FIBO
CLOUD
EDUCATION

AWS Solutions Architect

Container, Orchestration, DevOps

Н. Ганжигүүр
Fibo Cloud

FIBO
CLOUD
EDUCATION

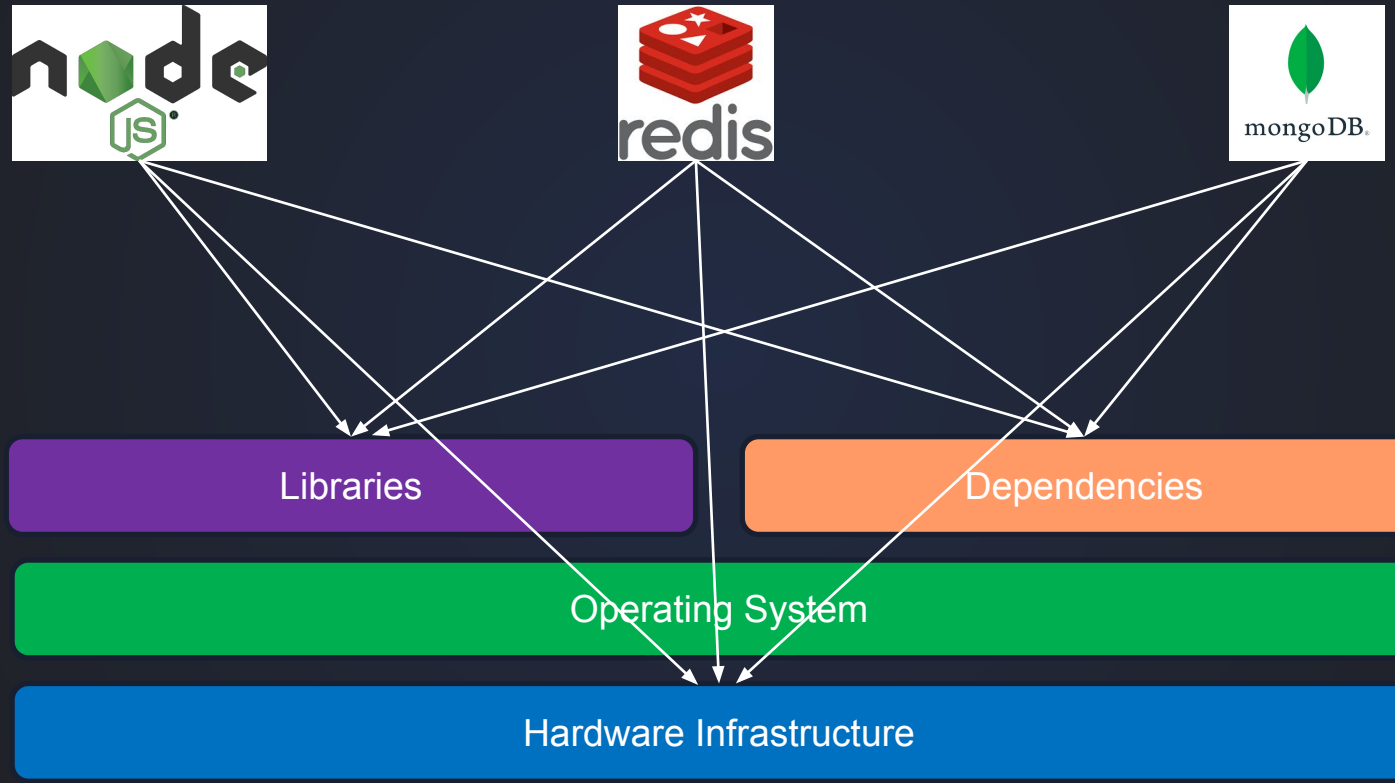
Container technology

What is a container?

FIBO
CLOUD
EDUCATION

Why container? (Isolation)

FIBO CLOUD EDUCATION



Matrix From Hell

FIBO CLOUD EDUCATION

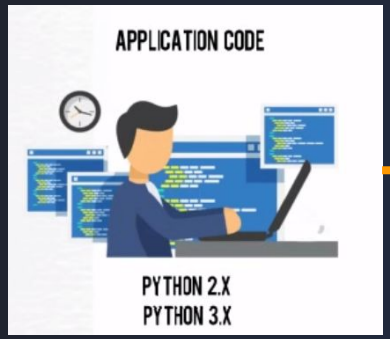
Backend	?	?	?	?	?	?
Web Frontend	?	?	?	?	?	?
User DB	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?
Cache	?	?	?	?	?	?
	Development VM	Production Server	Staging	Production on Cloud	Production on Bare Metal	Developer's Personal Laptop

