Application Containerization

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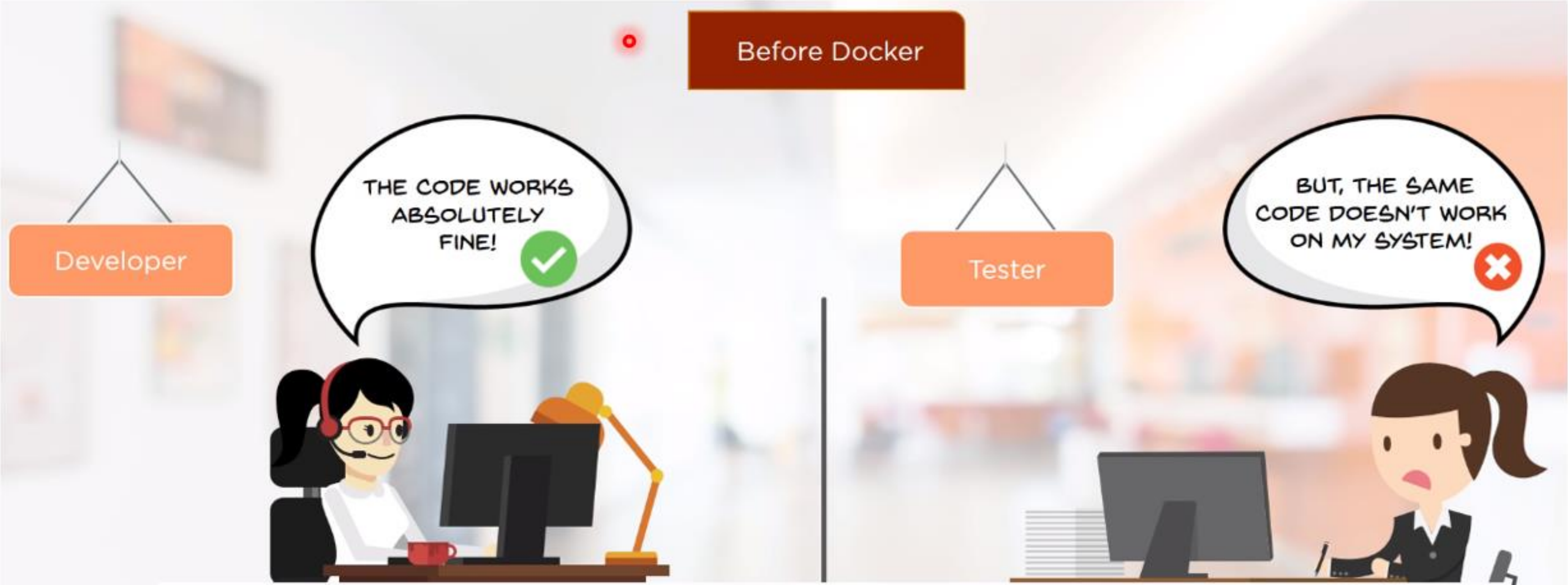
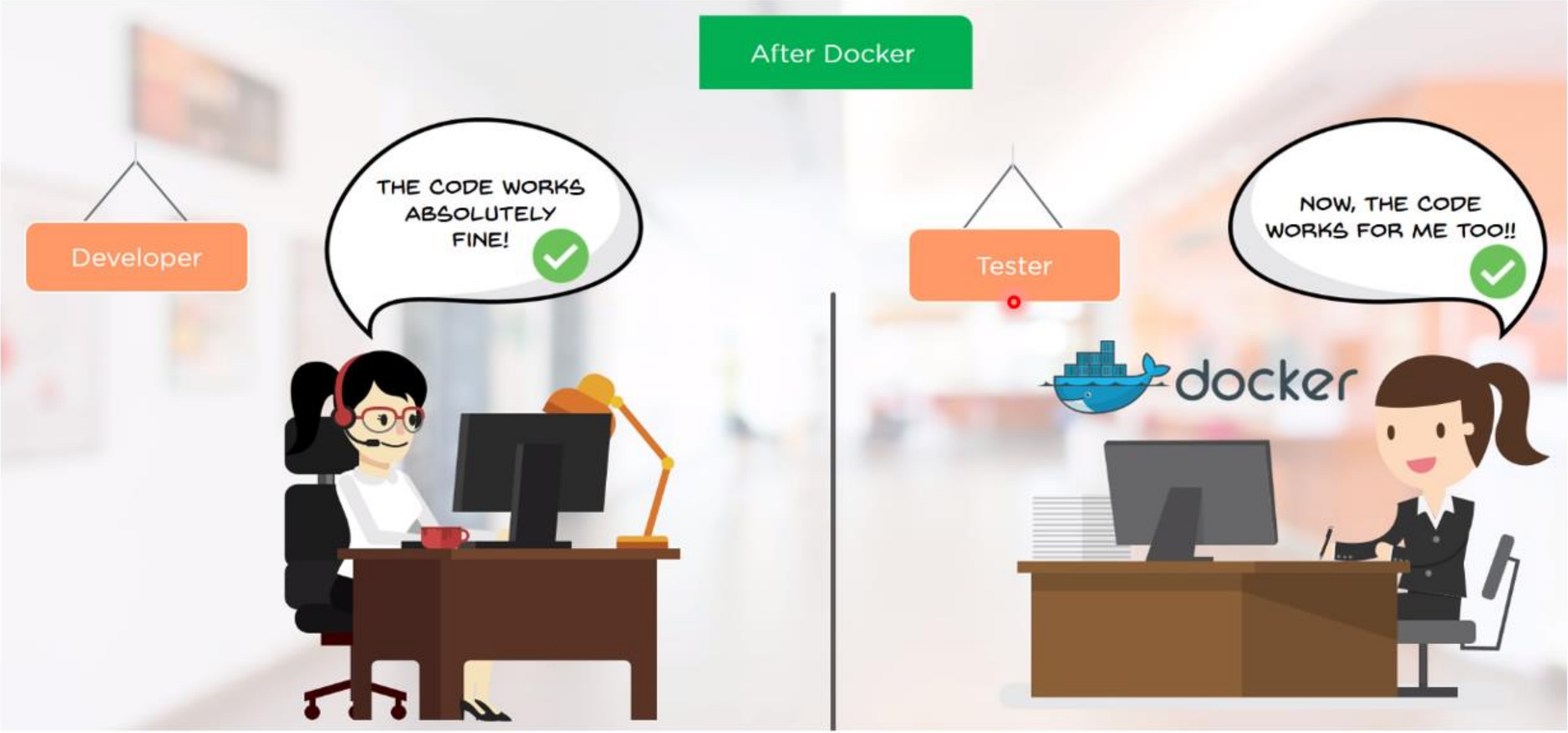
IT Issues Before Docker Containerization

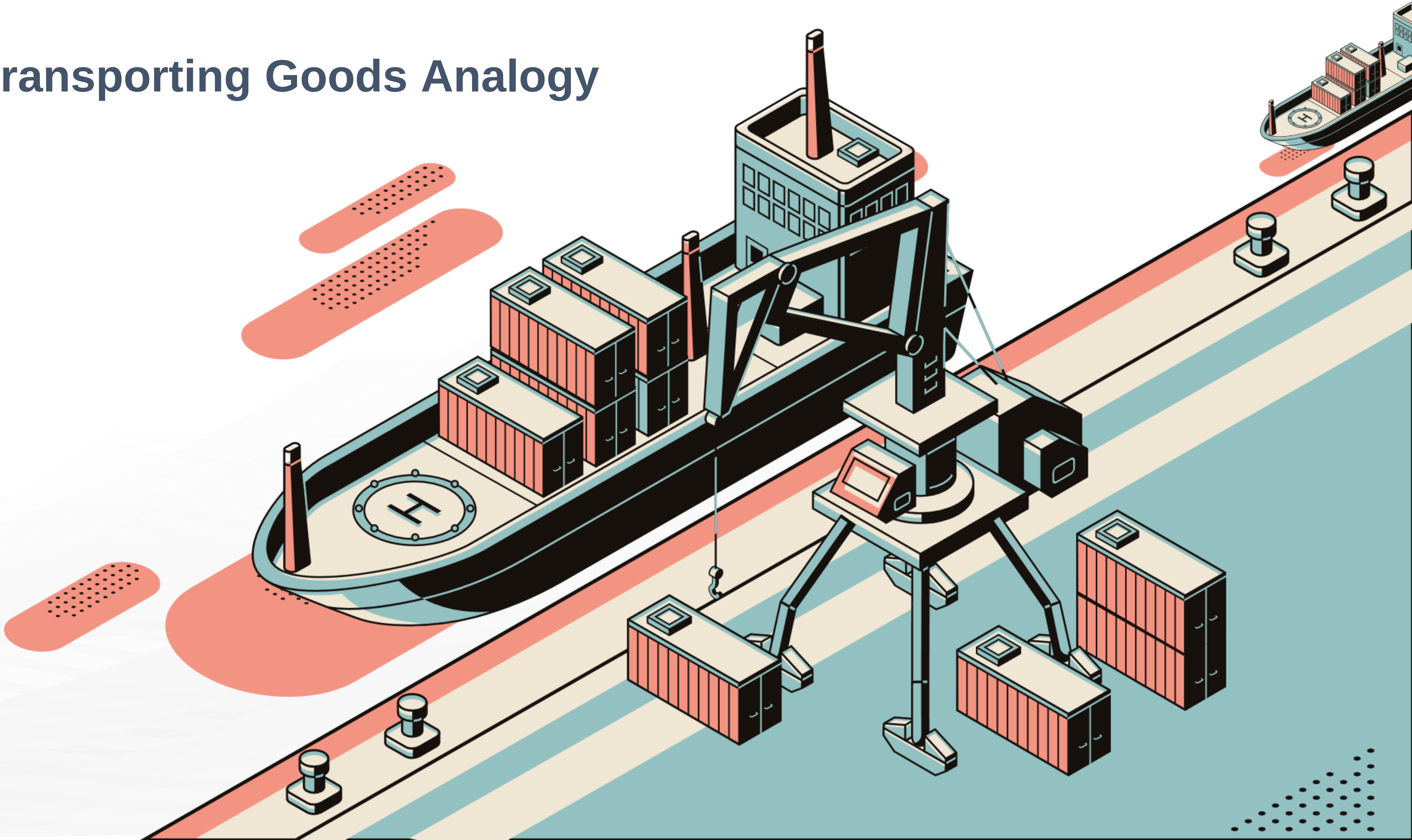

Before Docker
Developer
THE CODE WORKS ABSOLUTELY FINE! ✓
Tester
BUT, THE SAME CODE DOESN'T WORK ON MY SYSTEM! ✗

The code doesn’t work on the other system due to the difference in computer environments
So, what could be the solution to this?

