DEVNET Create

Packaging Network Automations with Docker

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Greg has over 25 years of IT experience in networking, information security, collaboration, contact center, virtualization, cloud, and software development. As a evangelist of automation, Greg has delivered numerous talks on coding, NetDevOps, and software-defined everything.

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What Problems Are We Trying to Solve?

- Packaging
- Ensuring code dependencies, libraries, etc. are met (and that newer versions don't break something)
- Versioning
  - E.g. Python 2 vs Python 3, features being added and deprecated in Ansible, etc.
- OS compatibility
  - Tools like Ansible and Cisco Network Services Orchestrator do not run on Windows

What Is a Container?

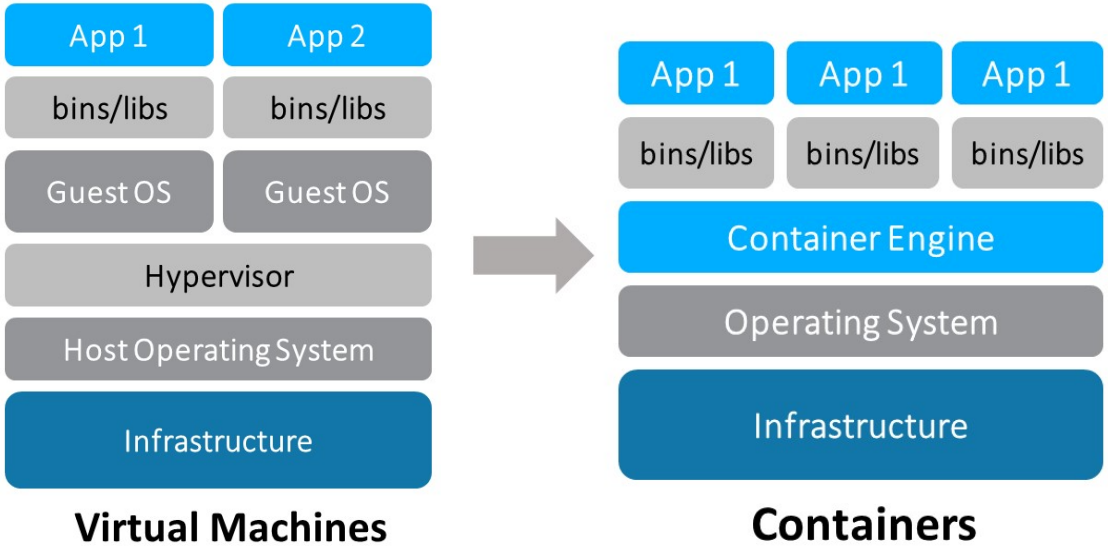


Image Source and Credits: https://rancher.com/playing-catch-docker-containers

Really, What Is a Container?

