



Containers

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Module 4: Containers

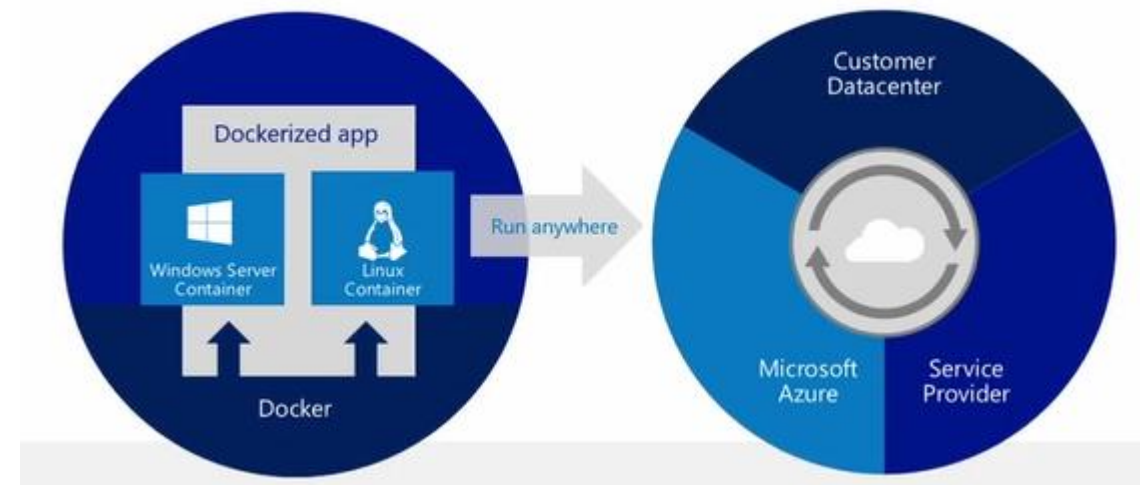
Module Overview

Objectives

- Understand what Containers are
- Learn Docker Fundamentals (Docker Engine and Client)
- Understand Container Images and Docker Registry
- Learn How to Build Container Image using Dockerfile
- Learn how to Start, Stop, and Remove Docker Containers
- Understand use of Tags for Versioning Images
- Microsoft Partnership with Docker Inc.

Why Docker?

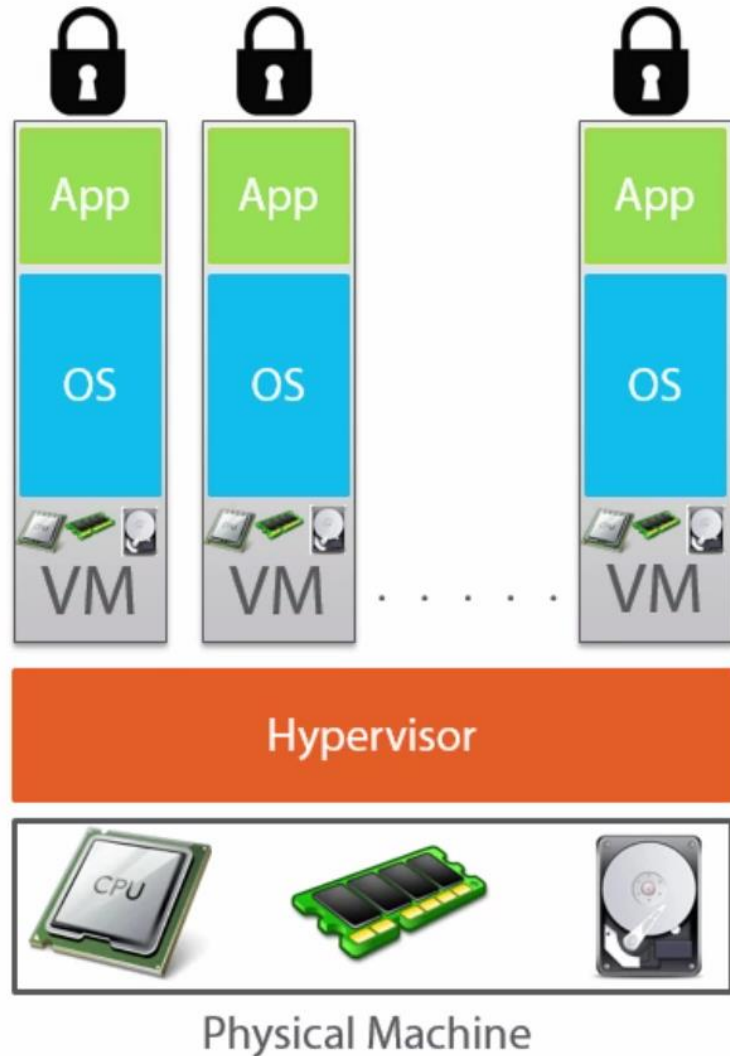
- Build any app in any language using any stack (OS)
- Dockerized apps can run anywhere on anything
- No more “It works on my machine”
- No more dependency daemons so Developers and System admins unite



Docker Vocabulary

Host	A machine running the Docker Daemon to host a collection of Docker Containers
Client	Where docker commands are executed (client/server)
Image	An <i>ordered collection of filesystems (layers)</i> to be used when instancing a container (more on it later)
Container	A runtime instance of an image
Registry	A collection of docker images