After Docker Containerization


After Docker
Developer
THE CODE WORKS ABSOLUTELY FINE!
Tester
docker
NOW, THE CODE WORKS FOR ME TOO!!

1.1 Transporting Goods Analogy



1.2 Problems in Shipping Industry before Containers

The shipping industry faced the following problems before containers:

- Shipping fragile goods with robust ones
- Shipping of edible food items with raw materials
- Shipping of cars
- Shipping of various goods via different mode of transports like railways, roadways, airways, waterways, etc.
- Loading and unloading of goods

1.3 Shipping Industry Challenges

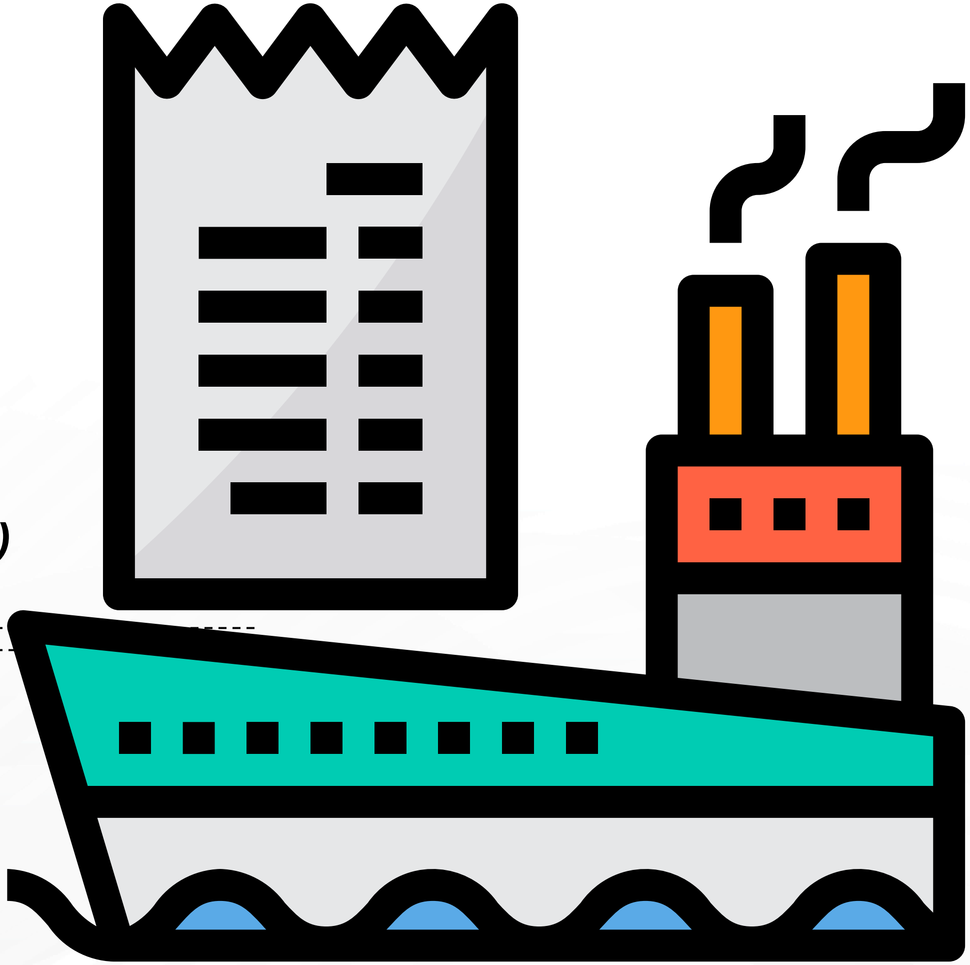
The various challenges faced by the shipping industry.

Multiplicity of goods

Do I worry about how goods interact? (e.g., coffee beans next to spices)

Multiplicity of methods for transporting/storing

Can I transport quickly & smoothly? (e.g., from boat to train to truck)



1.4 Container: The Saviour

How did the container become the saviour?

Multiplicity of goods

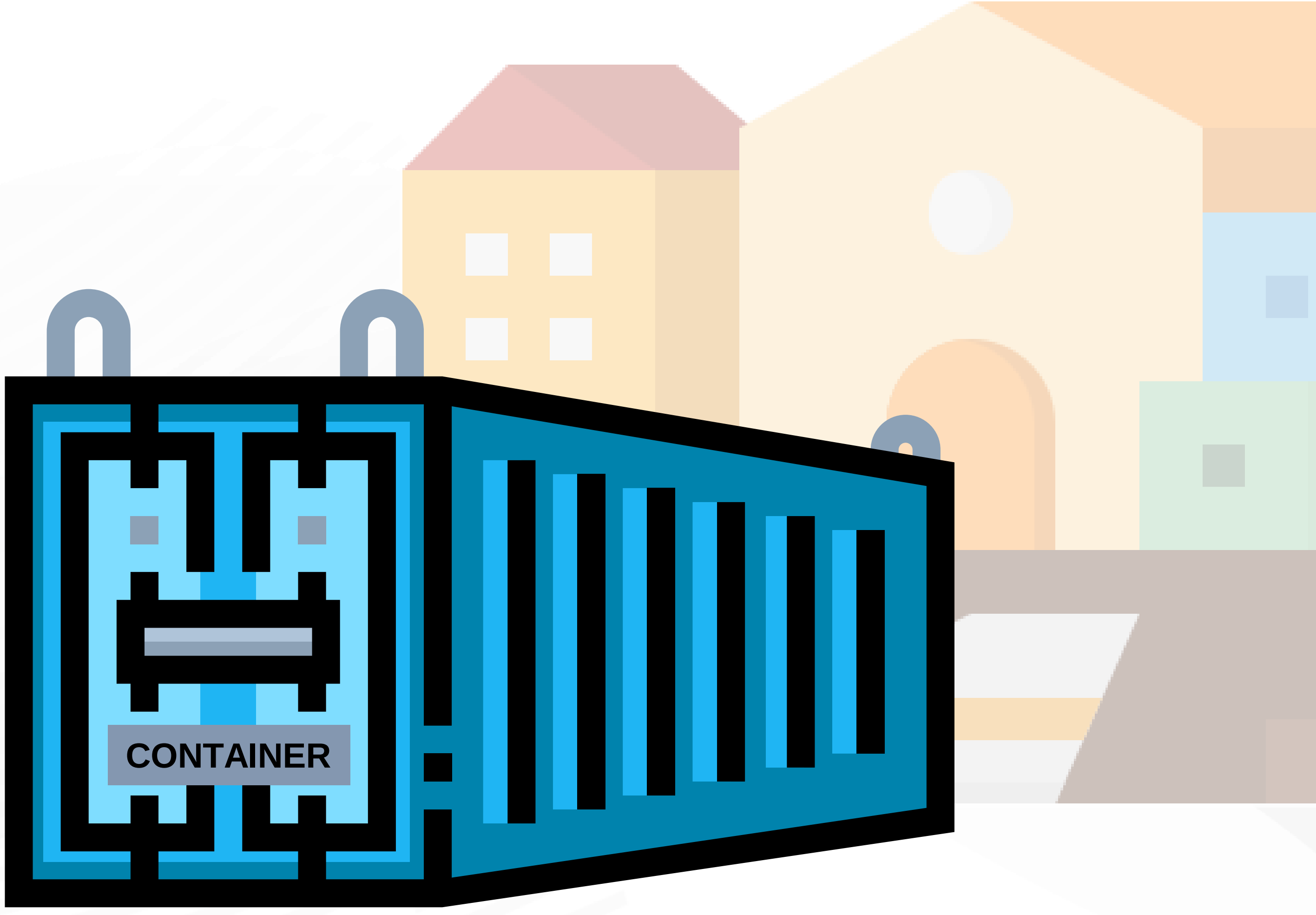
Do I worry about how goods interact? (e.g., coffee beans next to spices)

A standard container that is loaded with virtually any goods, & stays sealed until it reaches final delivery.

