุ constrain จาก custom label ที่สร้างขึ้น

```
docker service create -dt  --constraint
'node.labels.storage==sas' --name nodejs --replicas=5
labdocker/alpineweb:latest node hello.js
```

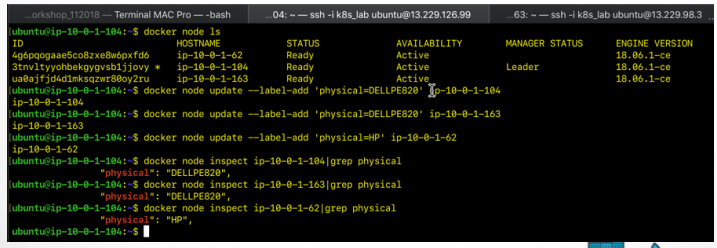


Orchestrator Assignment

- service placement preference (--placement-pref)

```
docker node update --label-add 'physical=DELLPE820' swarm-mng
docker node update --label-add 'physical=DELLPE820' swarm-node1
docker node update --label-add 'physical=HP' swarm-node2
```

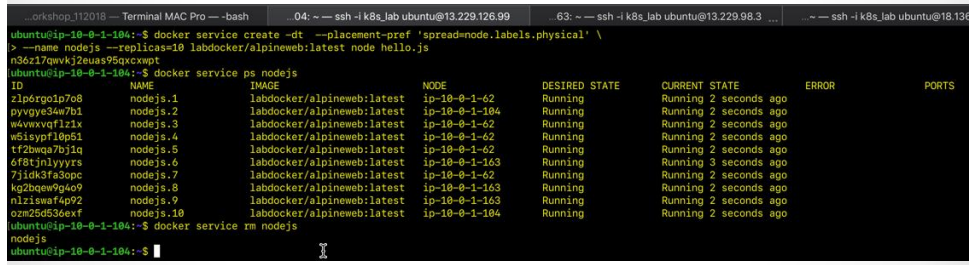
```
docker node inspect swarm-mng|grep physical
docker node inspect swarm-node1|grep physical
docker node inspect swarm-node2|grep physical
```



Orchestrator Assignment

- service placement preference

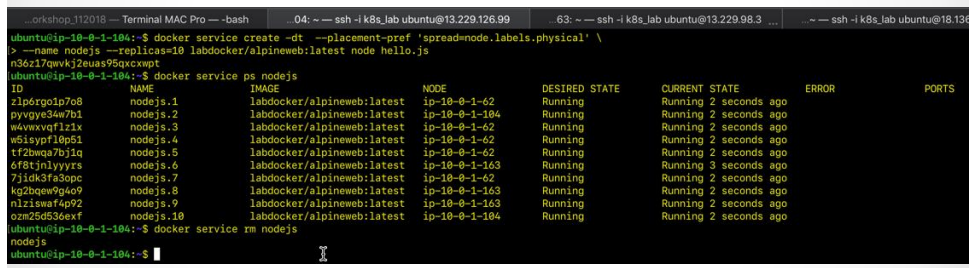
```
docker service create -dt --placement-pref 'spread=node.labels.physical' \
--name nodejs --replicas=10 labdocker/alpineweb:latest node hello.js
```



Workshop: Orchestrator

- สร้าง docker service โดยระบุใน swarm กระจายภายใต้ label

```
docker service create -dt --placement-pref
'spread=node.labels.physical' \
--name nodejs --replicas=10 labdocker/alpineweb:latest node hello.js
```



Config and Secret

- Make secret data and configuration great again !
- การทำงานของ microservice ที่รวมกันเป็น application stack จะมีส่วนของข้อมูลคอนฟิกต่าง ๆที่จำเป็นต้องใช้งานในระบบ เช่น
  - Root password of database
  - Environment variable
  - Custom variable
  - Path of mount volume data
  - Etc
- docker config จะใช้เพื่อจัดเก็บข้อมูลคอนฟิกต่าง ๆของ container
- docker secret ใช้จัดเก็บข้อมูลที่เป็นความลับโดยการเข้ารหัสข้อมูล

Config and Secret

- config can add/update with service anytime
  - Linux container: /<config name>
  - Windows container: c:\<config name>

```
echo "config value" | docker config create <config name> -
```

```
docker config create <config name> <config file>
```

```
docker config rm <config name>
```

- Apply config to service

```
docker service <create --config /update --config-add> \
source=<config name>,target=<path to map config>
```

```
docker service <rm/ --config-rm> <config name>
```


Config and Secret

- secret is all same as configure except that secret is encrypt all data (encode base64)
  - Linux container: /run/secrets/<secret name>
  - Windows container: c:\ProgramData\Docker\Secret

```
echo "config value" | docker secret create <secret name> -
```

```
docker secret create <secret name> <secret file>
```

```
docker secret rm <secret name>
```

- Apply config to service

```
docker service <create --secret/update --secret-add> <secret name>
```

```
docker service <rm/update --secret-rm> source=<secret name>
```


Workshop: Config and Secret

- สร้าง nginx service เพื่อรองรับการให้บริการ https (TLS 1.2) ผ่าน config and secret

```
docker config create nginx.conf /Share_DockerToolbox/nginx.conf
```

```
docker secret create labdocker.com.crt \
/Share_DockerToolbox/labdocker.com.crt

docker secret create labdocker.com.key \
/Share_DockerToolbox/labdocker.com.key
```

```
...orkshop_112018 — Terminal MAC Pro — -bash   ...04: ~ — ssh -i k8s_lab ubuntu@13.229.126.99   ...63: ~ — ssh -i k8s_lab ubuntu@13.229.98.3 ...
[ubuntu@ip-10-0-1-104:~$ docker config create nginx.conf ~/docker_workshop_112018/Workshop-2-4-Swarm/nginx.conf
bni17w6tmbks3911ri3ryvvxz
[ubuntu@ip-10-0-1-104:~$ docker config ls
ID                          NAME                CREATED             UPDATED
bni17w6tmbks3911ri3ryvvxz   nginx.conf          3 seconds ago       3 seconds ago
ubuntu@ip-10-0-1-104:~$ docker secret create labdocker.com.crt ~/docker_workshop_112018/Workshop-2-4-Swarm/labdocker.com.crt
pt2dhhjiqroqd7gb6ig9bv62n
ubuntu@ip-10-0-1-104:~$ docker secret create labdocker.com.key ~/docker_workshop_112018/Workshop-2-4-Swarm/labdocker.com.key
nu11fusm2zbl8l5l12s8pe6nb
[ubuntu@ip-10-0-1-104:~$ docker secret ls
ID                          NAME                DRIVER              CREATED                 UPDATED
pt2dhhjiqroqd7gb6ig9bv62n   labdocker.com.crt                       Less than a second ago   Less than a second ago
nu11fusm2zbl8l5l12s8pe6nb   labdocker.com.key                       Less than a second ago   Less than a second ago
ubuntu@ip-10-0-1-104:~$ docker service create -dt \
```