Problems

FIBO
CLOUD
EDUCATION

- Set up a new environment following many instructions and dependencies
- Setting up takes long time
- Different Dev/Prod/QA environment

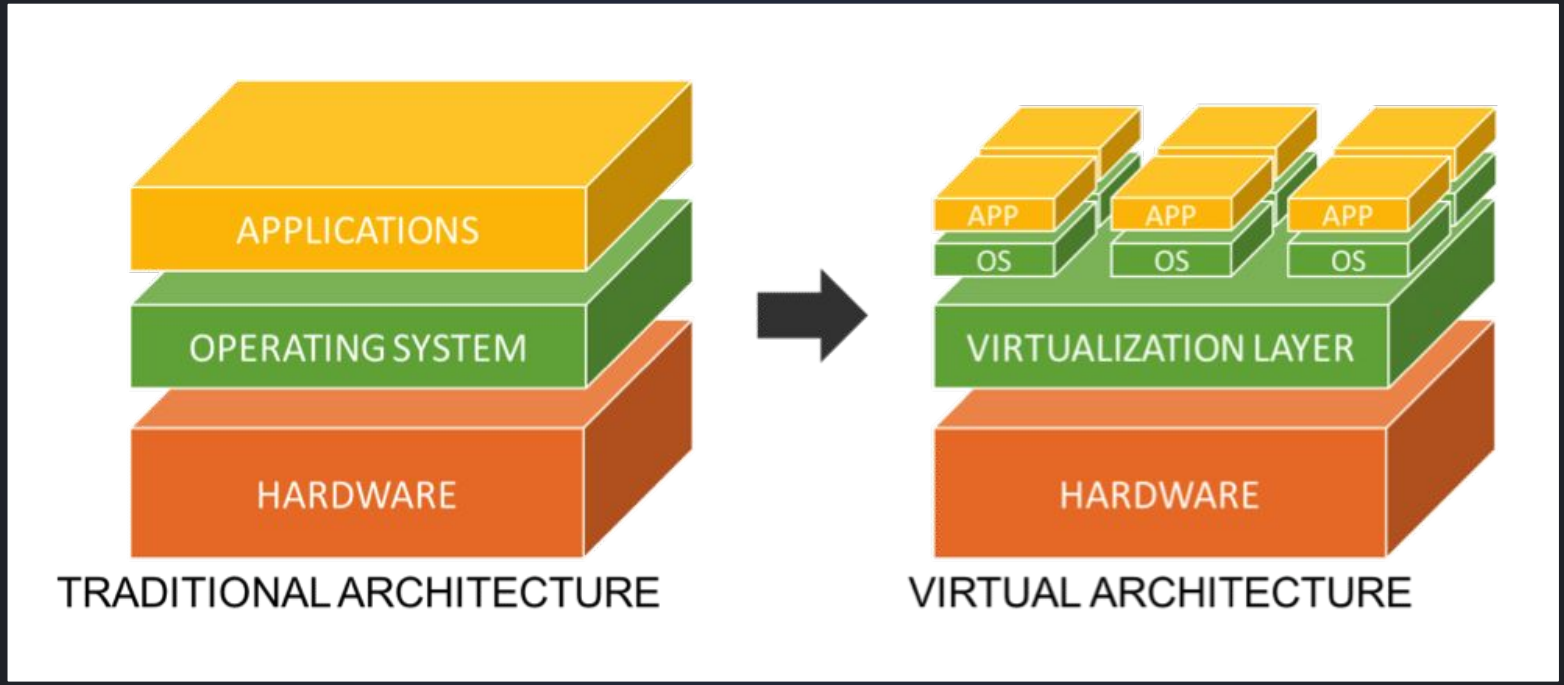
Problems



Works well

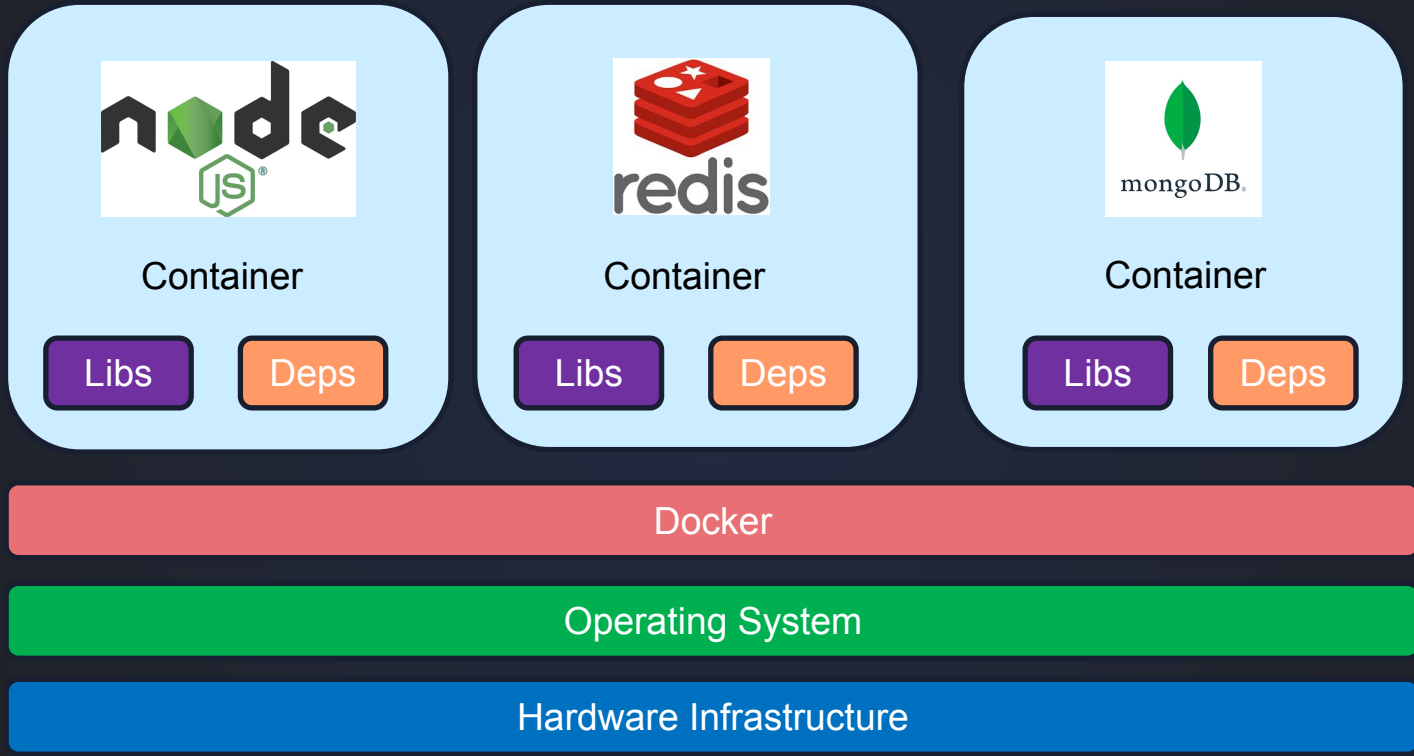
Not working !!!