Multiplicity of methods for transporting/storing

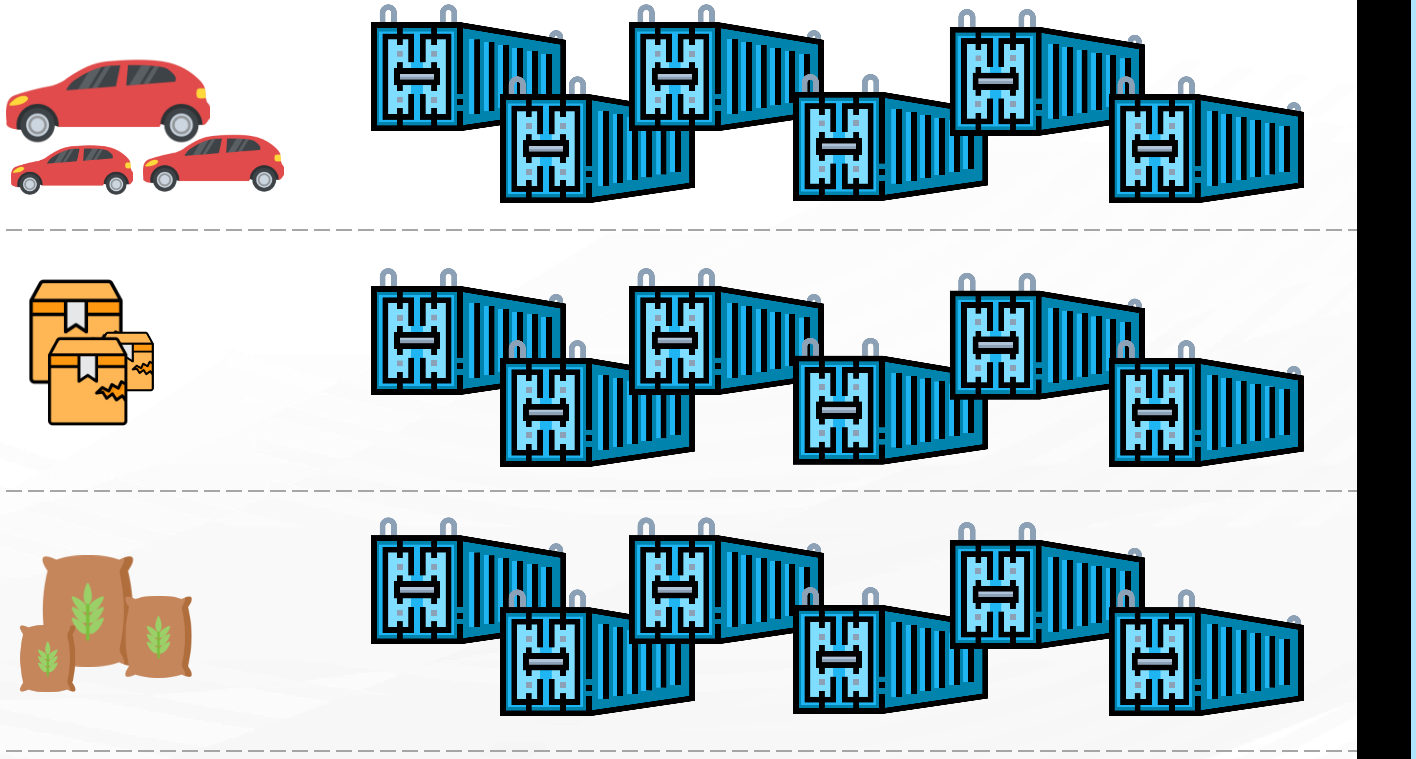
Can I transport quickly & smoothly? (e.g., from boat to train to truck)

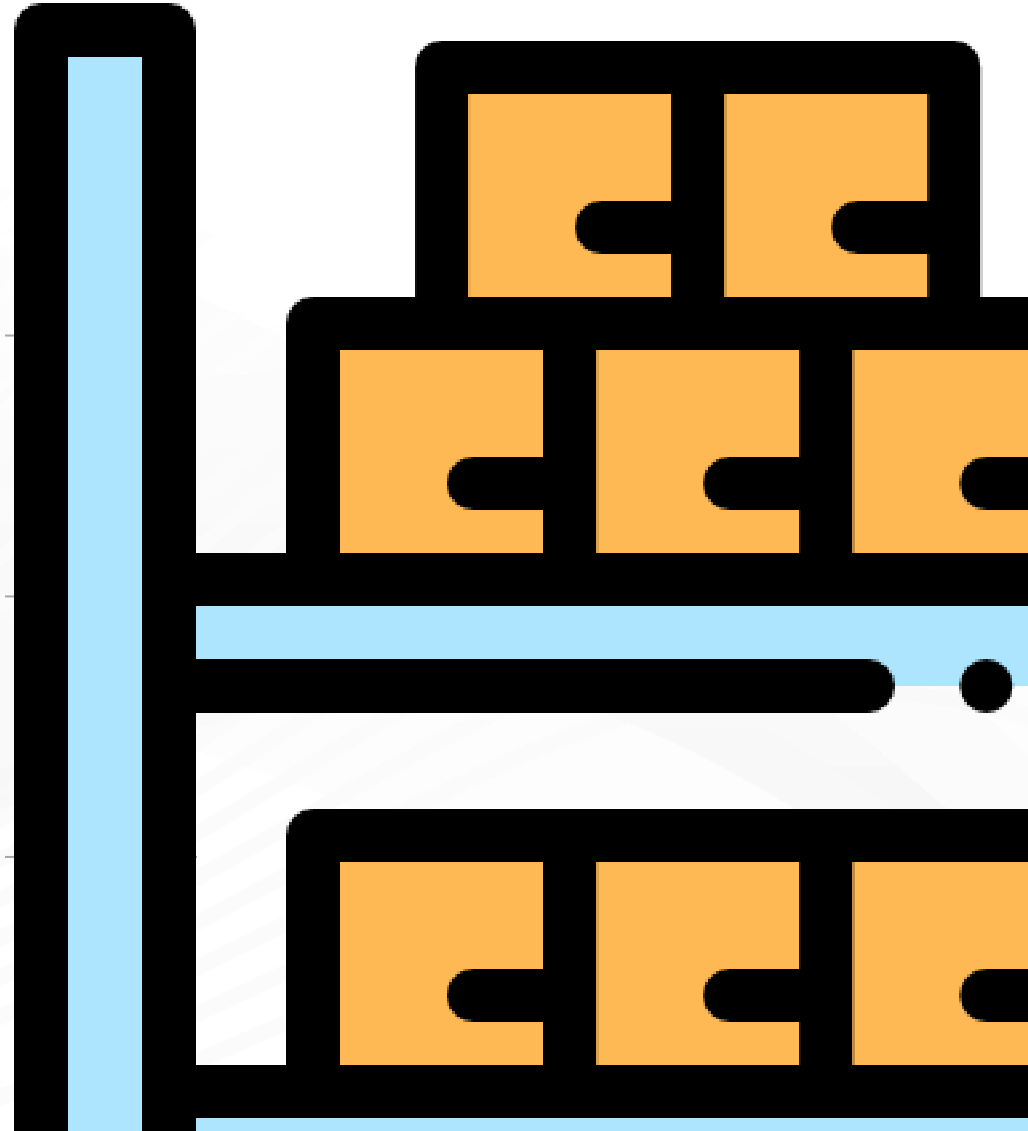
In between, can be loaded & unloaded, stacked, transported efficiently over long distances, & transferred from one mode of transport to the other.



1.5 Solution by Containers in the Shipping Industry

Everything falls into place with the help of containers.





1.6 Challenges in the Software Industry

The various challenges in the software industry are as follows:

1 The multiplicity of stacks

2 The multiplicity of environment

3 My own laptop

4 Hardware maintenance

5 Disaster recovery

6 Backup restore

7 Disaster recovery

1.6 Challenges in the Software Industry (Contd.)

The various challenges in the software industry are as follows:

Do services & apps interact appropriately? **Multiplicity of Stacks**

Static Website
nginx 1.5, modsecurity, openssl, bootstrap2

User DB
postgresql, pgv8, v8

Web frontend
Ruby, Rails, sass, Unicorn

Background workers
Python 3.0, celery, pyredis, libcurl, ffmpeg, libopencv,nodejs, phantomjs

API Endpoint
Python 2.7, Flask, pyredis, celery, psycopg, postgresql-client

Queue
Redis, redis-sentinel

Can I migrate smoothly & quickly? **Multiplicity of hardware environments**

Development VM **Customer Data Center** **Contributor’s laptop** **Public Cloud**

QA server **Production cluster** **Data recovery** **Production Servers**

1.7 Problems in Software Industry Before Containers

The chaos in the software industry while managing diverse stack in different environments:

	Development VM	QA Server	Single Prod Sever	Onsite Cluster	Public Cloud	Contributor Laptop	Customer Servers
Static Website	?	?	?	?	?	?	?
Background Workers	?	?	?	?	?	?	?
Web Front End	?	?	?	?	?	?	?
User DB	?	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?	?
Queue	?	?	?	?	?	?	?

1.8 Put that in Container!

Multiplicity of stacks

Developer: Build once, run anywhere(finally)

Static Website
nginx 1.5, modsecurity, openssl, bootstrap2

User DB
postgresql, pgv8, v8

Web frontend
Ruby, Rails, sass, Unicorn

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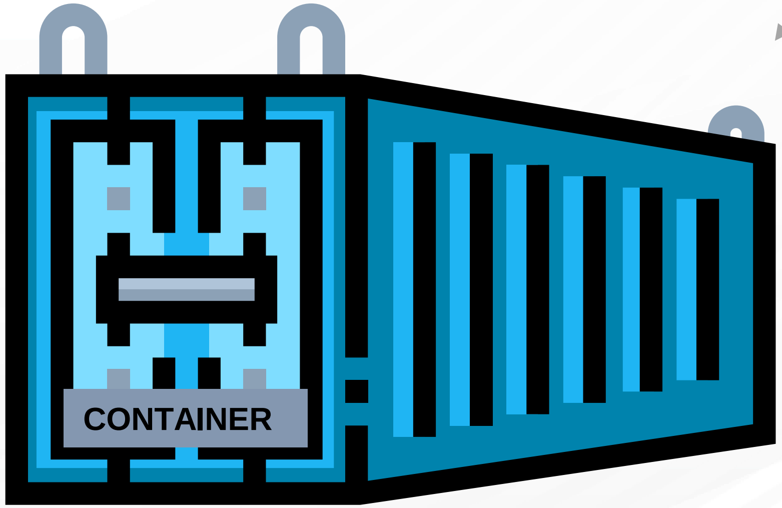