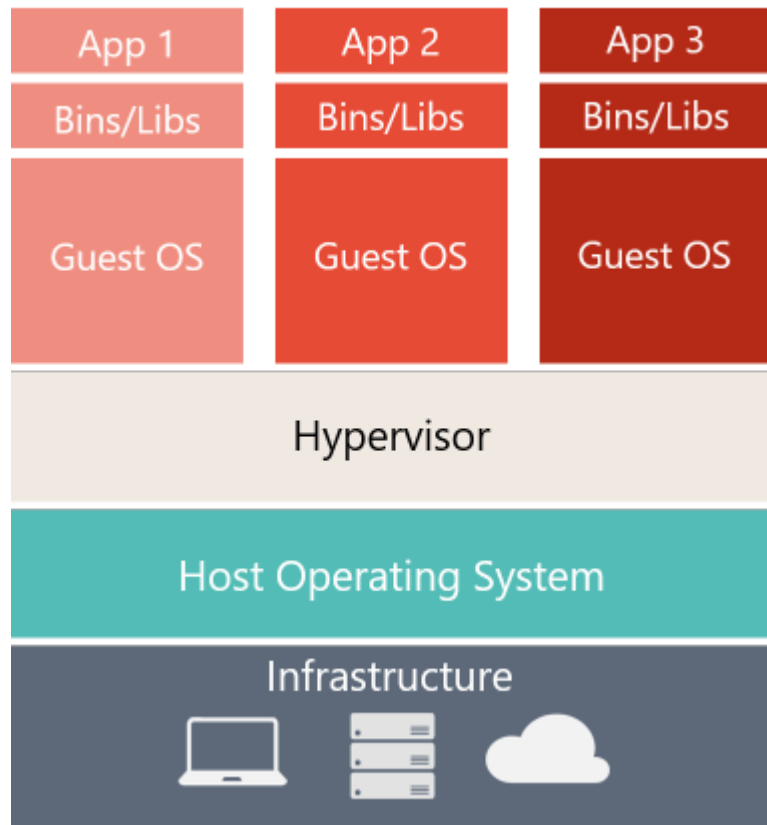
Challenges with Virtualization



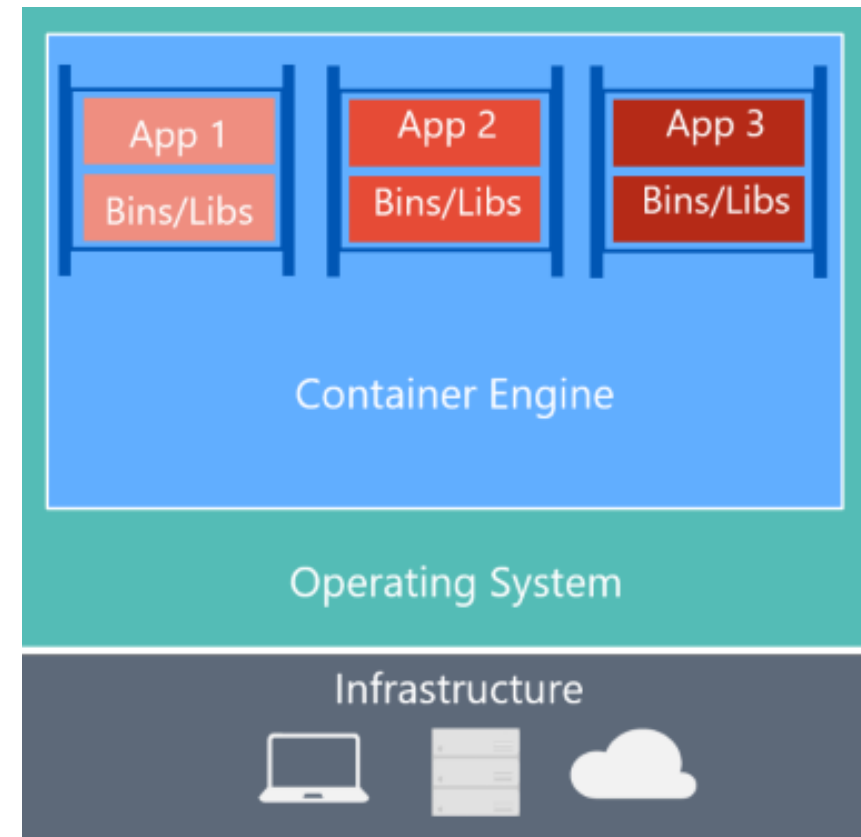
> OS != Business Value

Virtual Machines versus Containers

Virtual Machine

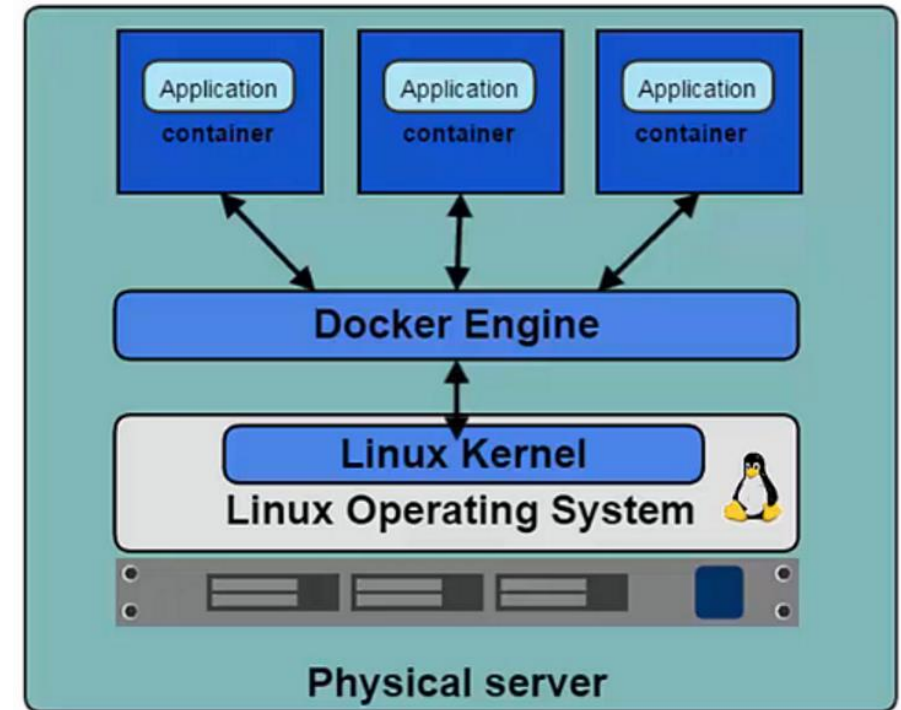


Container



Docker Platform

- Docker Engine (a.k.a. Docker Daemon)
 - The program that enables containers to be built, shipped, and run.
 - Uses Linux Kernel namespaces and control groups to give an isolated runtime environment for each application
- Docker Hub
 - A online registry of Docker images
- Docker Trusted Registry
 - Private on-site Registry for Docker images

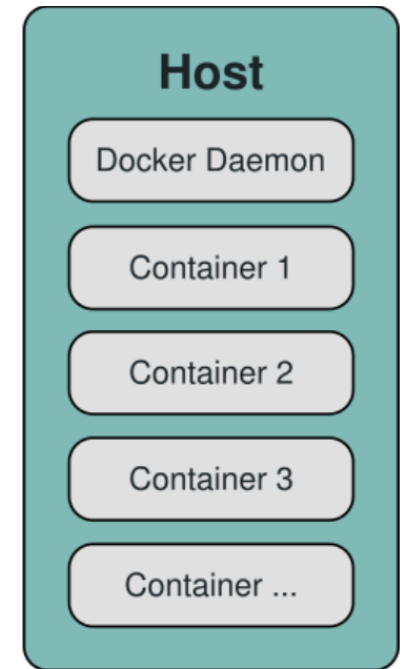


Docker Platform (Cont.)

- Docker Client
 - Takes user inputs and sends them to the Daemon.
 - Client and Daemon can run on the same host or on different hosts.
- Docker Images
 - Read-only template used to create containers.
 - Contains a set of instructions for creating the containers.
- Docker Containers
 - Isolated application platform based on one or more images.