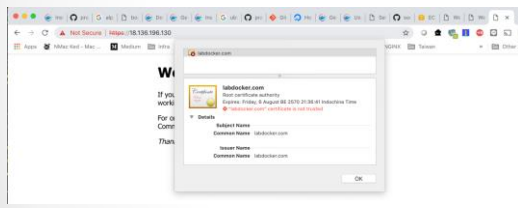

Workshop: Config and Secret

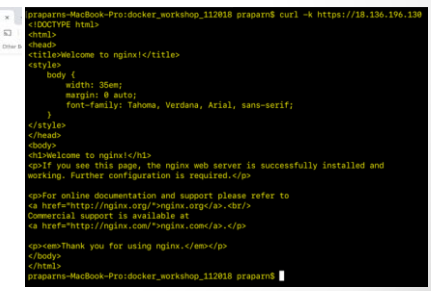
- nginx.conf

```
server {
listen 443 ssl;
server_name localhost;
ssl_certificate          /run/secrets/labdocker.com.crt;
ssl_certificate_key      /run/secrets/labdocker.com.key;
location / {
root /usr/share/nginx/html;
index index.html index.htm;
}
```


Workshop: Config and Secret

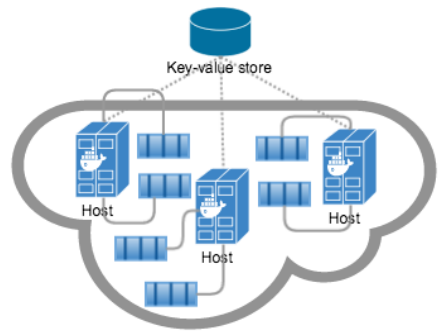
```
docker service -dt create \
--name nginx \
--secret labdocker.com.key \
--secret labdocker.com.crt \
--config source=nginx.conf,target=/etc/nginx/nginx.conf \
-p 443:443 labdocker/nginx:latest
```





Overlay and Ingress Network

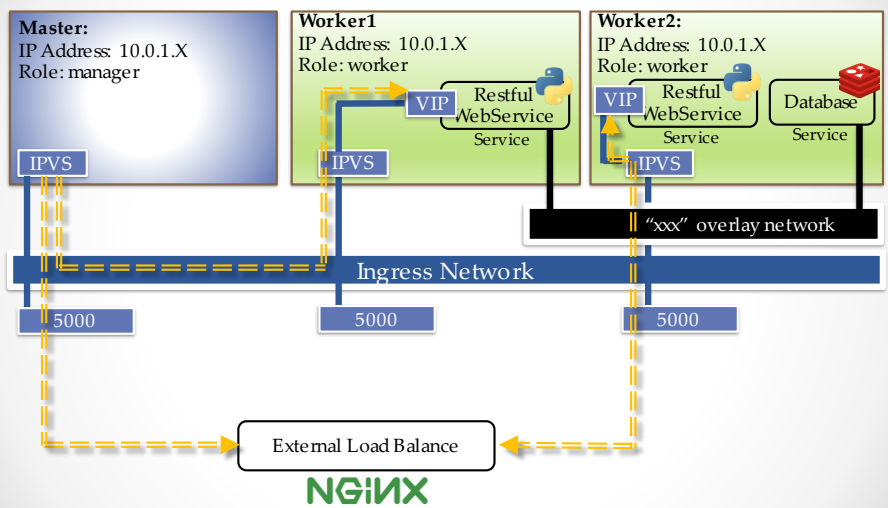
- เพื่อให้ทุกๆ node ภายใต้ swarm cluster สามารถมองเห็นกันได้ docker ได้เตรียมระบบ network แบบ overlay
- การทำงานของ overlay จะอาศัยกลไกของ key value store เป็นหลักในการตรวจสอบ (Discovery / Network status / IP Address etc)
- Default swarm จะสร้าง overlay network ชื่อ "ingress" เพื่อรองรับการใช้งาน service