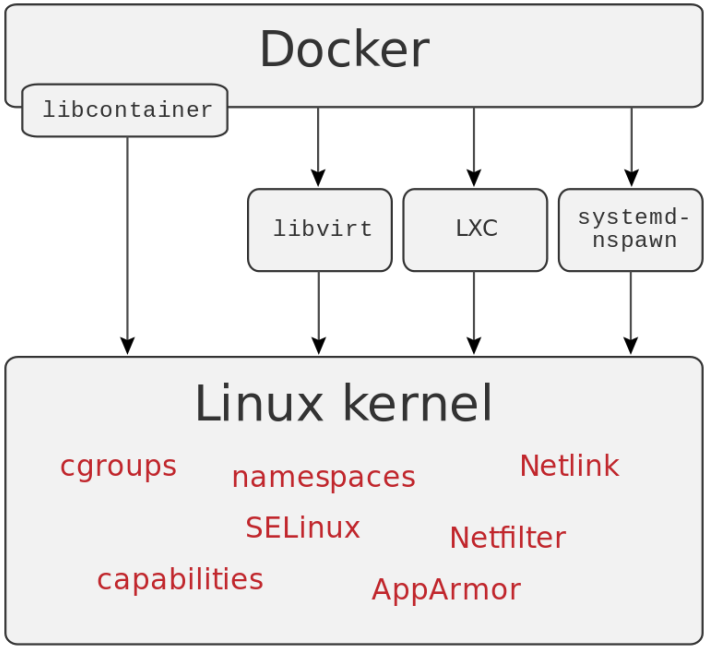


Image Source and Credits: https://delftswa.github.io/chapters/docker/

Docker on Windows and macOS

- Docker Desktop for Windows
  - Windows 10 64bit: Pro, Enterprise or Education
  - Linux VM runs on Hyper-V
- Docker Desktop for Mac
  - macOS Sierra 10.12 and newer
  - Linux VM runs on HyperKit
- Docker Toolbox for Windows / Mac
  - Linux VM runs on Oracle VirtualBox

Hello World

```
docker run hello-world
```

```
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
1b930d010525: Pull complete
Digest: sha256:2557e3c07ed1e38f26e389462d03ed943586f744621577a99efb77324b0fe535
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.
```

- What just happened?
  - Downloaded (pulled) the " hello-world:latest" image from Docker Hub
  - Created a new container from that image
  - Output from the container streamed to your terminal

Try Something More Ambitious

```
docker run -it ubuntu bash
```

```
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu
Digest: sha256:7a47ccc3bbe8a451b500d2b53104868b46d60ee8f5b35a24b41a86077c650210
Status: Downloaded newer image for ubuntu:latest
root@95afdbfda5c1:/#
```

- What just happened?
  - Downloaded (pulled) the " ubuntu:latest" image
  - Created a new container from that image
  - "`-it`" means "Interactive" and "tty"
- Type "exit" to exit bash, which causes the container to stop

Common Docker Commands

Show all containers, including stopped:

```
docker ps -a
```

Remove a stopped container:

```
docker rm <container id>
```

Show downloaded images:

```
docker images
```

Remove a downloaded image:

```
docker rmi <image>
```

Dockerfile

```
FROM ubuntu:bionic

RUN DEBIAN_FRONTEND=noninteractive apt-get -y update \
    && DEBIAN_FRONTEND=noninteractive apt-get -y install
fortune-mod fortunes cowsay

ENTRYPOINT /usr/games/fortune computers |
/usr/games/cowsay
```

Build an Image From a Dockerfile

```
$ git clone https://github.com/ganuzelli/Network_Automation_Docker.git
$ cd “Quotes example”
$ docker build –t quotes .

$ docker images
REPOSITORY    TAG       IMAGE ID      CREATED             SIZE
quotes        latest    40fa...       3 minutes ago 159MB
```

Other Common Dockerfile Instructions

```
# A comment
```

`ENTRYPOINT ["executable","param1","param2"]`

Preferred form for ENTRYPOINT

`COPY <src> <dst>`

Copies files from the host to the container image

`WORKDIR <dir>`

Set the current working directory within the image

Layers

- Certain Dockerfile instructions (e.g. RUN and COPY) result in the creation of a layer
- Use of Layers can speed builds/rebuilds and decrease the amount of data downloaded by docker pull
- But can also make the total image size bigger
- Consolidate your RUN / COPY lines to save space
- Separate RUN / COPY lines to build layers where beneficial

Volumes

- Map directories in the container to directories on your host
- Dockerfile syntax:

```
VOLUME /myvol
```

- Use to expose any database storage area, configuration storage, or files/folders created by your docker container
- Do not store persistent data in a container

Docker-compose.yml

```
version: "3.5"
services:
  my-automation:
    image: my-automation
    build:
      context: .
      dockerfile: Dockerfile
    volumes:
      - .:/data
    entrypoint: sh -c "python3 -u test.py"
```

Docker Compose Commands

`docker-compose build`

Builds the Docker image specified in the "build" section

`docker-compose run [--rm] my-automation`

Starts the container, and executes the "entrypoint" instruction (-rm means delete the container when done)

`docker-compose ps [-a]`

Shows running containers (-a means show stopped containers too)