Multiplicity of hardware environments

Operator: Configure once, run anything

Development VM

Production Servers

Customer Data Center

Contributor’s laptop

QA server

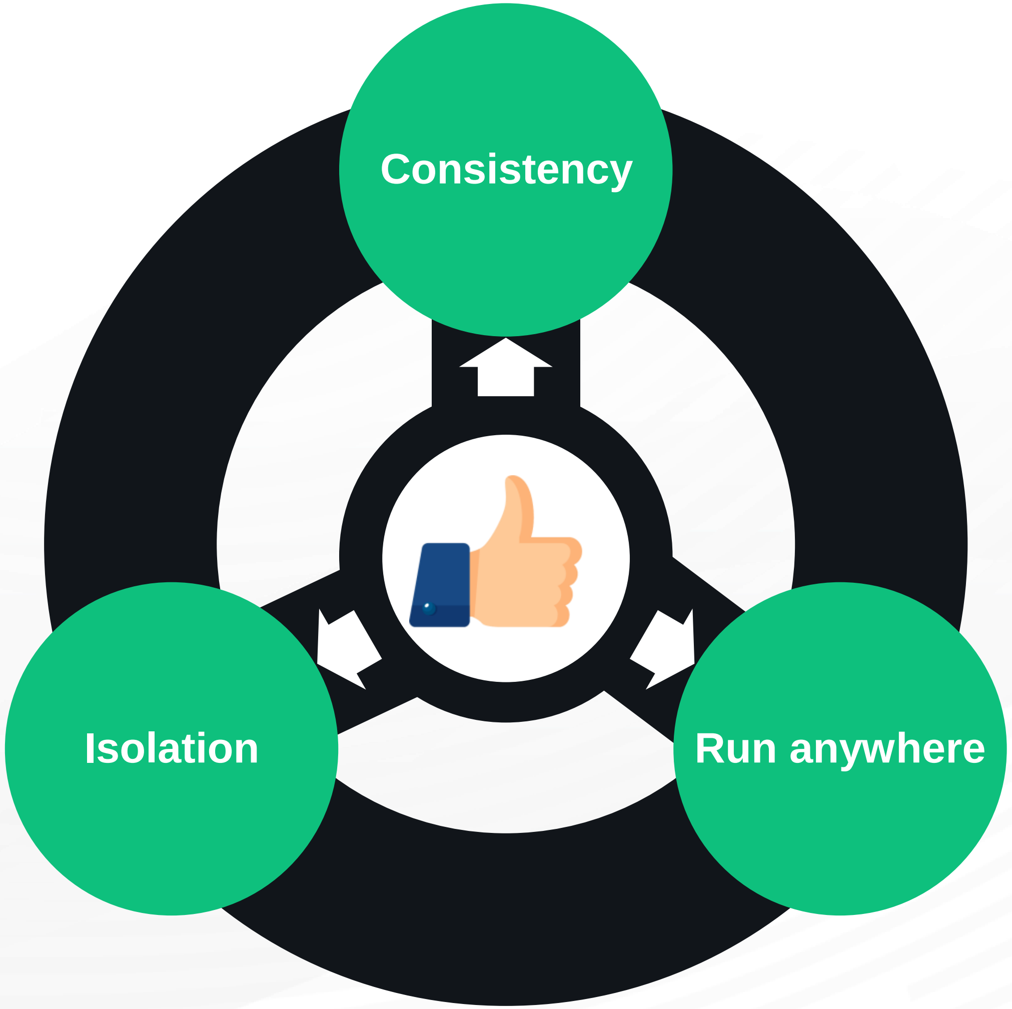
Production cluster

Data recovery

Source: https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRWHcB-4JmViuSdW3tEtckQ2HLOrlhv-AnO9_6jzUohl1NmPyOV&s

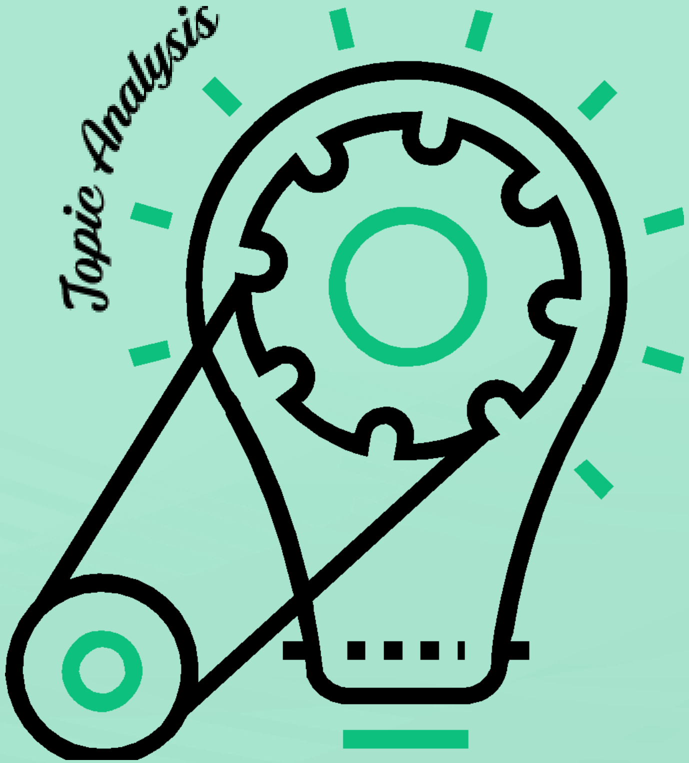
1.9 Solution by containers in the Software Industry

Keeping everything in container solves our problems easily on the factors below:



Module 1: Understanding Containers

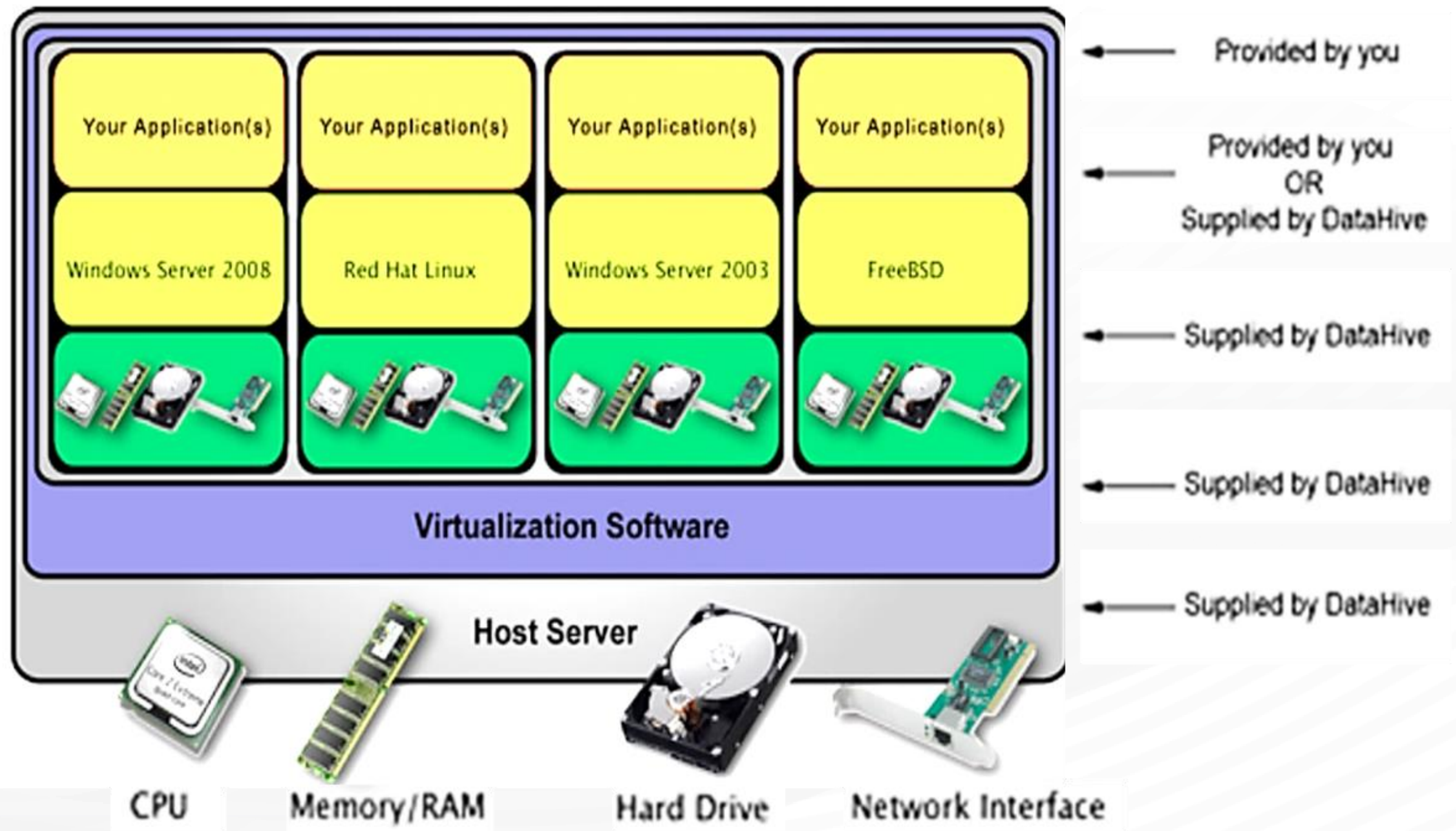
What did you Grasp?