Docker: The Next-Gen of Virtualization

337

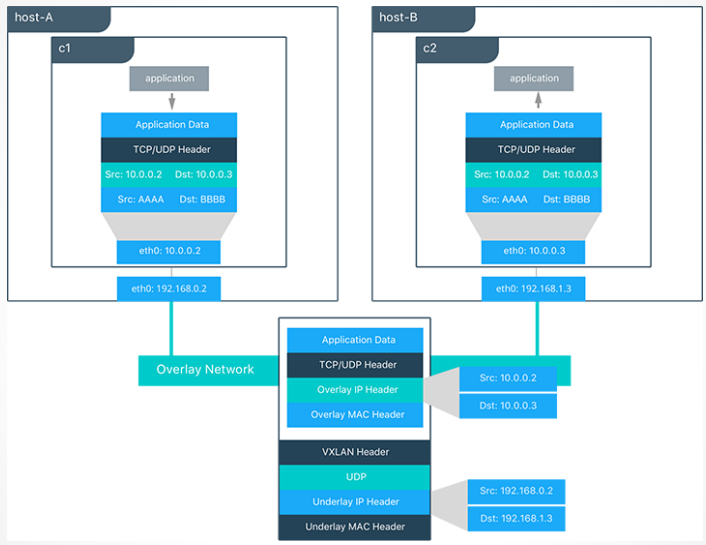
Overlay and Ingress Network



Docker: The Next-Gen of Virtualization

338

Overlay and Ingress Network



Workshop: Overlay and Ingress

- สร้าง overlay network บน swarm manager

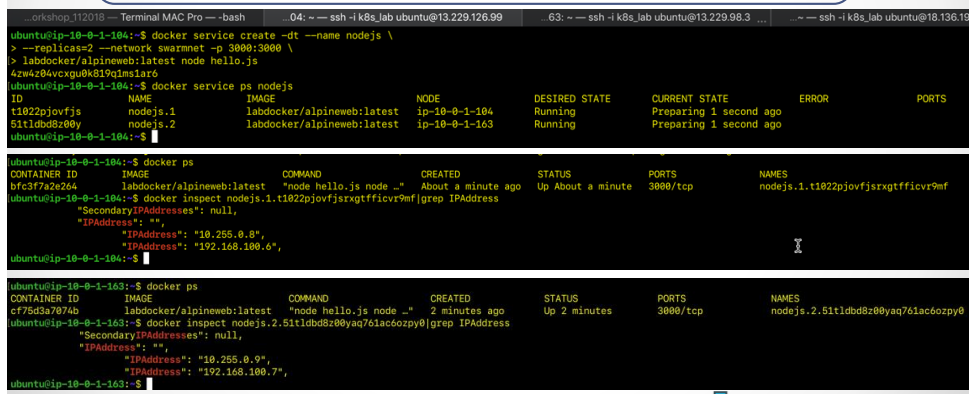
```
docker network create --driver overlay --
subnet=192.168.100.0/24 swarmnet
```

```
...orkshop_112018 — Terminal MAC Pro — -bash   ...04: ~ — ssh -i k8s_lab ubuntu@13.229.126.99   ...63: ~ — ssh -
ubuntu@ip-10-0-1-104:~$ docker network create --driver overlay --subnet=192.168.100.0/24 swarmnet
lwxhyfrildn83atwsqxdb9ior
ubuntu@ip-10-0-1-104:~$ docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
cdb776996466        bridge              bridge              local
7f907ae7a4c9        docker_gwbridge     bridge              local
d44f5d624dd1        host                host                local
hd63tliqe10s        ingress             overlay             swarm
a1ef67647608        none                null                local
lwxhyfrildn8        swarmnet            overlay             swarm
ubuntu@ip-10-0-1-104:~$
```

Workshop: Overlay and Ingress

- สร้าง new service เพื่อใช้งาน swarm network

```
docker service -dt create --name nodejs --replicas=2 --
network-add swarmnet -p 3000:3000
labdocker/alpineweb:latest node hello.js
```



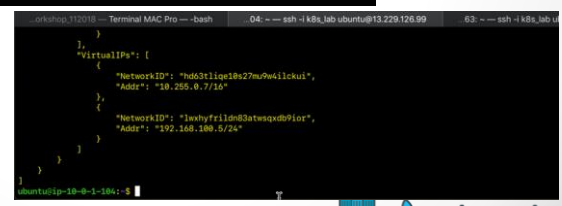
Docker: The Next-Gen of Virtualization

341

Workshop: Overlay and Ingress

- ตรวจสอบ IP Address ของ servcice และทดสอบ Ping ข้าม node

```
docker service inspect nodejs|more
```



Docker: The Next-Gen of Virtualization

342

Workshop: Overlay and Ingress

- ตรวจสอบ IP Address ของ service และทดสอบ Ping ข้าม node

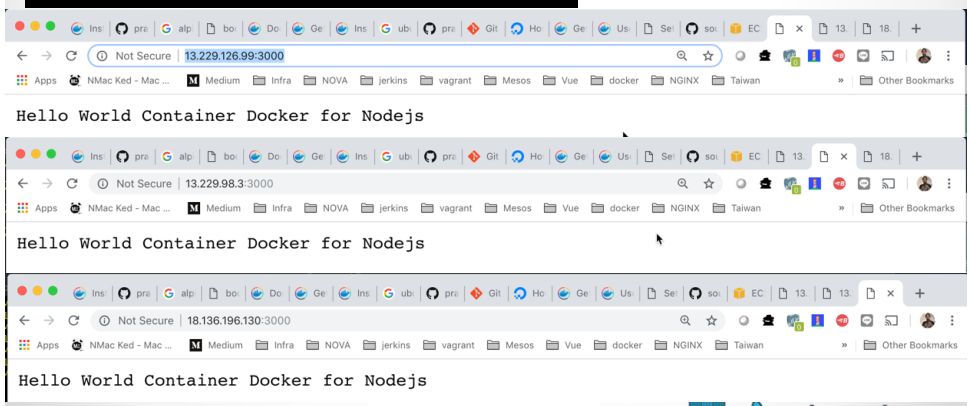
```
ubuntu@ip-10-0-1-104:~$ docker ps
CONTAINER ID        IMAGE                        COMMAND                  CREATED             STATUS              PORTS               NAMES
bfc3f7a2e264        labdocker/alpineweb:latest   "node hello.js node …"   4 minutes ago       Up 4 minutes        3000/tcp            nodejs.1.t1022pjovfjsrxgtfficvr9mf
ubuntu@ip-10-0-1-104:~$ docker exec -it nodejs.1.t1022pjovfjsrxgtfficvr9mf ping 192.168.100.5
PING 192.168.100.5 (192.168.100.5): 56 data bytes
64 bytes from 192.168.100.5: seq=0 ttl=64 time=0.116 ms
64 bytes from 192.168.100.5: seq=1 ttl=64 time=0.076 ms
^C
--- 192.168.100.5 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.076/0.096/0.116 ms
ubuntu@ip-10-0-1-104:~$ docker exec -it nodejs.1.t1022pjovfjsrxgtfficvr9mf ping 192.168.100.7
PING 192.168.100.7 (192.168.100.7): 56 data bytes
64 bytes from 192.168.100.7: seq=0 ttl=64 time=1.114 ms
64 bytes from 192.168.100.7: seq=1 ttl=64 time=0.226 ms
^C
--- 192.168.100.7 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.226/0.670/1.114 ms
ubuntu@ip-10-0-1-104:~$
```

```
ubuntu@ip-10-0-1-163:~$ docker ps
CONTAINER ID        IMAGE                        COMMAND                  CREATED             STATUS              PORTS               NAMES
cf75d3a7074b        labdocker/alpineweb:latest   "node hello.js node …"   7 minutes ago       Up 7 minutes        3000/tcp            nodejs.2.51tldbd8z00yaq761ac6ozpy0
ubuntu@ip-10-0-1-163:~$ docker exec -it nodejs.2.51tldbd8z00yaq761ac6ozpy0 ping 192.168.100.5
PING 192.168.100.5 (192.168.100.5): 56 data bytes
64 bytes from 192.168.100.5: seq=0 ttl=64 time=0.100 ms
64 bytes from 192.168.100.5: seq=1 ttl=64 time=0.062 ms
^C
--- 192.168.100.5 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.062/0.081/0.100 ms
ubuntu@ip-10-0-1-163:~$ docker exec -it nodejs.2.51tldbd8z00yaq761ac6ozpy0 ping 192.168.100.6
PING 192.168.100.6 (192.168.100.6): 56 data bytes
64 bytes from 192.168.100.6: seq=0 ttl=64 time=0.244 ms
64 bytes from 192.168.100.6: seq=1 ttl=64 time=0.237 ms
^C
--- 192.168.100.6 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.237/0.240/0.244 ms
ubuntu@ip-10-0-1-163:~$
```