`docker-compose rm`

Remove stopped containers

Docker Image Options

- Ubuntu, Centos, etc
  - Full featured
  - Ubuntu 18.04 and later images are now "slim"
- Alpine
  - Small footprint, small security surface area
- Official "purpose built" images from Docker Hub, e.g. "python", "ansible"

Exposing Network Ports

Expose TCP/UDP ports from your container with "-p"

```
docker run -p 8080:80 nginx
```

TCP port 8080 on your host maps to port 80 in the container

Network Ports in docker-compose.yml

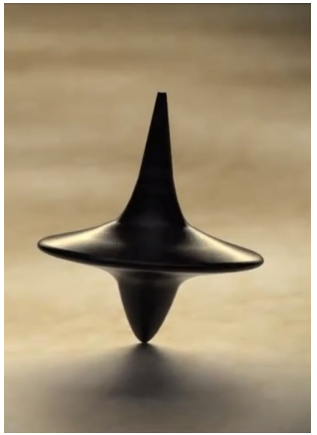
```
ports:
   - "8000:8000"
   - "5000-5010:5000-5010"
   - "8080:80"
   - "127.0.0.1:10022:10022"
   - "162:162/udp"
```

Docker Networking

Your laptop	->	Docker Linux VM	->	Container
`10.1.1.1`	->	`192.168.65.3`	->	`172.17.0.2`

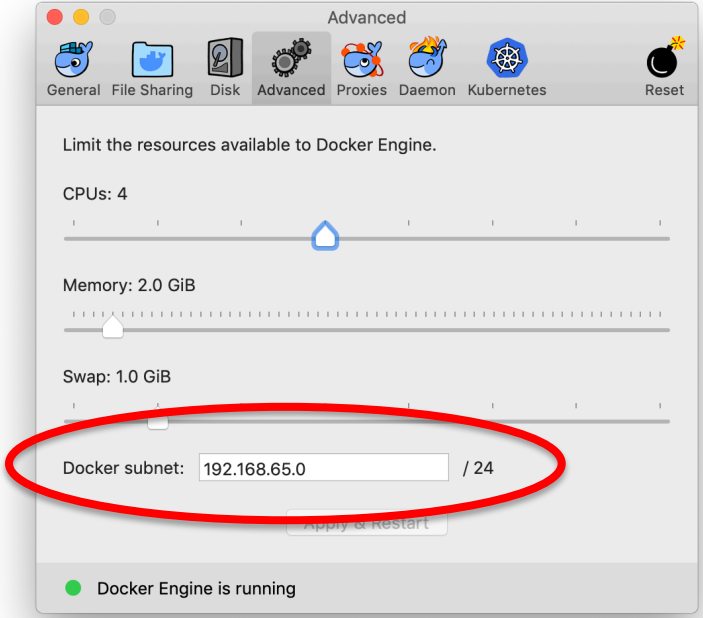
Outbound traffic: NAT to host IP

Inbound traffic: SNAT through container gateway (e.g. 172.17.0.1)



Resolving Network Address Conflicts

- Docker Linux VM network
  - Change through Docker Desktop GUI



Resolving Network Address Conflicts

- Container IP network
  - E.g. 172.17.0.0/24
- Create network in docker compose file, and reference it from your service
- Carrier-grade NAT IP space is a good option (100.64.0.0/10)

```
services:
  my-automation:
    ...
    networks:
      - my-network
networks:
  my-network:
    name: my-network
    driver: bridge
    ipam:
      config:
        - subnet: 100.64.99.0/24
```

Container Distribution

- A container repository supports "pulls" (e.g. `docker-compose pull`)

- Docker Hub
- GitLab
- Other 3rd party solutions
- Roll your own: docs.docker.com/registry/deploying

Lab

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Lab Overview

- Build a container with Cisco Network Services Orchestrator, and use it to simulate an IOS device
- Build a container with a Python network automation which creates a Loopback interface on the simulated IOS device

```
git clone https://github.com/ganuzelli/Network_Automation_Docker.git
```

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