1. Which is the key-factor which helped shipping and software industry to overcome the problems?
   - **A) Isolation**
   - **B) Availability**
   - **C) Consistency**
   - **D) Performance**

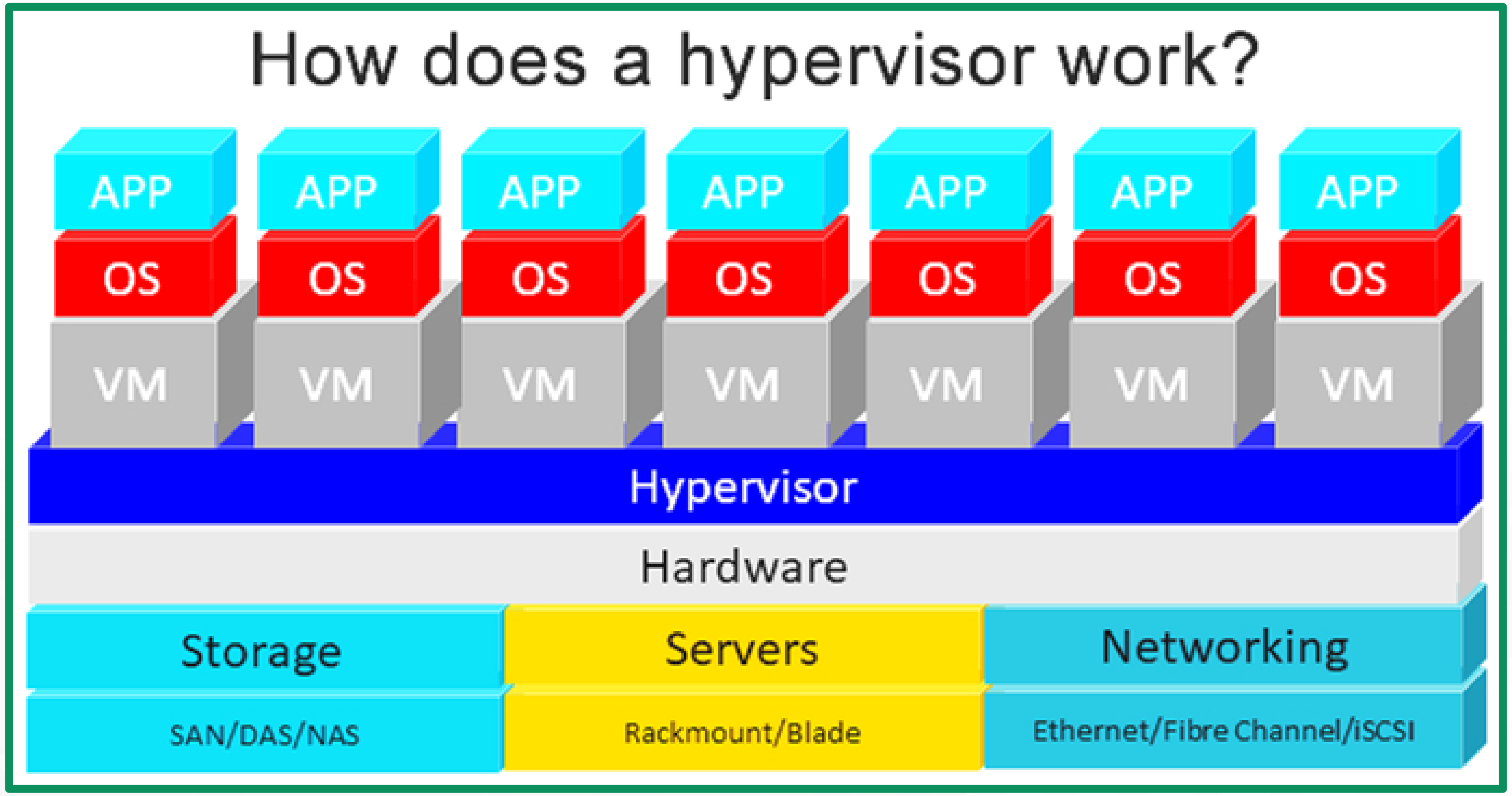
1.10 Virtualisation

Virtualization is a technology to run multiple same or different operating systems which are completely isolated from each other.



- □ Consolidation
- □ Shared CPU, Mem, Disk, NIC
- □ Maximum resource utilization
- □ Centralized Management
- □ Migration
- □ Less TCO (total cost of ownership)

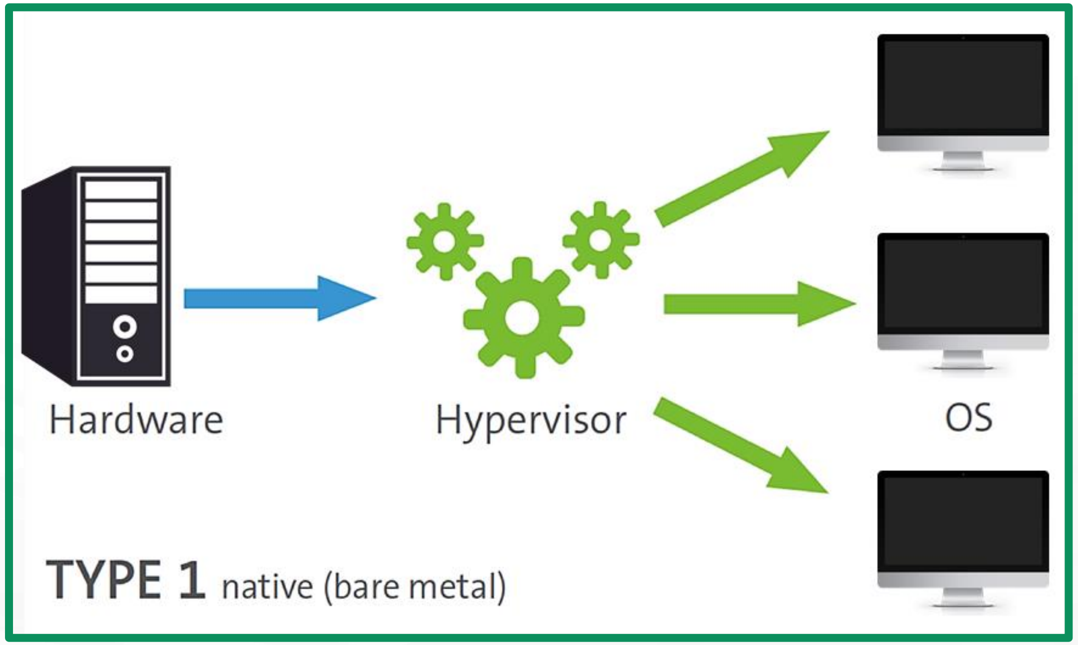
1.11 What is Hypervisor?