Workshop: Overlay and Ingress

- เรียกใช้บริการผ่าน http port ด้วย browser/curl

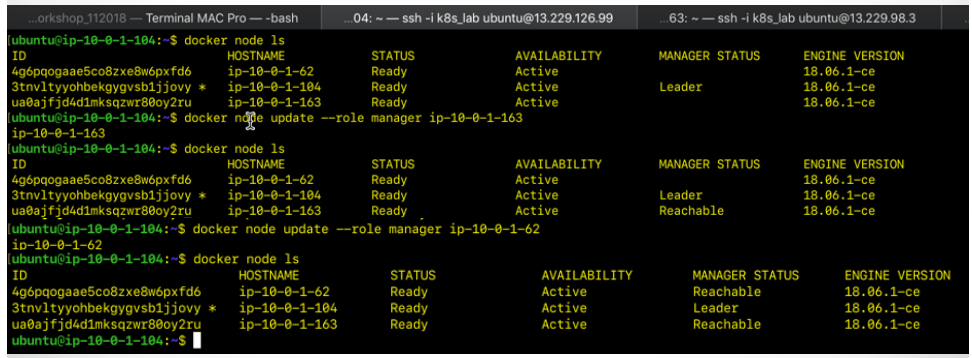
```
praparns-MacBook-Pro:docker_workshop_112018 praparn$ curl http://18.136.196.130:3000
Hello World Container Docker for Nodejs
praparns-MacBook-Pro:docker_workshop_112018 praparn$ curl http://13.229.126.99:3000
Hello World Container Docker for Nodejs
praparns-MacBook-Pro:docker_workshop_112018 praparn$ curl http://13.229.98.3:3000
Hello World Container Docker for Nodejs
praparns-MacBook-Pro:docker_workshop_112018 praparn$
```



HA Manager Role

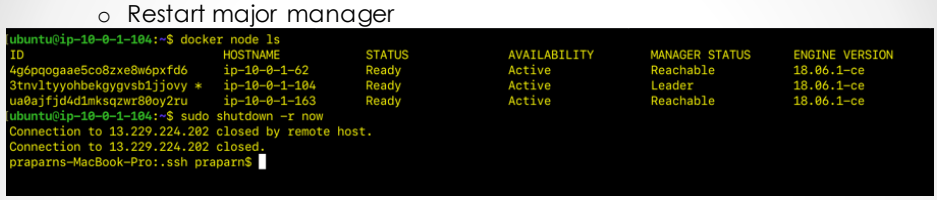
- Add redundancy swarm manager in swarm cluster
  - ทำการ change role node จาก worker ➔ manager

```
docker node update --role manager <node id>
```



HA Manager Role

- Add redundancy swarm manager in swarm cluster
  - Restart major manager



  - Other will take role for manager within 5 min.

HA Manager Role

- Remove
  - Update node to worker2 and set “Drain” to node

```
ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
4g6pqogaae5co8zxe8w6pxfd6     ip-10-0-1-62        Ready               Active              Reachable           18.06.1-ce
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-104:~$ docker node update --role worker ip-10-0-1-62
ip-10-0-1-62
ubuntu@ip-10-0-1-104:~$ docker node update --availability drain ip-10-0-1-62
ip-10-0-1-62
ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
4g6pqogaae5co8zxe8w6pxfd6     ip-10-0-1-62        Ready               Drain                                   18.06.1-ce
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-104:~$
```

  - Leave swarm on node “labdocker”

```
...orkshop_112018 — Terminal MAC Pro — -bash
ubuntu@ip-10-0-1-62:~$ docker swarm leave
Node left the swarm.
ubuntu@ip-10-0-1-62:~$

ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
4g6pqogaae5co8zxe8w6pxfd6     ip-10-0-1-62        Down                Drain                                   18.06.1-ce
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-104:~$ docker node rm ip-10-0-1-62
ip-10-0-1-62
ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-104:~$
```


HA Manager Role

- Add redundancy swarm manager in swarm cluster
  - ทำการ join node เข้าไปเป็น manager swarm cluster ด้วยคำสั่ง

```
docker swarm join --ca-hash <hash> <ip of swarm manager:port>
```

```
...orkshop_112018 — Terminal MAC Pro — -bash   ...4: ~ — ssh -i k8s_lab ubuntu@13.229.224.202   ...63: ~ — ssh -i k8s_lab ubuntu@13.229.98.3   ...~ — ssh -i k8s_lab ubuntu@18.136.196
ubuntu@ip-10-0-1-62:~$ docker swarm leave
Node left the swarm.
ubuntu@ip-10-0-1-62:~$ docker swarm join --token SWMTKN-1-1qnpobqw0hilpc5i90sz803tlhyi1h4k84uok10y814bvhyqf2-3u9rqxfwhbhw52qwqeeiewybl 10.0.1.104:2377
This node joined a swarm as a manager.
ubuntu@ip-10-0-1-62:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
mydkcrgwkurxyjjb1kf14od17 *   ip-10-0-1-62        Ready               Active              Reachable           18.06.1-ce
3tnvltyyohbekgygvsb1jjovy     ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-62:~$
```

  - ตรวจสอบค่า token เพื่อ join swarm

```
ubuntu@ip-10-0-1-62:~$ docker swarm join-token manager
To add a manager to this swarm, run the following command:

    docker swarm join --token SWMTKN-1-1qnpobqw0hilpc5i90sz803tlhyi1h4k84uok10y814bvhyqf2-3u9rqxfwhbhw52qwqeeiewybl 10.0.1.62:2377

ubuntu@ip-10-0-1-62:~$
```