 - Contains everything needed to run your application.

Docker Client

`docker pull`
`docker run`
`docker ...`



Quick Question?

How fast you can launch a fully functional WordPress blog engine?

How about multiple WordPress blog engines running side by side on same host?

```
Razis-MacBook-Pro:~ Razi$ docker run -d -p 80:80 tutum/wordpress
Unable to find image 'tutum/wordpress:latest' locally
latest: Pulling from tutum/wordpress

3387d9ff0016: Extracting [=====> ] 63.5 MB/65.68 MB
8b52deaaf0ed: Download complete
4bd501fad6de: Download complete
a3ed95caeb02: Download complete
790f0e8363b9: Downloading [=====> ] 80.01 MB/83.82 MB
11f87572ad81: Download complete
841e06373981: Download complete
709079cecfb8: Download complete
55bf9bbb788a: Download complete
b41f3cfd3d47: Download complete
70789ae370c5: Download complete
1018096310c2: DOMUj09q cowbj6r6
04T43C4q3q41: DOMUj09q cowbj6r6
02P40PPP1889: DOMUj09q cowbj6r6
0001ac6f109: DOMUj09q cowbj6r6
```

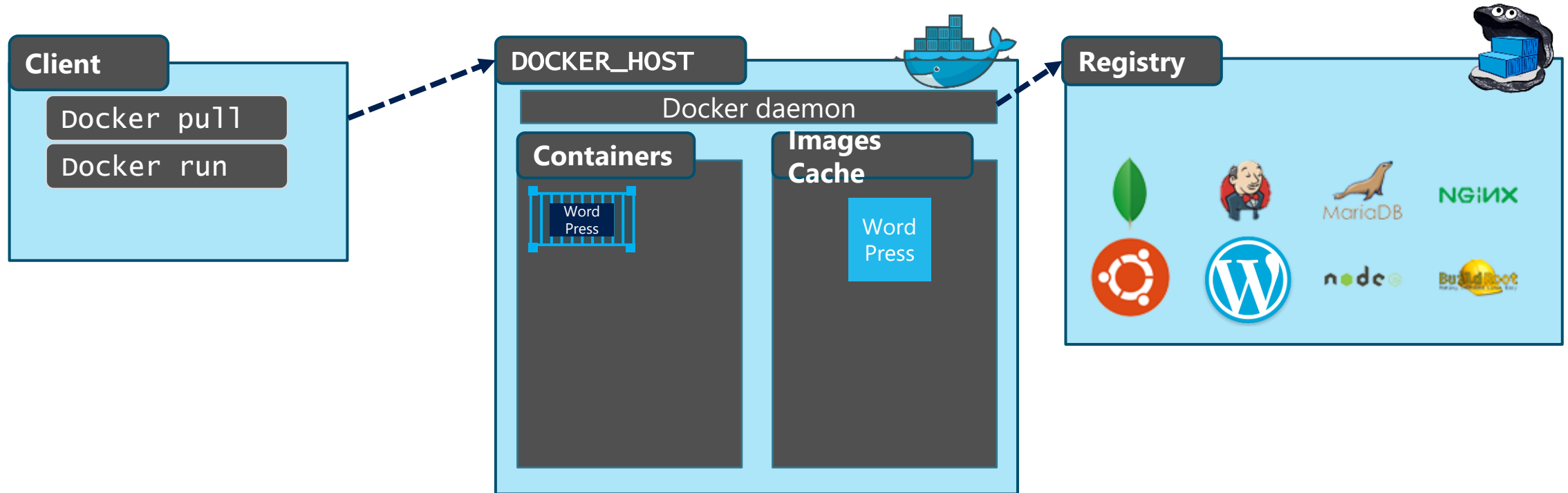
Demonstration: Running Docker Containers