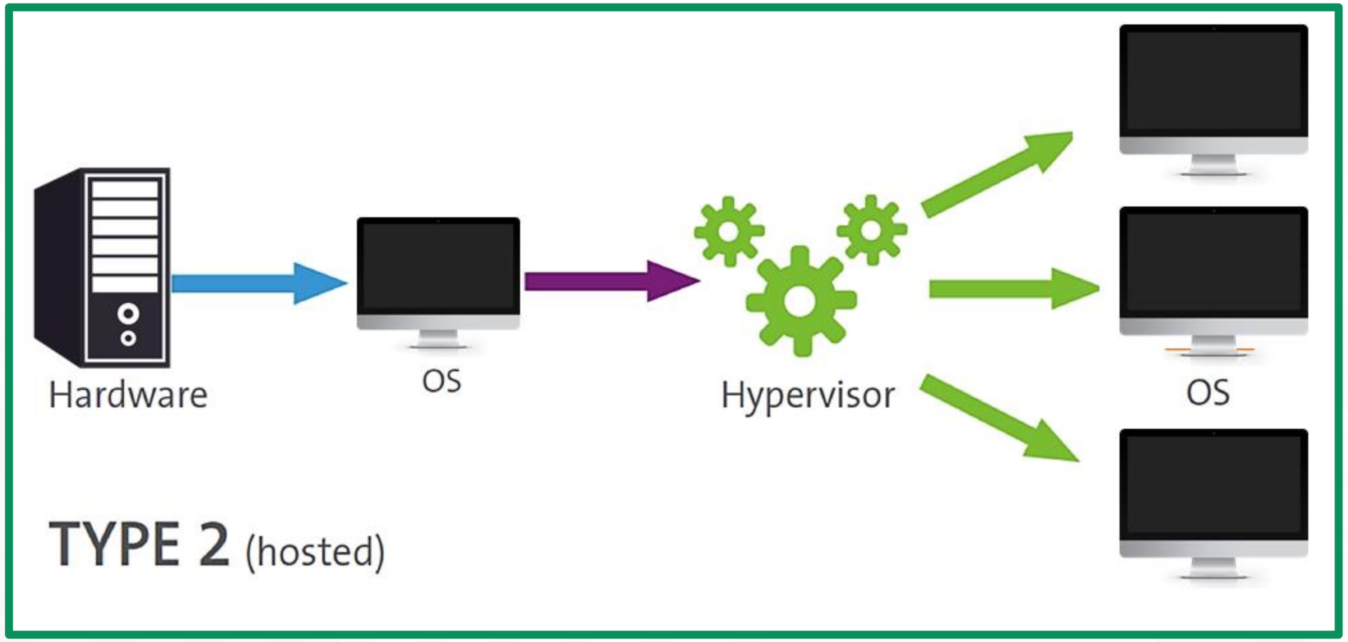


Source: https://www.data-storage.uk/articles/how-does-a-hypervisor-work/

1.12 Types of Hypervisors

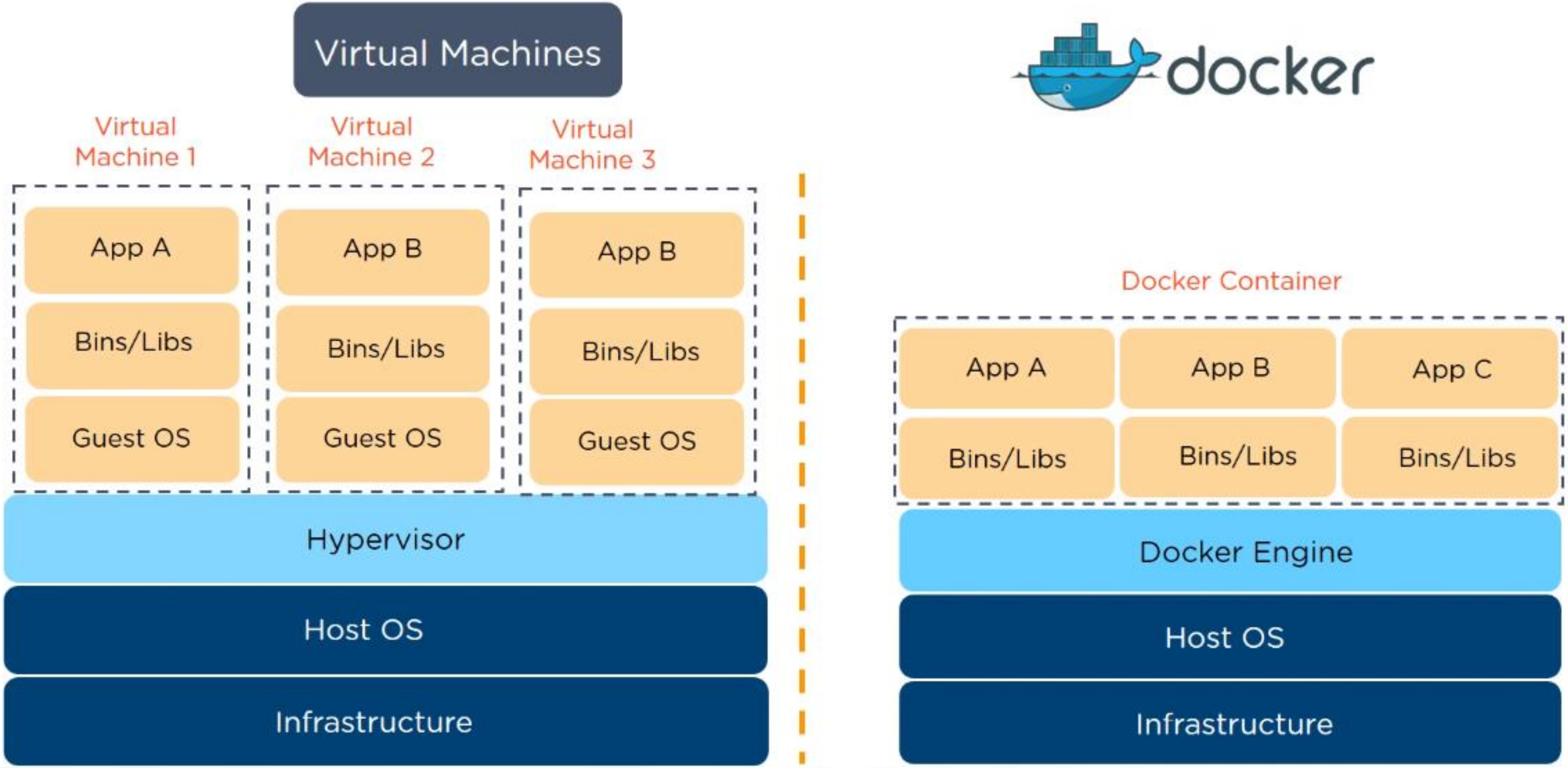
The two types of hypervisors are as follows:





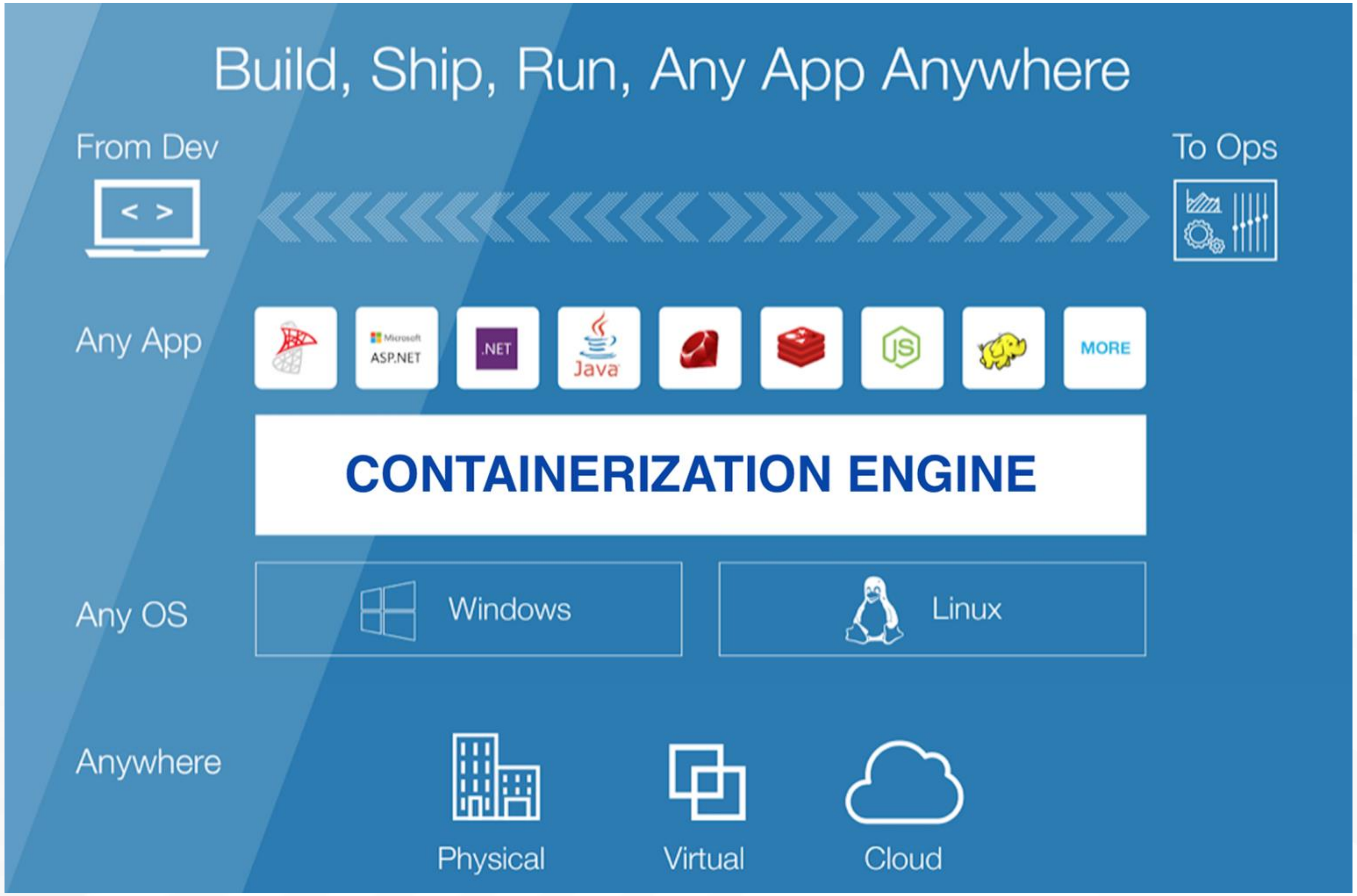
Source: https://www.flexiant.com/2014/02/05/what-does-a-hypervisor-do/

Virtual Machines vs Docker Containers



1.16 Container Platform

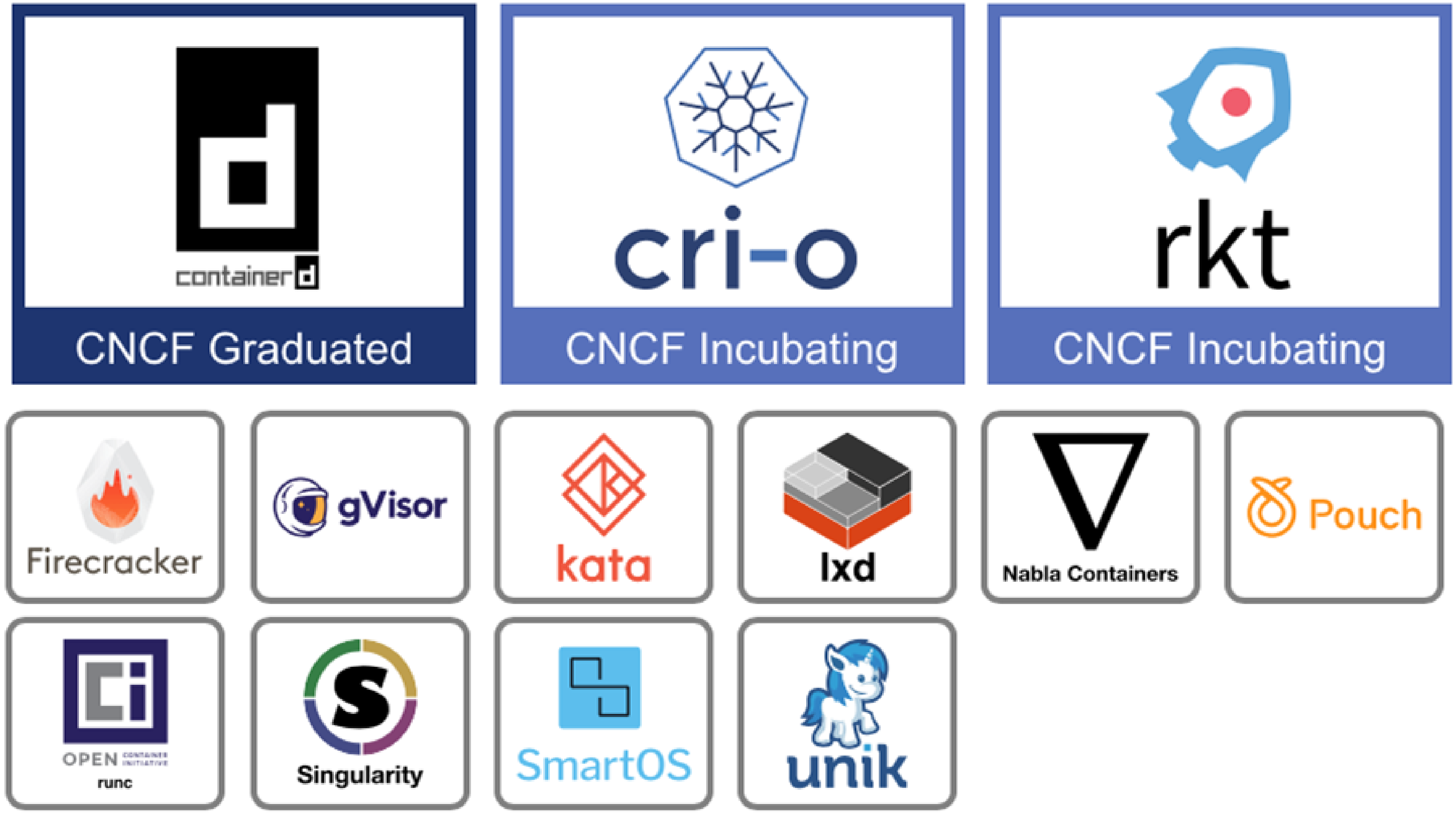
Containerization platform: It can be defined as a technology to isolate processes from each other, in such a manner that processes run like they are running in a normal operating system which is enforced by the container runtime.