Workshop: HA Manager Role

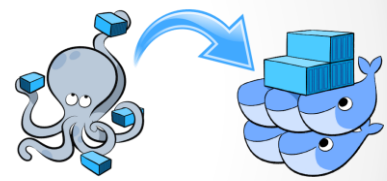
- ทำการ join new manager เข้าสู่ swarm cluster/update/drain

```
ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
4g6pqogaae5co8zxe8w6pxfd6     ip-10-0-1-62        Ready               Active              Reachable           18.06.1-ce
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Leader              18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Reachable           18.06.1-ce
ubuntu@ip-10-0-1-104:~$
```

```
ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
4g6pqogaae5co8zxe8w6pxfd6     ip-10-0-1-62        Ready               Active              Reachable           18.06.1-ce
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-104:~$ docker node update --role worker ip-10-0-1-62
ip-10-0-1-62
ubuntu@ip-10-0-1-104:~$ docker node update --availability drain ip-10-0-1-62
ip-10-0-1-62
ubuntu@ip-10-0-1-104:~$ docker node ls
ID                            HOSTNAME            STATUS              AVAILABILITY        MANAGER STATUS      ENGINE VERSION
4g6pqogaae5co8zxe8w6pxfd6     ip-10-0-1-62        Ready               Drain                                   18.06.1-ce
3tnvltyyohbekgygvsb1jjovy *   ip-10-0-1-104       Ready               Active              Reachable           18.06.1-ce
ua0ajfjd4d1mksqzwr80oy2ru     ip-10-0-1-163       Ready               Active              Leader              18.06.1-ce
ubuntu@ip-10-0-1-104:~$
```

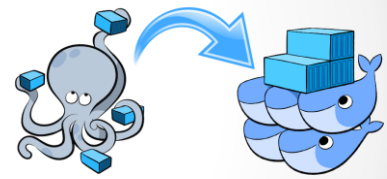

Docker Stack Deploy (Compose)

- Compose syntax: (docker stack deploy)
  - services:
    - XXX (service name): (Current Version 3.3)
      - image: <image name>
      - **deploy: <SWARM>**
        - mode
          - global
          - replicated
        - resource:
          - limits:
            - cpus: 'X.X'
            - memory: XXXM
          - reservations:
            - cpus: 'X.X'
            - memory: 2=XXM
        - restart_policy:
          - condition: on-failure/any
          - delay: XXs
          - max_attempts: X
          - windows: XXs
        - update_config:
          - parallelism: X
          - delay: XXs
          - failure_action: Xms
          - max_failure_ratio: X



Docker Stack Deploy (Compose)

- Not support for docker stack deploy
  - build
  - cgroup_parent
  - container_name
  - devices
  - dns
  - dns_search
  - tmpfs
  - external_links
  - links
  - network_mode
  - security_opt
  - stop_signal
  - sysctls
  - userns_mode



Docker Stack Deploy (Compose)

- Compose syntax: (docker stack deploy)

```
docker stack deploy –c <compose file> <stack name>
```

```
docker stack ls
```

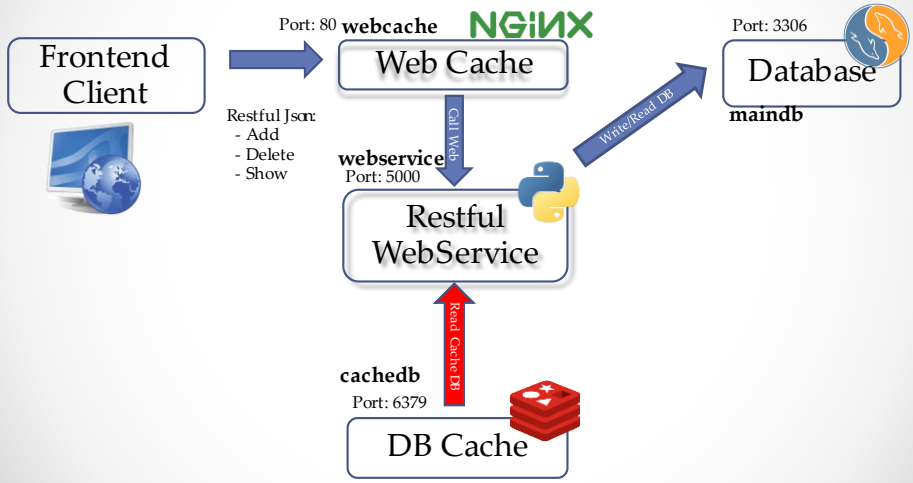
```
docker stack ps <stack name>
```

```
docker stack services <stack name>
```

```
docker stack rm <stack name>
```

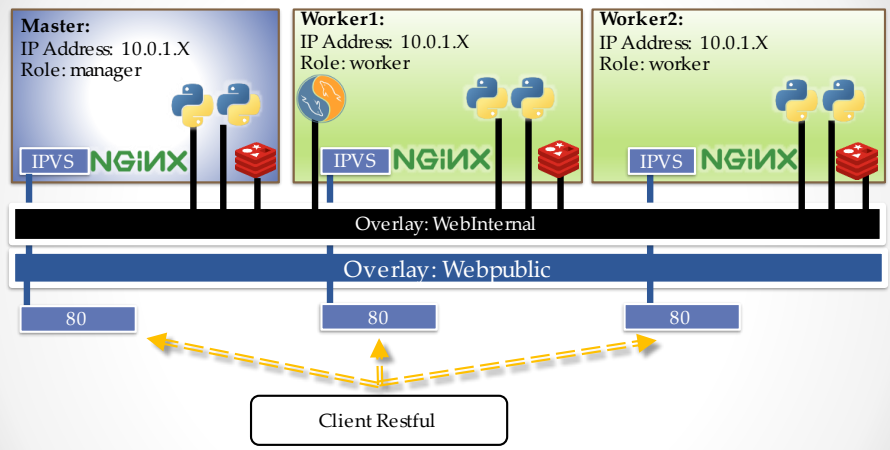

Workshop: Swarm Compose

- Optimize for WorkLoad



Docker: The Next-Gen of Virtualization

Workshop: Swarm Compose



Docker: The Next-Gen of Virtualization

Workshop: Swarm Compose

```yaml
version: '3.3'
services:
  webcache:
    image: labdocker/cluster:webcache
    container_name: nginx
    deploy:
      mode: global
      update_config:
        parallelism: 1
        delay: 10s
      restart_policy:
        condition: on-failure
        delay: 30s
        max_attempts: 5
        window: 60s
      endpoint_mode: vip
    depends_on:
      - webservice
      - cachedb
      - maindb
    networks:
      webpublic:
        aliases:
        - webcache
      webinternal:
        aliases:
        - webcache
    ports:
      - "80:80"

  webservice:
    image: labdocker/cluster:webservice
    container_name: webservice
    deploy:
      mode: replicated
      replicas: 6
      update_config:
        parallelism: 2
        delay: 10s
      restart_policy:
        condition: on-failure
        delay: 30s
        max_attempts: 3
        window: 60s
      endpoint_mode: vip
    depends_on:
      - cachedb
      - maindb
    networks:
      webinternal:
        aliases:
        - webservice
    ports:
      - "5000:5000"
```