Launch a single WordPress
Container

Running multiple WordPress
Containers side by side

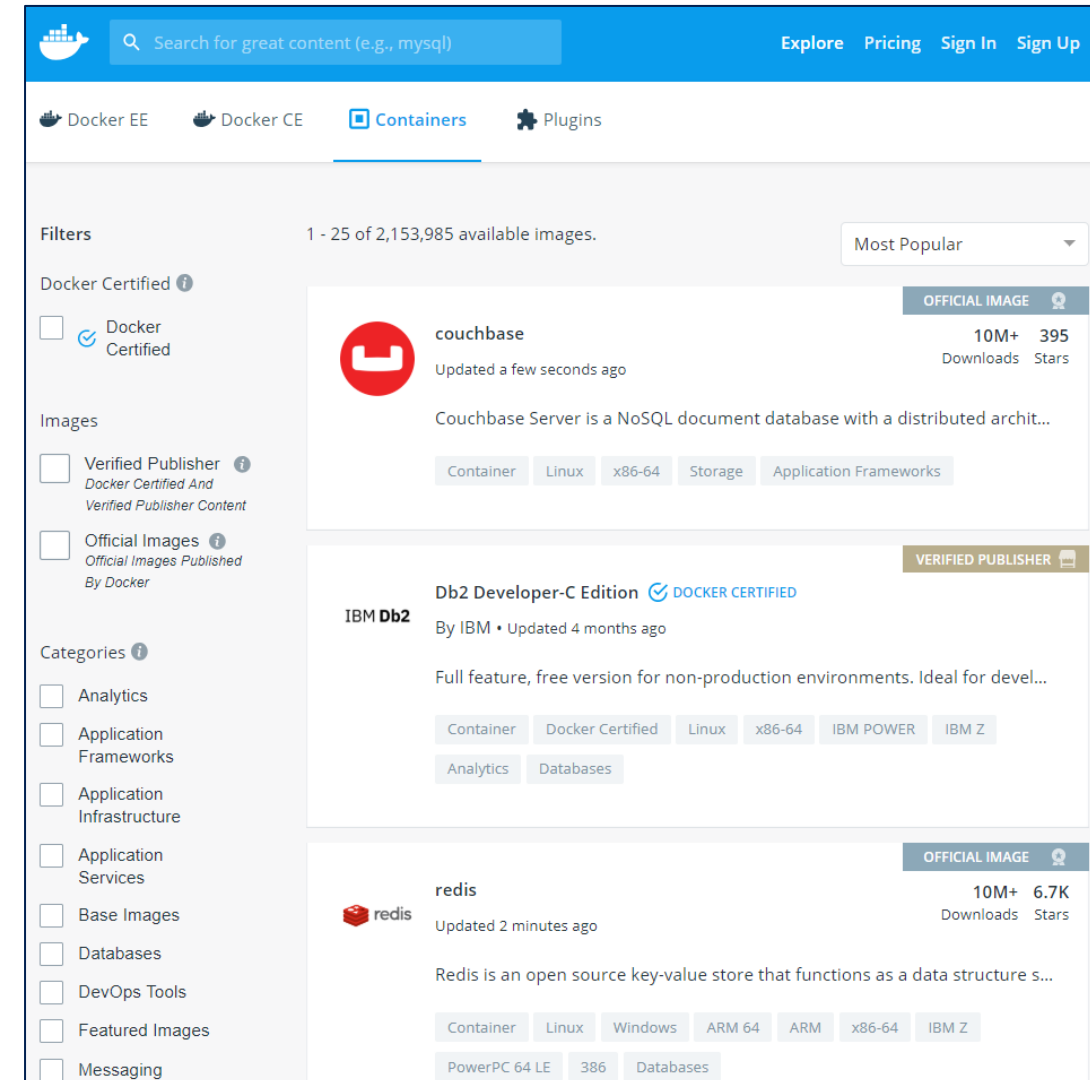


Docker In Action



Docker Registry

- Stores docker images
- Searchable
- Public Registry – hub.docker.com
- Private Registries – Instanced for you. E.g. Azure Container Registry
- The Registry is open-source under the permissive Apache License