Source: https://1.bp.blogspot.com/-kx-LtOGIwqU/XOzPWiztcVI/AAAAAAAAIvE/qURId5PRX40aV-TFJ-B7GA8t5CqAUF_3gCEwYBhgL/s1600/docker.png

1.17 Container Runtime

Container runtime: It is a Container execution environment, which ensures the allocation of limited shares of resources (e.g., CPU, memory, disk) to the containerized application, also exposes the services and APIs and tools for managing containers.



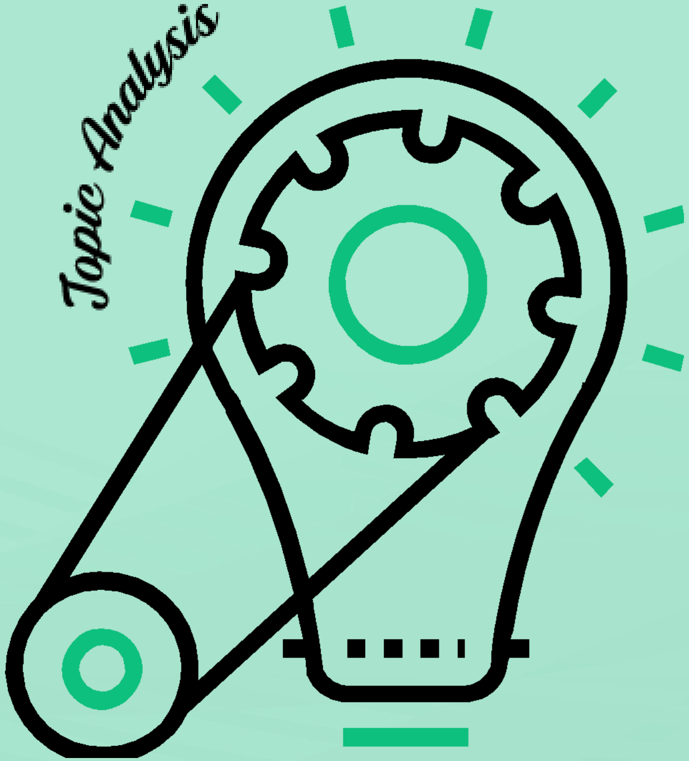
*Source: https://miro.medium.com/max/2486/1*OnB-Ah-FehjzQfhu5-BHmQ.png*

Virtual Machines vs Docker Containers

Criteria	✗ Virtual Machine	Docker ✓
OS support	Occupies a lot of memory space	Docker Containers occupy less space
Boot-up time	Long boot-up time	Short boot-up time
Performance	Running multiple virtual machines leads to unstable performance	Containers have a better performance as they are hosted in a single Docker engine
Scaling	Difficult to scale up	Easy to scale up
Efficiency	Low efficiency	High efficiency
Portability	Compatibility issues while porting across different platforms	Easily portable across different platforms
Space allocation	Data volumes cannot be shared	Data volumes can be shared and reused among multiple containers

VS

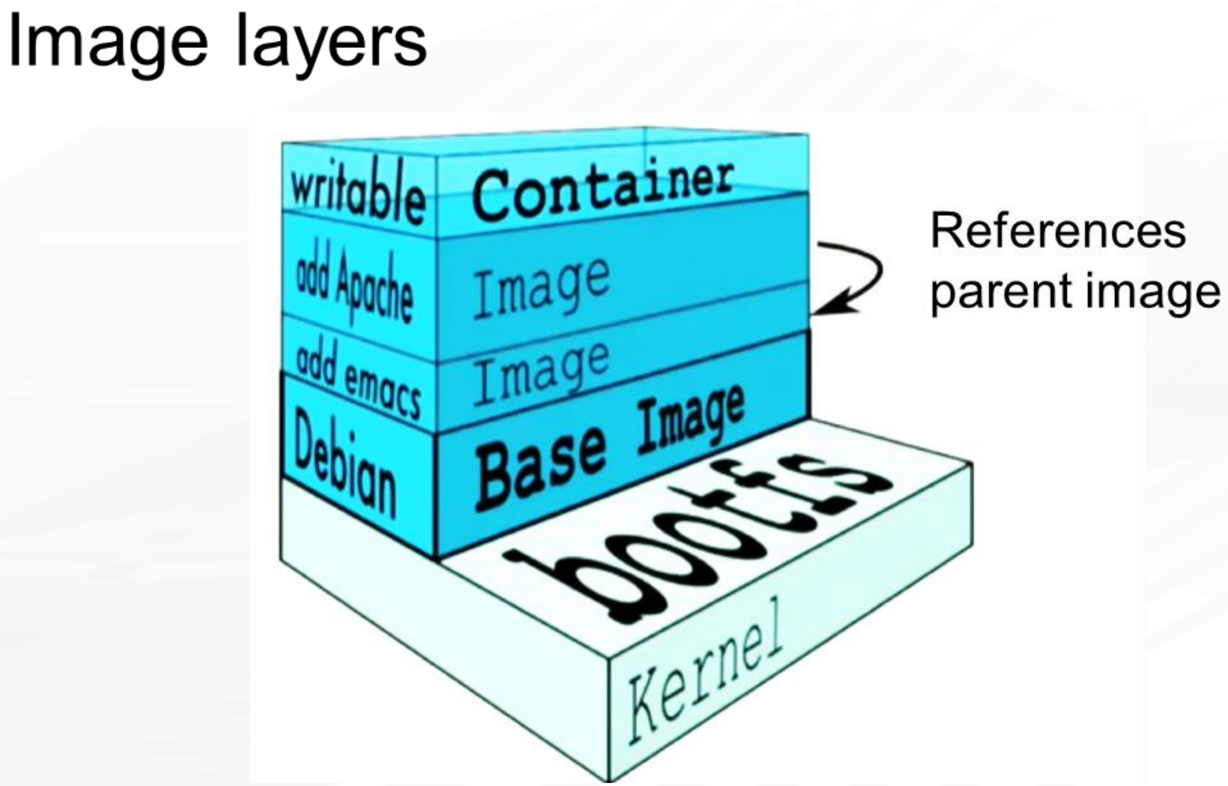
What did you Grasp?



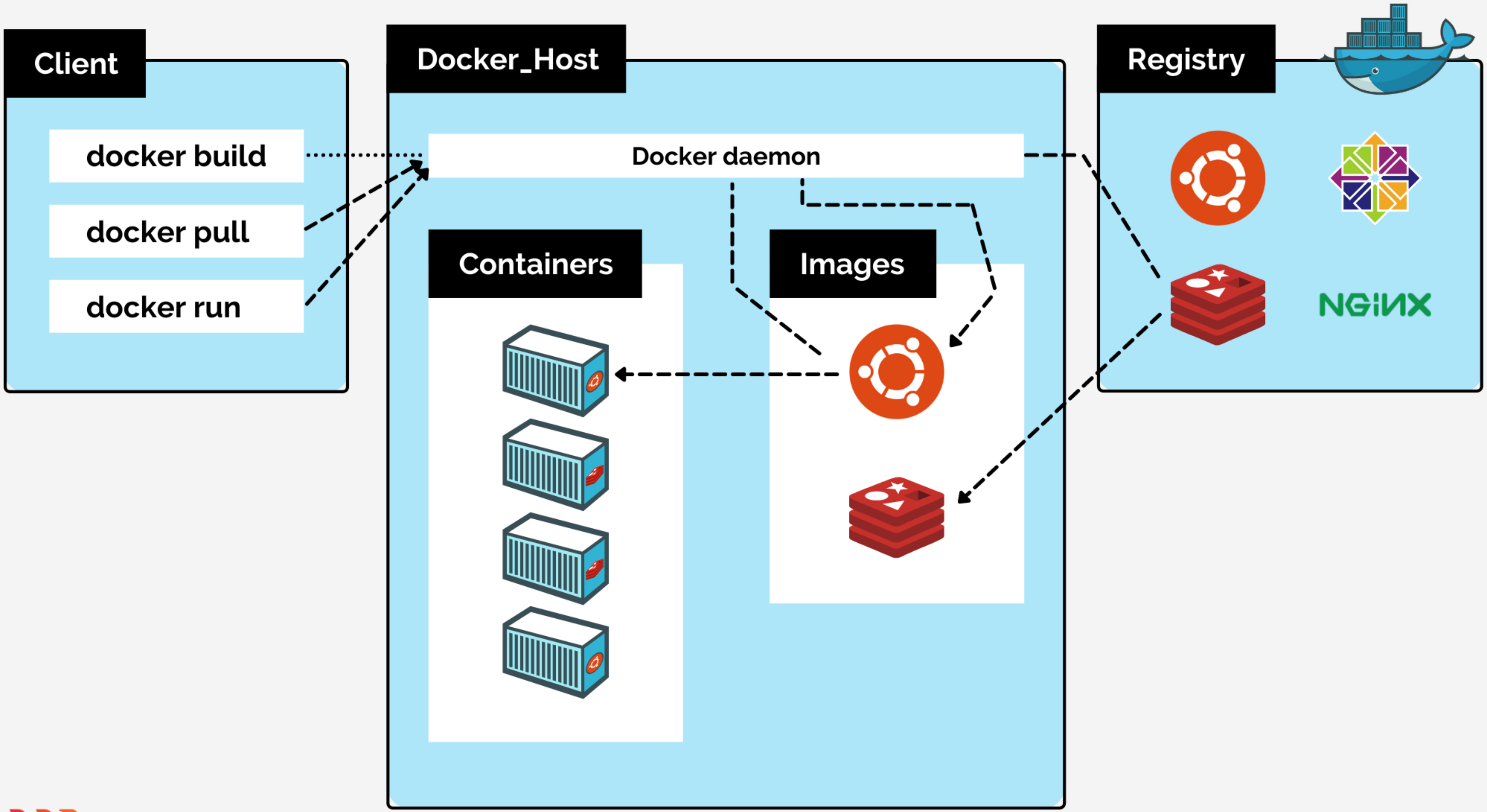
1. What is the main difference between Containerisation and Virtualization?
   - **A) Lifecycle**
   - **B) Isolation**
   - **C) Extraction at software level**
   - **D) Extraction at hardware level**

1.18 Container Images

Image: Images are readable files which will be used to spin up containers. An image defines the file system and execution parameters for the container. Images can be layered, composable, depending on the format of the runtime.