Workshop: Swarm Compose

```yaml
  maindb:
    image: labdocker/mariadb:latest
    container_name: maindb
    deploy:
      mode: replicated
      replicas: 1
      endpoint_mode: vip
    environment:
      - MYSQL_ROOT_PASSWORD=password
    networks:
      webinternal:
        aliases:
        - maindb

  cachedb:
    image: labdocker/redis:latest
    container_name: cachedb
    deploy:
      mode: global
      endpoint_mode: vip
    networks:
      webinternal:
        aliases:
        - cachedb

networks:
    webpublic:
      driver: overlay
      ipam:
        driver: default
        config:
        - subnet: 192.168.100.0/24
    webinternal:
      driver: overlay
      ipam:
        driver: default
        config:
        - subnet: 192.168.101.0/24
```


Workshop: Swarm Compose

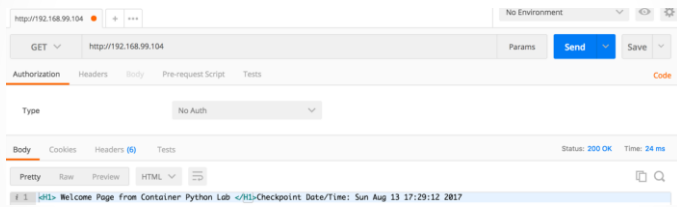
```
ubuntu@ip-10-0-1-104:~/docker_workshop_112018/Workshop-2-4-Swarm/python_restfulset$ docker stack deploy -c docker-compose_swarm.yml webservice
Ignoring deprecated options:

container_name: Setting the container name is not supported.

Creating network webservice_webpublic
Creating network webservice_webinternal
Creating service webservice_webcache
Creating service webservice_webservice
Creating service webservice_maindb
Creating service webservice_cachedb
ubuntu@ip-10-0-1-104:~/docker_workshop_112018/Workshop-2-4-Swarm/python_restfulset$
```


Workshop: Swarm Compose

```
docker@swarm-mng:/Share_DockerToolbox/python_restfulset$ docker stack ps webservice
ID                  NAME                                    IMAGE                                 NODE                DESIRED STATE       CURRENT STATE
       ERROR                       PORTS
mcj0ux4x25uv        webservice_webcache.wwzx60rvl5res39v0lxir2gfh   labdocker/cluster:webcache            swarm-node2         Running             Running 46 seconds ag
o
ol223n2c2htp        webservice_webcache.0k95omm28xfef22thummpz3uf   labdocker/cluster:webcache            swarm-mng           Running             Running 49 seconds ag
o
fj0qu565u8mt        webservice_webcache.q814dhi3bzl4sze4zmjpiy3qa   labdocker/cluster:webcache            swarm-node1         Running             Running 50 seconds ag
o
kw8oprgn8b3v        webservice_webcache.wwzx60rvl5res39v0lxir2gfh   labdocker/cluster:webcache            swarm-node2         Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
a4foun5hzks3        webservice_webcache.0k95omm28xfef22thummpz3uf   labdocker/cluster:webcache            swarm-mng           Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
horm2nocrzrvt        webservice_webcache.q814dhi3bzl4sze4zmjpiy3qa   labdocker/cluster:webcache            swarm-node1         Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
vhutisinb7np        webservice_webcache.wwzx60rvl5res39v0lxir2gfh   labdocker/cluster:webcache            swarm-node2         Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
ktjzx8thiq6k        webservice_webcache.q814dhi3bzl4sze4zmjpiy3qa   labdocker/cluster:webcache            swarm-node1         Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
7slaoo4hnvmh        webservice_webcache.0k95omm28xfef22thummpz3uf   labdocker/cluster:webcache            swarm-mng           Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
axdh6t2ua971        webservice_cachedb.wwzx60rvl5res39v0lxir2gfh    labdocker/redis:latest                swarm-node2         Running             Running about a minut
e ago
t8jc8aopm6wu        webservice_cachedb.q814dhi3bzl4sze4zmjpiy3qa    labdocker/redis:latest                swarm-node1         Running             Running about a minut
e ago
32d2fao3cjcu        webservice_cachedb.0k95omm28xfef22thummpz3uf    labdocker/redis:latest                swarm-mng           Running             Running about a minut
e ago
mtbhxlkuwjg7        webservice_webservice.1                 labdocker/cluster:webservice          swarm-node1         Running             Running 39 seconds ag
o
nw2jky8drn42         \_ webservice_webservice.1             labdocker/cluster:webservice          swarm-mng           Shutdown            Failed about a minute
 ago    "task: non-zero exit (1)"
ivhofu5u9kxe        webservice_maindb.1                     labdocker/mysql:latest                swarm-node2         Running             Running about a minut
```


Workshop: Swarm Compose

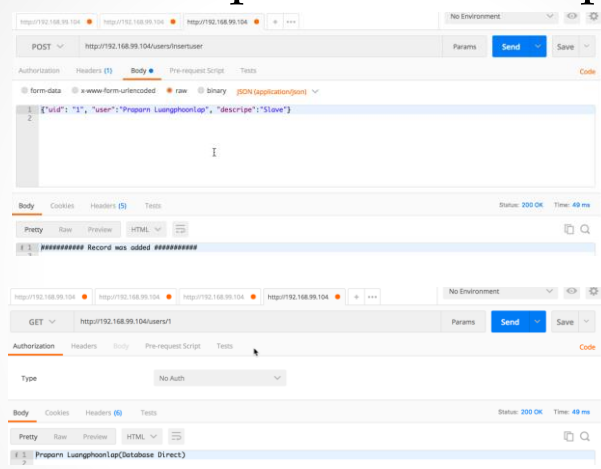
```
praparns-MacBook-Pro:~ praparn$ docker-machine ls
NAME          ACTIVE   DRIVER       STATE     URL                         SWARM   DOCKER        ERRORS
labdocker     -        virtualbox   Running   tcp://192.168.99.103:2376           Unknown       Unable to query docker version: Get https://192.168.99.103:2376/
v1.15/version: x509: certificate is valid for 192.168.99.100, not 192.168.99.103
swarm-mng     -        virtualbox   Running   tcp://192.168.99.104:2376           v17.06.0-ce
swarm-node1   -        virtualbox   Running   tcp://192.168.99.105:2376           v17.06.0-ce
swarm-node2   -        virtualbox   Running   tcp://192.168.99.106:2376           v17.06.0-ce
praparns-MacBook-Pro:~ praparn$ export Server_IP=192.168.99.104
praparns-MacBook-Pro:~ praparn$ curl http://$Server_IP:$Server_Port/
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Sun Aug 13 17:27:58 2017
```