Demonstration: Docker Registry

Search Docker Registry using
Docker CLI

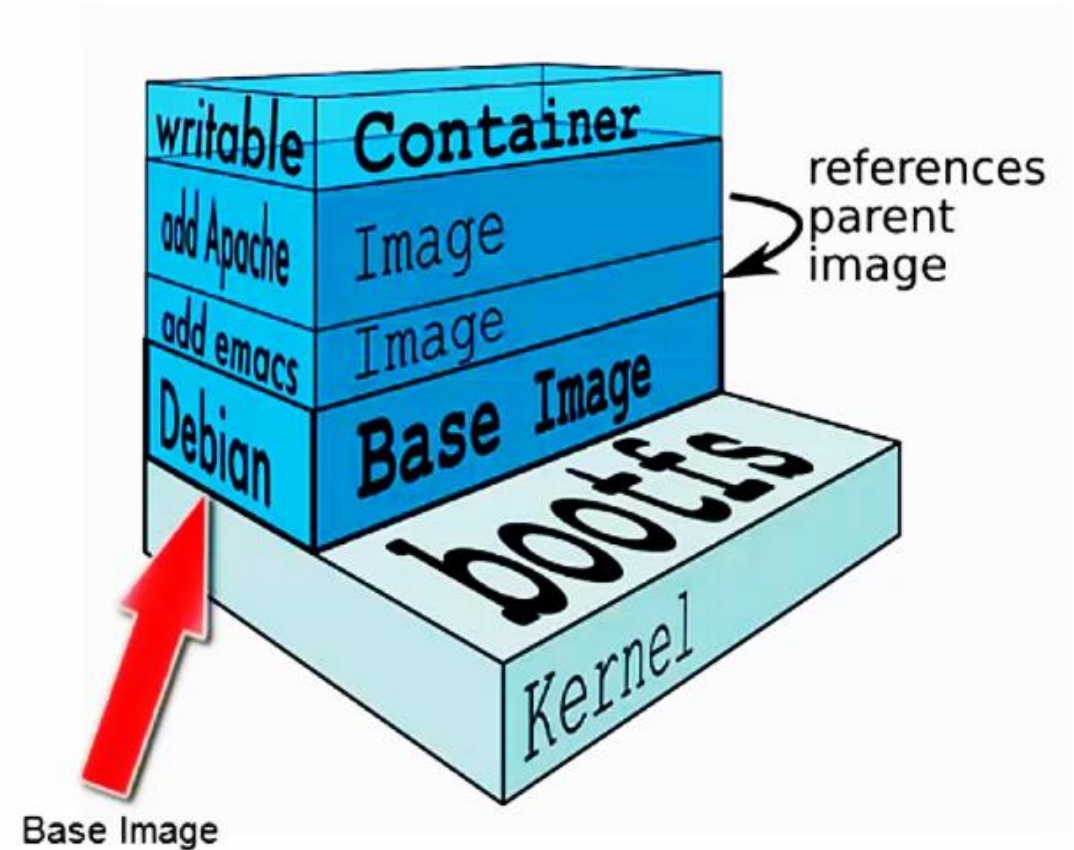
Search Images on DockerHub

Docker Image Naming
Convention



Docker Images

- A Docker image is built up from a series of layers.
- Base platform OS image is provided by vendors like Microsoft for Windows OS image, Canonical for Ubuntu image etc. These images get published to DockerHub.
- Each layer represents an instruction in the image's Dockerfile.
- Each layer except the last one is read-only.



Dockerfile

- Text file with Docker commands in it to create a new image. You can think of it as a configuration file with set of instructions needed to assemble a new image.
- Docker has a docker build command that parses Dockerfile to build a new container image.

```
# Simple Dockerfile for NGINX

FROM nginx:stable-alpine

MAINTAINER Razi Rais

COPY index.html /usr/share/nginx/html/index.html

CMD ["nginx", "-g", "daemon off;"]

CWD ["/usr/share/nginx/html"]
```

```
FROM microsoft/dotnet:1.1.0-sdk-projectjson

COPY . /app

WORKDIR /app

RUN ["dotnet", "restore"]

RUN ["dotnet", "build"]

EXPOSE 5000/tcp

CMD ["dotnet", "run", "--server.urls", "http://*:5000"]

CWD ["/app"]

EXPOSE 5000
```

```
# Simple Dockerfile for NodeJS

FROM node:boron

MAINTAINER Razi Rais

# Create app directory
RUN mkdir -p /usr/src/app
WORKDIR /usr/src/app

# Install app dependencies
COPY package.json /usr/src/app/
RUN npm install

# Bundle app source
COPY . /usr/src/app

EXPOSE 8080

CMD [ "npm", "start" ]

CWD [ "/usr/src/app" ]

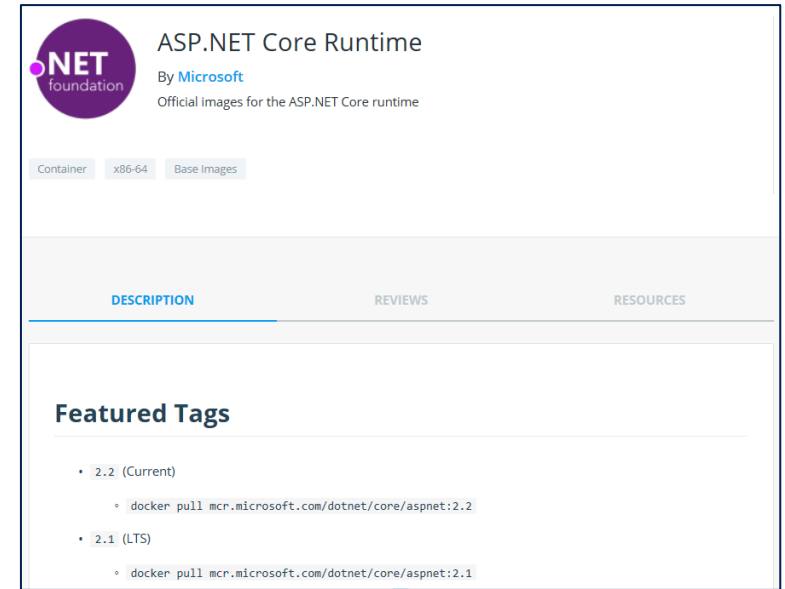
EXPOSE 8080
```