Source: https://s3.amazonaws.com/dev.assets.neo4j.com/wp-content/uploads/20160112150631/image-layers-docker.png



Client

docker build

docker pull

docker run

Docker_Host

Docker daemon

Containers

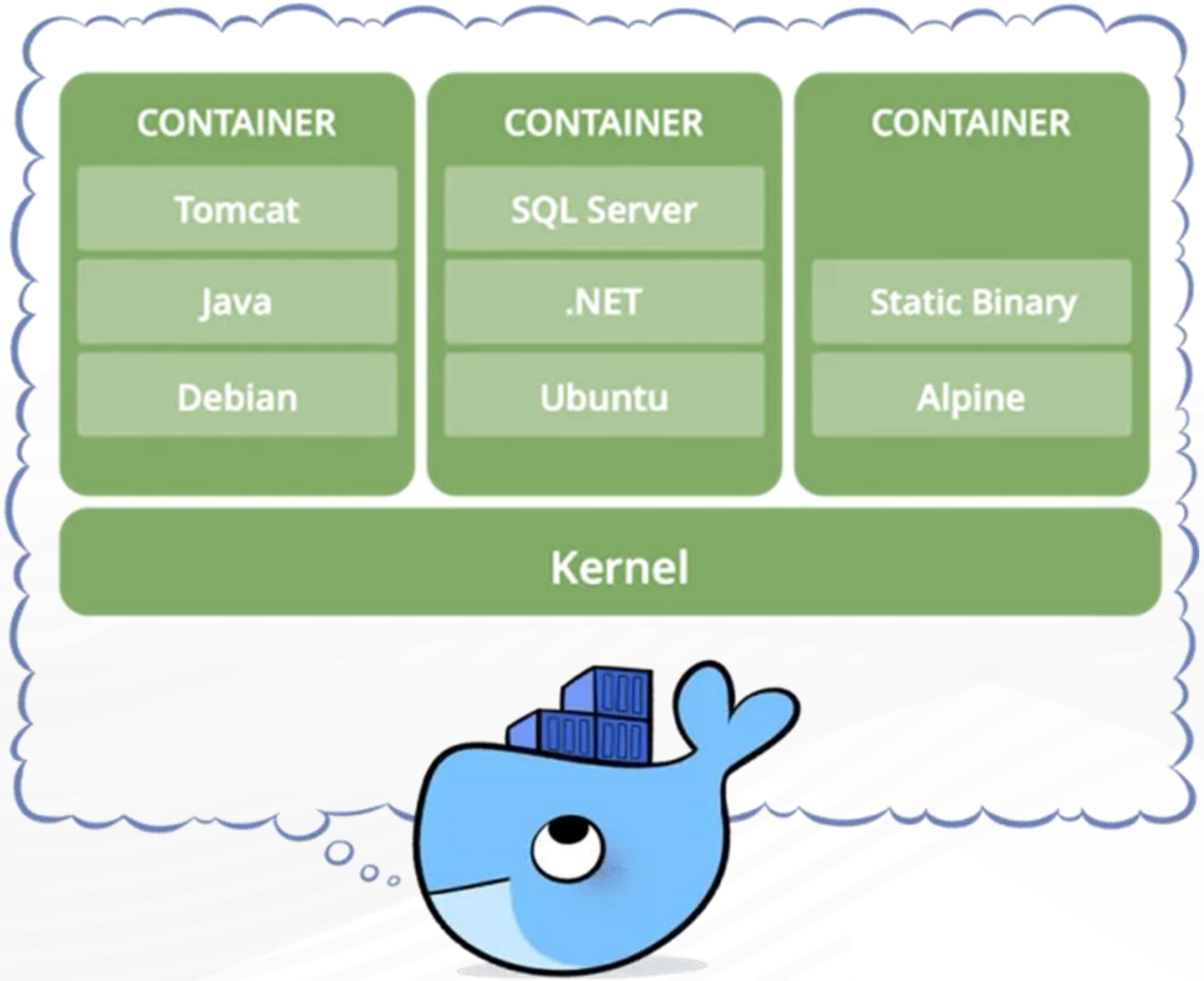
Images

Registry

WHIZLABS

1.23 Docker

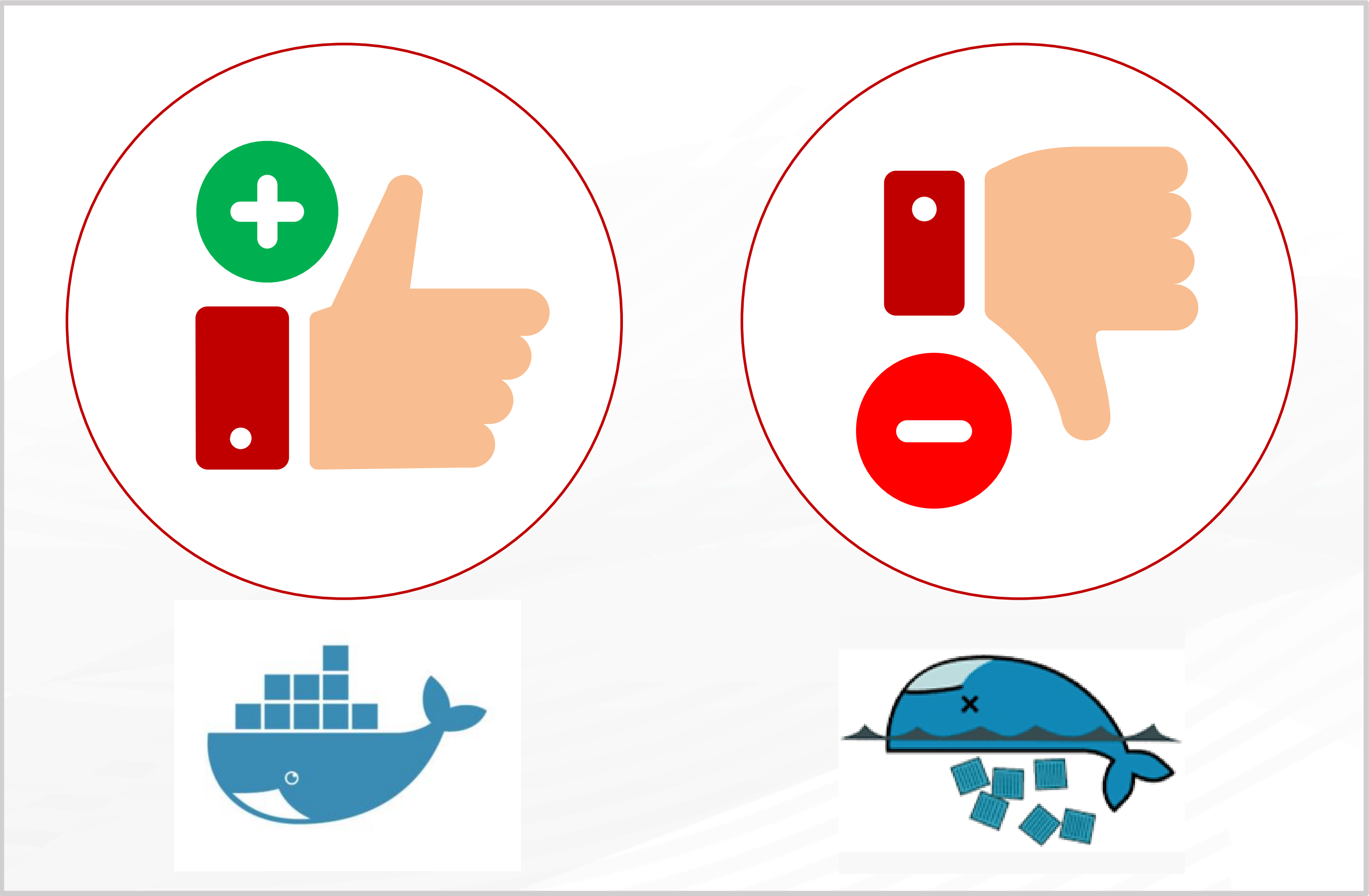
In 2013, the first version of Docker was introduced. Developed by Google engineers collaborating with Docker over libcontainer and porting the core concepts and abstractions to libcontainer.



Source: https://i0.wp.com/www.docker.com/blog/wp-content/uploads/011f3ef6-d824-4d43-8b2c-36dab8eaaa72-1.jpg?fit=650%2C530&ssl=1

2.10 Advantages and Drawbacks of Containerization

Now, we will discuss the advantages and disadvantages of containerization.



2.10.1 Advantages of Containerization

Advantages

Some advantages of Docker are as follows:

- Cost saving
- Standardization and productivity
- Rapid deployment
- Isolution
- Security

2.10.2 Disadvantages of Containerization

Disadvantages

Some disadvantages of Docker are as follows:

- Bare metal speed is better than container
- Ecosystem of a container
- Persistent data storage
- Containers are not compatible with all types of application

Docker Commands (Hands-On)

```
docker –version
docker pull
docker run
docker ps
docker ps -a
docker run -it
docker stop
docker login
docker push
docker images
docker rm
docker rmi
docker build
```