Docker: The Next-Gen of Virtualization

359

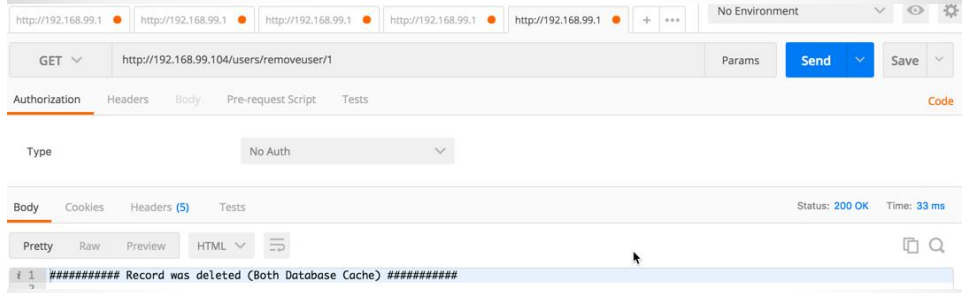
Workshop: Swarm Compose



Docker: The Next-Gen of Virtualization

360

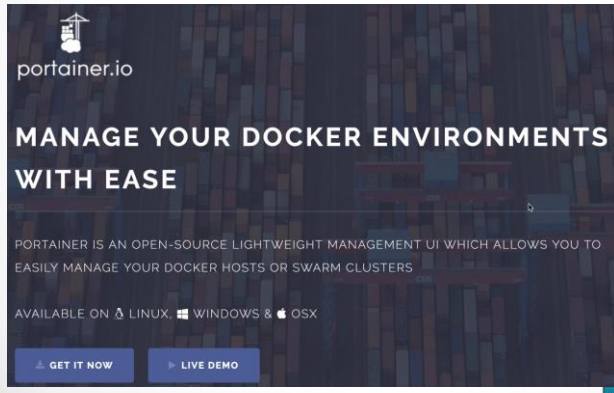
Workshop: Swarm Compose



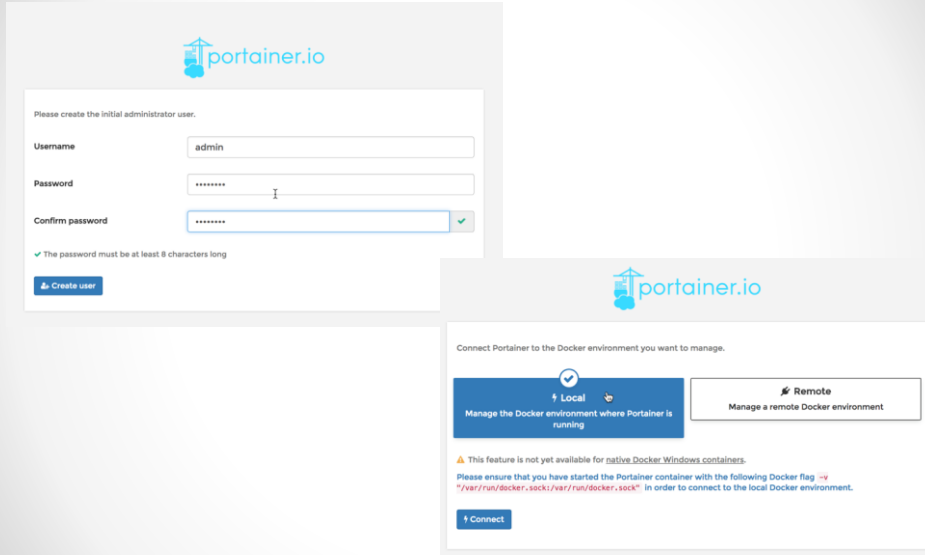
Portainer for Docker

portainer for Docker

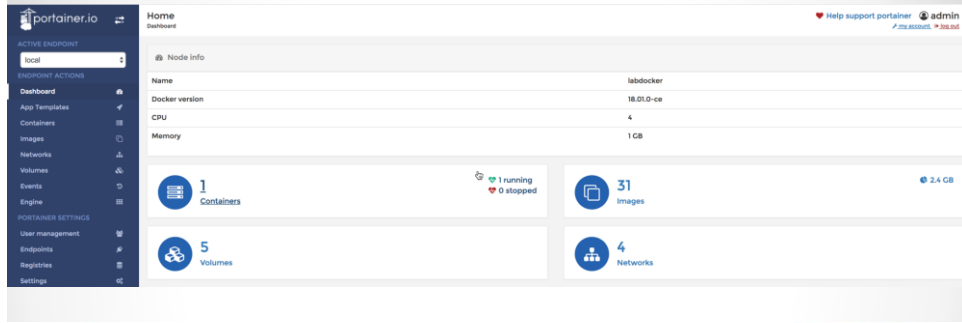
- portainer.io เป็น open source management ที่สามารถใช้บริหารจัดการ docker-machine ผ่านหน้า GUI web ได้อย่างมีประสิทธิภาพแบบ On premise
- การใช้งาน portainer จะใช้การบริหารจัดการผ่านหน้าเว็บ (x.x.x.x:9000)