Common Dockerfile Instructions

- **FROM** instruction initializes a new build stage and sets the Base Image for subsequent instructions.
- **LABEL** is a key-value pair, stored as a string. You can specify multiple labels for an object, but each key-value pair must be unique within an object.
- **RUN** will execute any commands in a new layer on top of the current image and commit the results.
- **WORKDIR** instruction sets the working directory for any **RUN**, **CMD**, **ENTRYPOINT**, **COPY** and **ADD** instructions that follow it.
- **ADD** instruction copies new files, directories or remote file URLs from `<src>` and adds them to the filesystem of the image at the path `<dest>`.
- **COPY** instruction copies new files or directories from `<src>` and adds them to the filesystem of the container at the path `<dest>`.
- **CMD** provide defaults for an executing container. These defaults can include an executable.
- **ENTRYPOINT** allows you to configure a container that will run as an executable.
- **EXPOSE** instruction informs Docker that the container listens on the specified network port(s).

Image Tags

- A Tag name is a string value that you can use to distinguish versions of your Docker images so you can preserve older copies or variants of a primary build.
- You can group your images together using names and tags (if you don't provide any tag default value of latest is assumed)



ASP.NET Core Runtime
By [Microsoft](#)
Official images for the ASP.NET Core runtime

Container x86-64 Base Images

DESCRIPTION REVIEWS RESOURCES

Featured Tags

- 2.2 (Current)
 - `docker pull mcr.microsoft.com/dotnet/core/aspnet:2.2`
- 2.1 (LTS)
 - `docker pull mcr.microsoft.com/dotnet/core/aspnet:2.1`

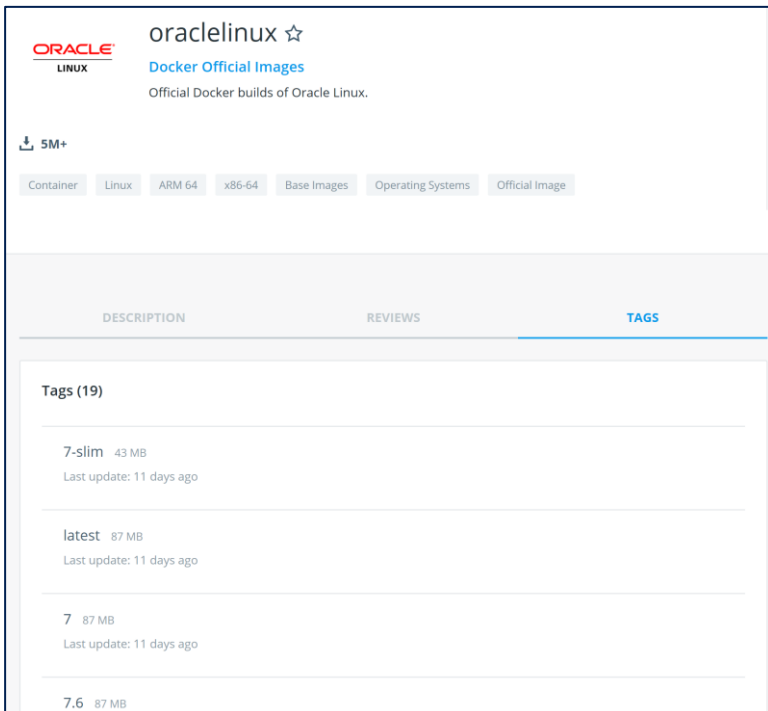


Linux amd64 tags

- 2.2.4-stretch-slim, 2.2-stretch-slim, 2.2.4, 2.2, latest (Dockerfile)
- 2.2.4-alpine3.9, 2.2-alpine3.9 (Dockerfile)
- 2.2.4-alpine3.8, 2.2-alpine3.8, 2.2.4-alpine, 2.2-alpine (Dockerfile)
- 2.2.4-bionic, 2.2-bionic (Dockerfile)
- 2.1.10-stretch-slim, 2.1-stretch-slim, 2.1.10, 2.1 (Dockerfile)
- 2.1.10-alpine3.9, 2.1-alpine3.9 (Dockerfile)
- 2.1.10-alpine3.7, 2.1-alpine3.7, 2.1.10-alpine, 2.1-alpine (Dockerfile)
- 2.1.10-bionic, 2.1-bionic (Dockerfile)

Windows Server, version 1809 amd64 tags

- 2.2.4-nanoserver-1809, 2.2-nanoserver-1809, 2.2.4, 2.2, latest (Dockerfile)
- 2.1.10-nanoserver-1809, 2.1-nanoserver-1809, 2.1.10, 2.1 (Dockerfile)