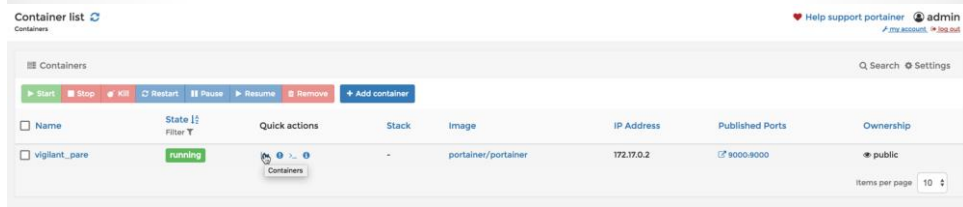


portainer for Docker



portainer for Docker

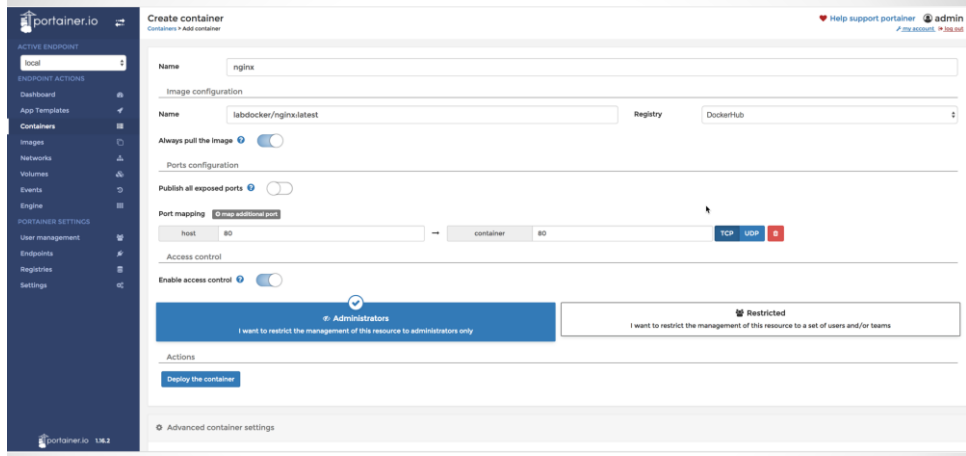




Docker: The Next-Gen of Virtualization

365

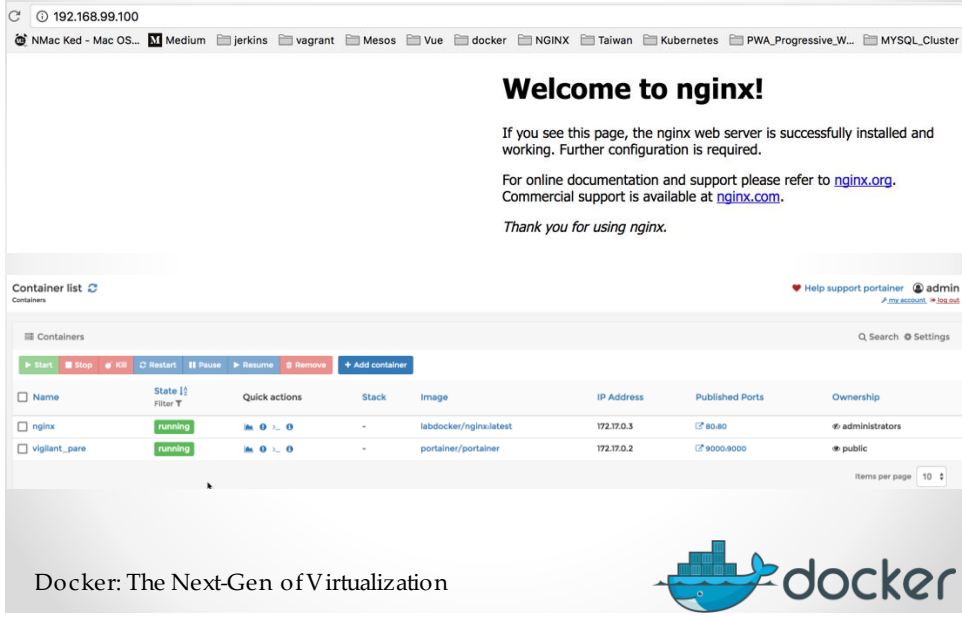
portainer for Docker



Docker: The Next-Gen of Virtualization

366

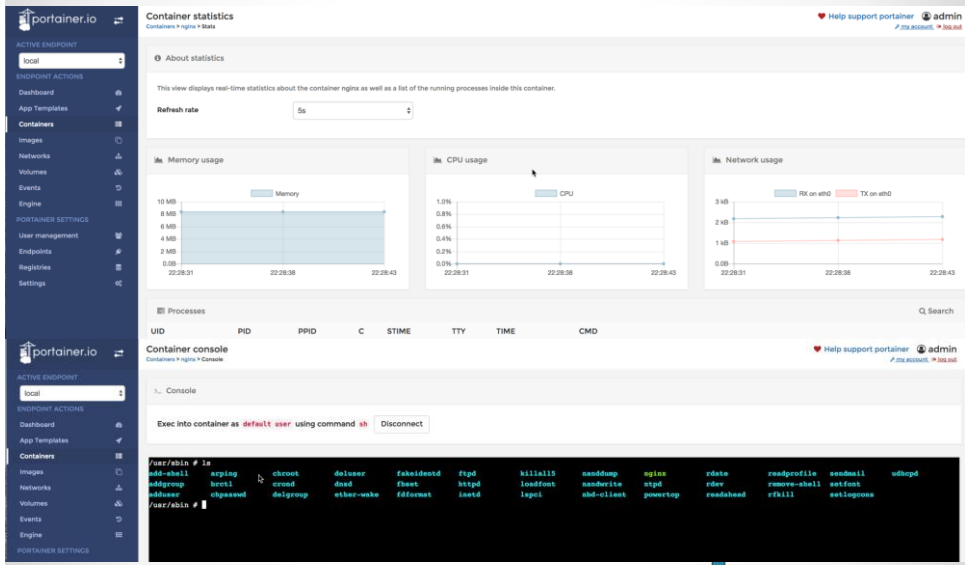
portainer for Docker



Docker: The Next-Gen of Virtualization

367

portainer for Docker



Docker: The Next-Gen of Virtualization

368

Recapture for Day 2

- Dockerfile and Build
- Compose
- Registry
- Swarm Mode
  - Conceptual of Swarm
  - Swarm Mode Architecture
  - Swarm init/join cluster system
  - Swarm service
  - Orchestrator Assignment
  - Config and Secret
  - Network Overlay and Ingress
  - HA Manager Role
  - Docker Stack Deploy (Compose Swarm Mode)
- portainer for Docker
- Q&A