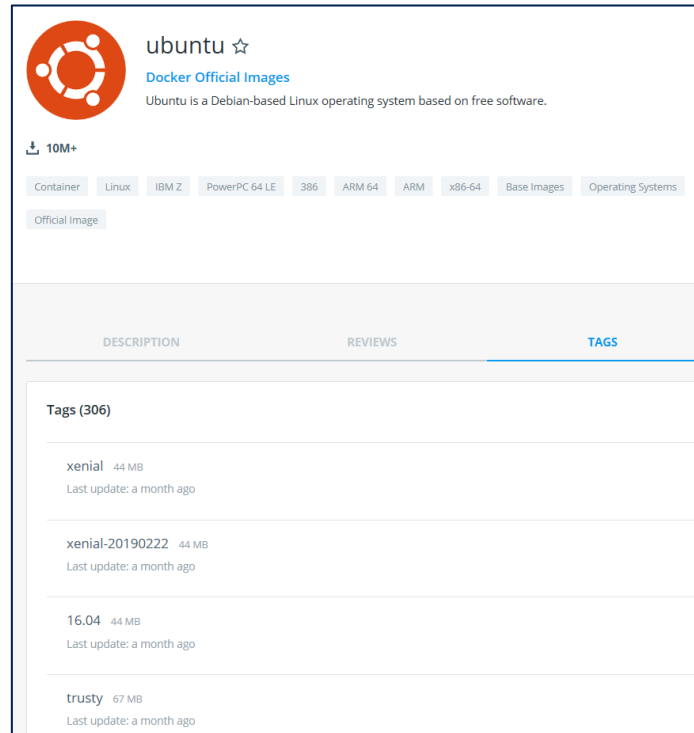
oraclelinux ☆
Docker Official Images
Official Docker builds of Oracle Linux.

Container Linux ARM 64 x86-64 Base Images Operating Systems Official Image

DESCRIPTION REVIEWS TAGS

Tags (19)

- 7-slim 43 MB
Last update: 11 days ago
- latest 87 MB
Last update: 11 days ago
- 7 87 MB
Last update: 11 days ago
- 7.6 87 MB



ubuntu ☆
Docker Official Images
Ubuntu is a Debian-based Linux operating system based on free software.

Container Linux IBM Z PowerPC 64 LE 386 ARM 64 ARM x86-64 Base Images Operating Systems

DESCRIPTION REVIEWS TAGS

Tags (306)

- xenial 44 MB
Last update: a month ago
- xenial-20190222 44 MB
Last update: a month ago
- 16.04 44 MB
Last update: a month ago
- trusty 67 MB
Last update: a month ago

Demonstration: Dockerfile and Docker Build

Working with Dockerfile

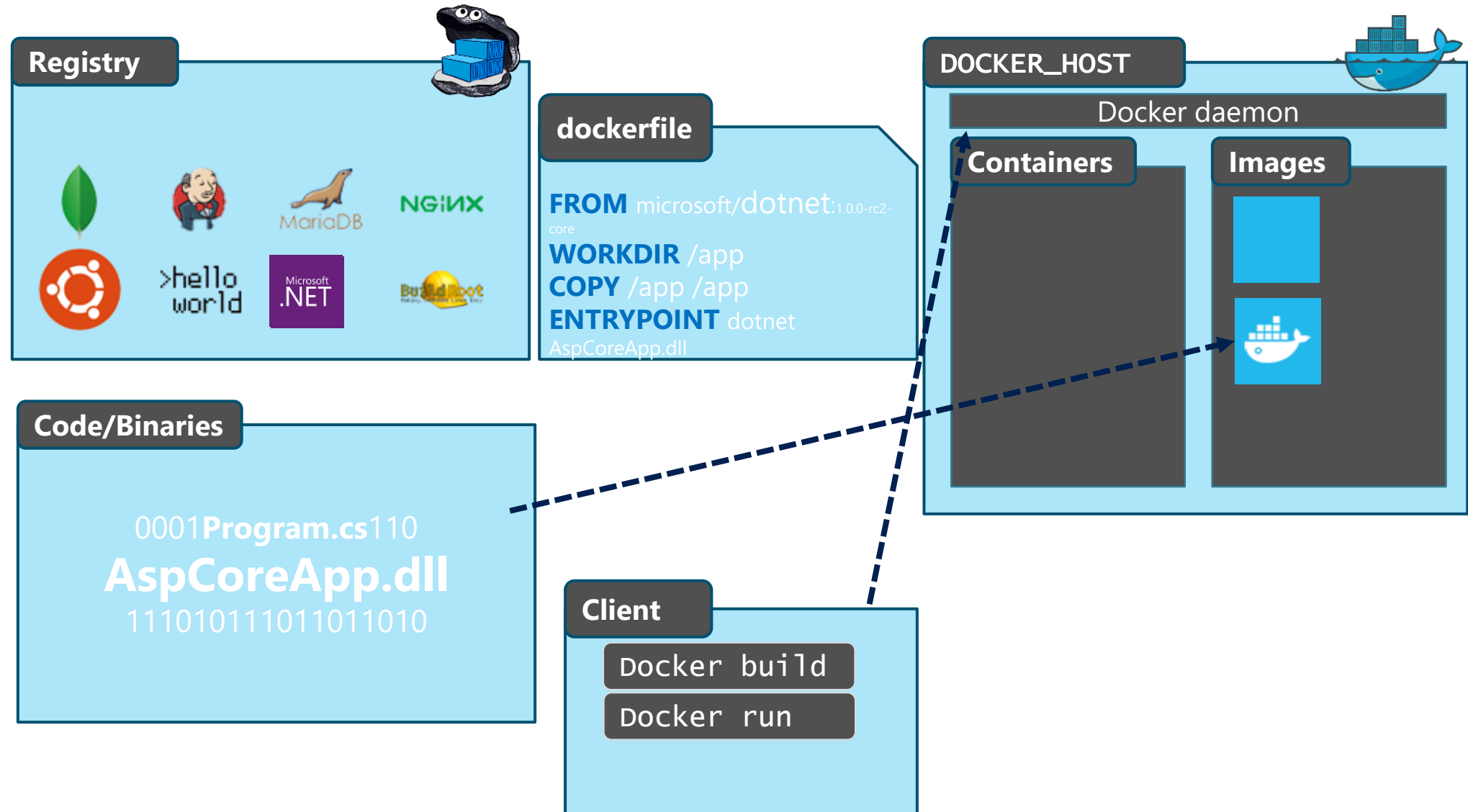
Build container images using Docker
build command:

- NodeJs
- Nginx
- ASP.NET Core

Using Image Tags

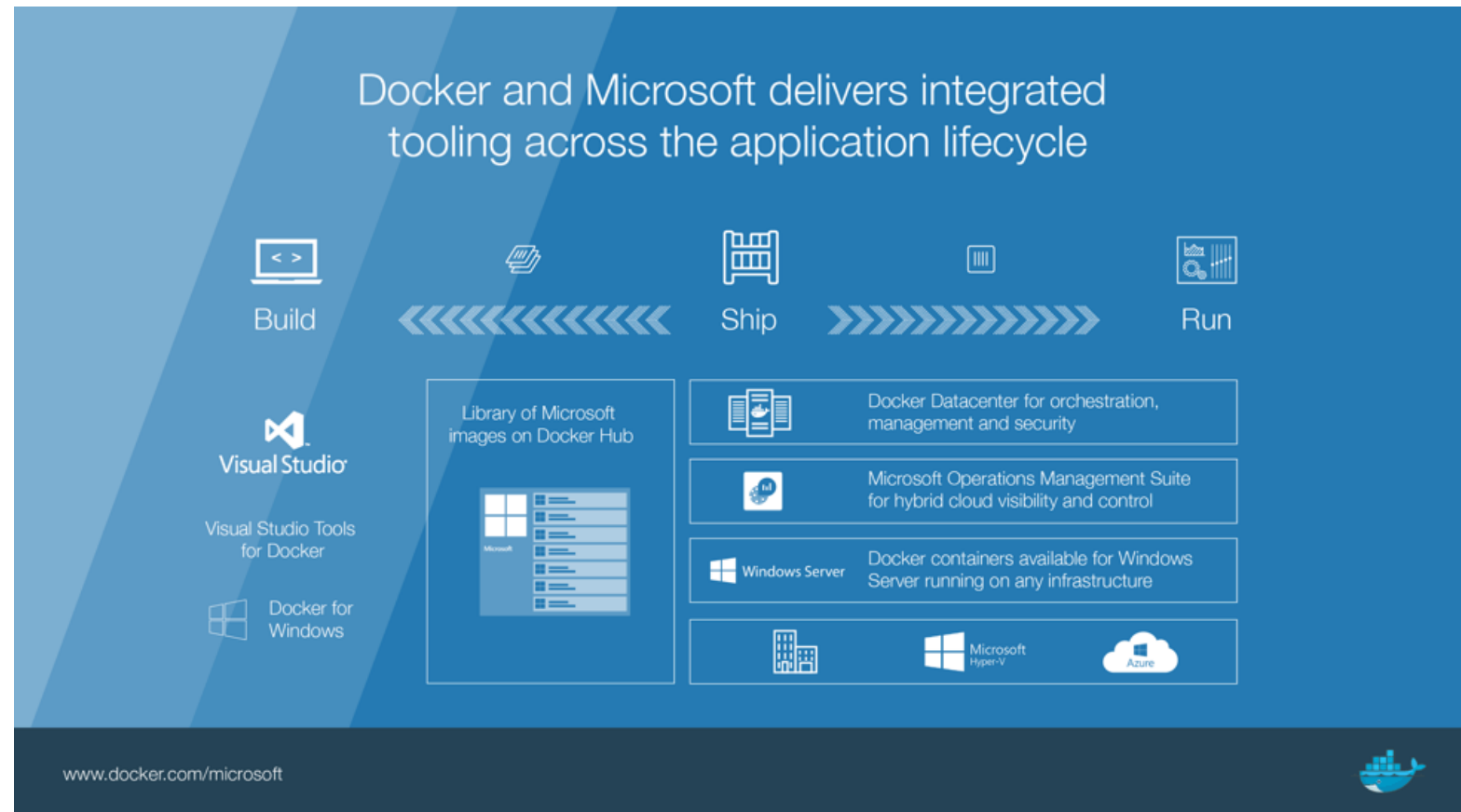


How does Docker build work?



Docker and Microsoft Partnership

- Docker Engine is tested, validated, and supported on Windows Server 2016/2019 and Windows 10 at no additional cost.
- Microsoft provides Windows Server 2016/2019 customers enterprise support for Docker Enterprise Edition.
- Docker is supported throughout Microsoft Cloud and on-premises ecosystem.



Docker and Microsoft Partnership (Cont.)

- For developers, the integration of Visual Studio Tools for Docker and Docker Desktop provides complete desktop development environments for building Dockerized Windows apps
- To jumpstart app development, Microsoft has contributed Windows Server container base images and apps to Docker Hub
- For IT pros, Docker Enterprise for Azure is designed to manage Windows Server environments in addition to the Linux environments with the Docker Universal Control Plane