Virtualization



Docker/Container

FIBO CLOUD EDUCATION



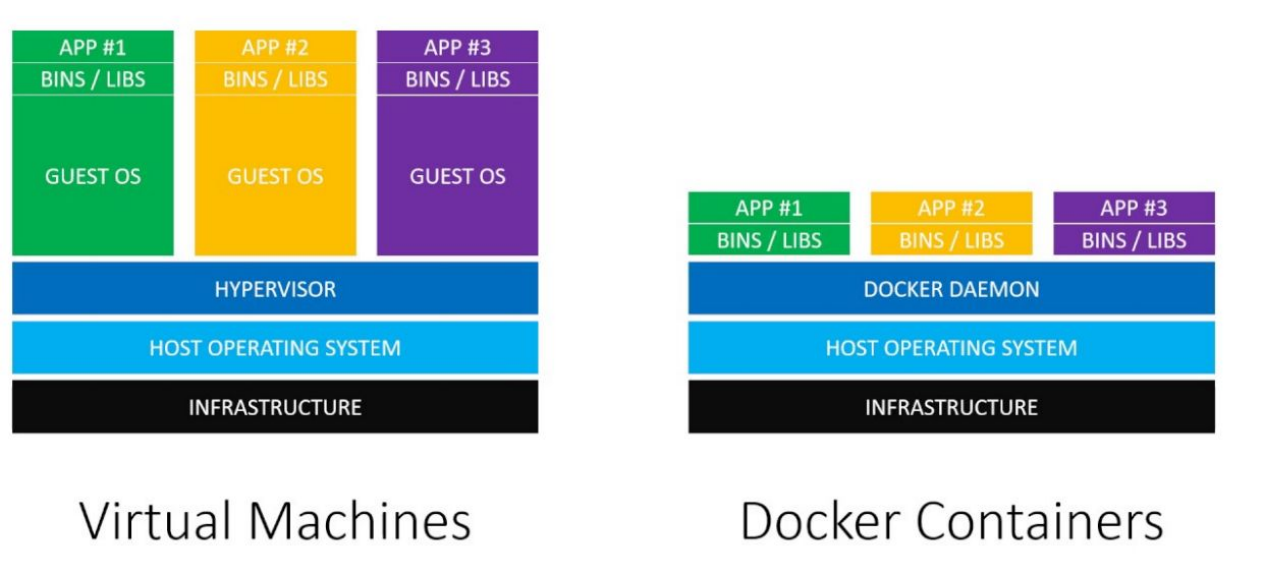
Containers

FIBO CLOUD EDUCATION

Тодорхой бэлдсэн орчинд ажиллах процессийг linux container гэнэ.

Container = Process, Network, File system isolation.

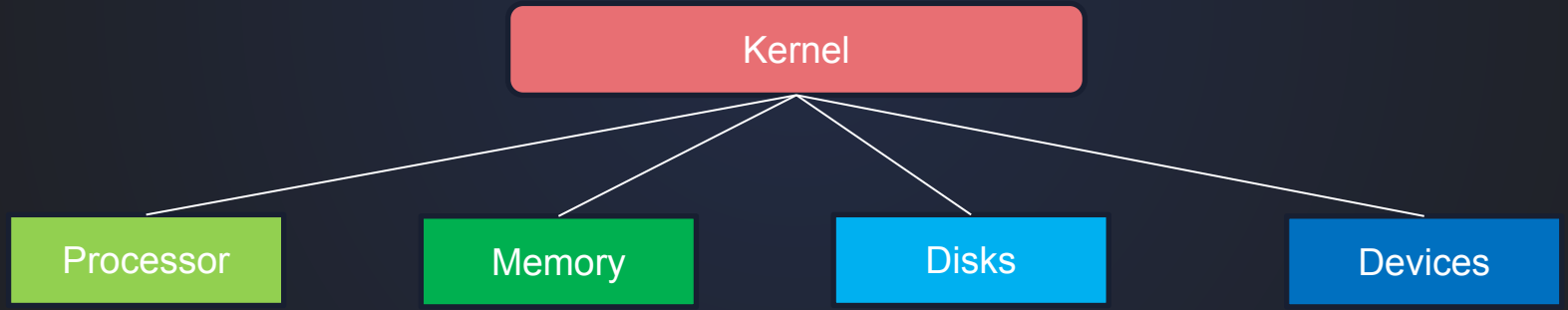
https://www.youtube.com/watch?v=Utf-A4rODH8



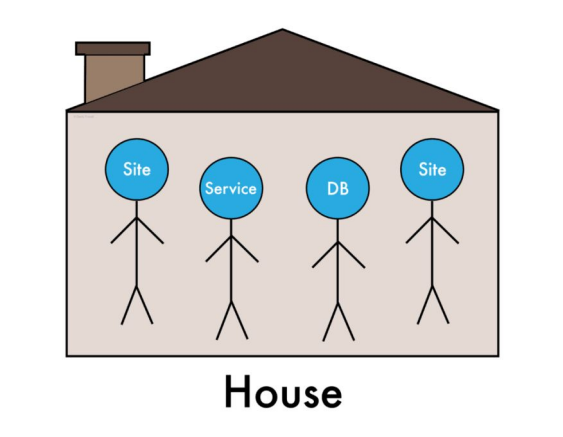
Containers

FIBO CLOUD EDUCATION

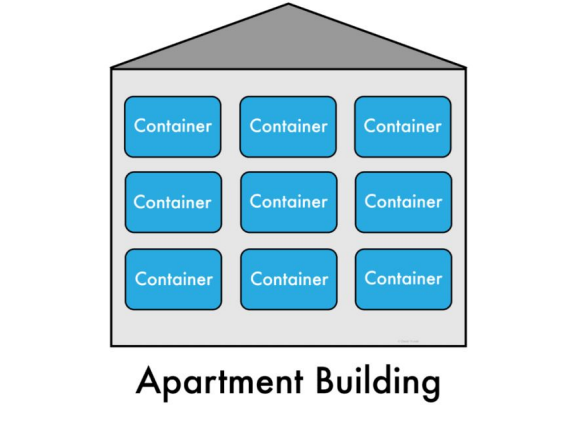
- Isolated environment that can have their own PROCESSES, NETWORK INTERFACES, THEIR OWN MOUNTS
- The difference between Virtual Machines and Container is that Containers share **the same OS Kernel** as their host operating System



Analogy



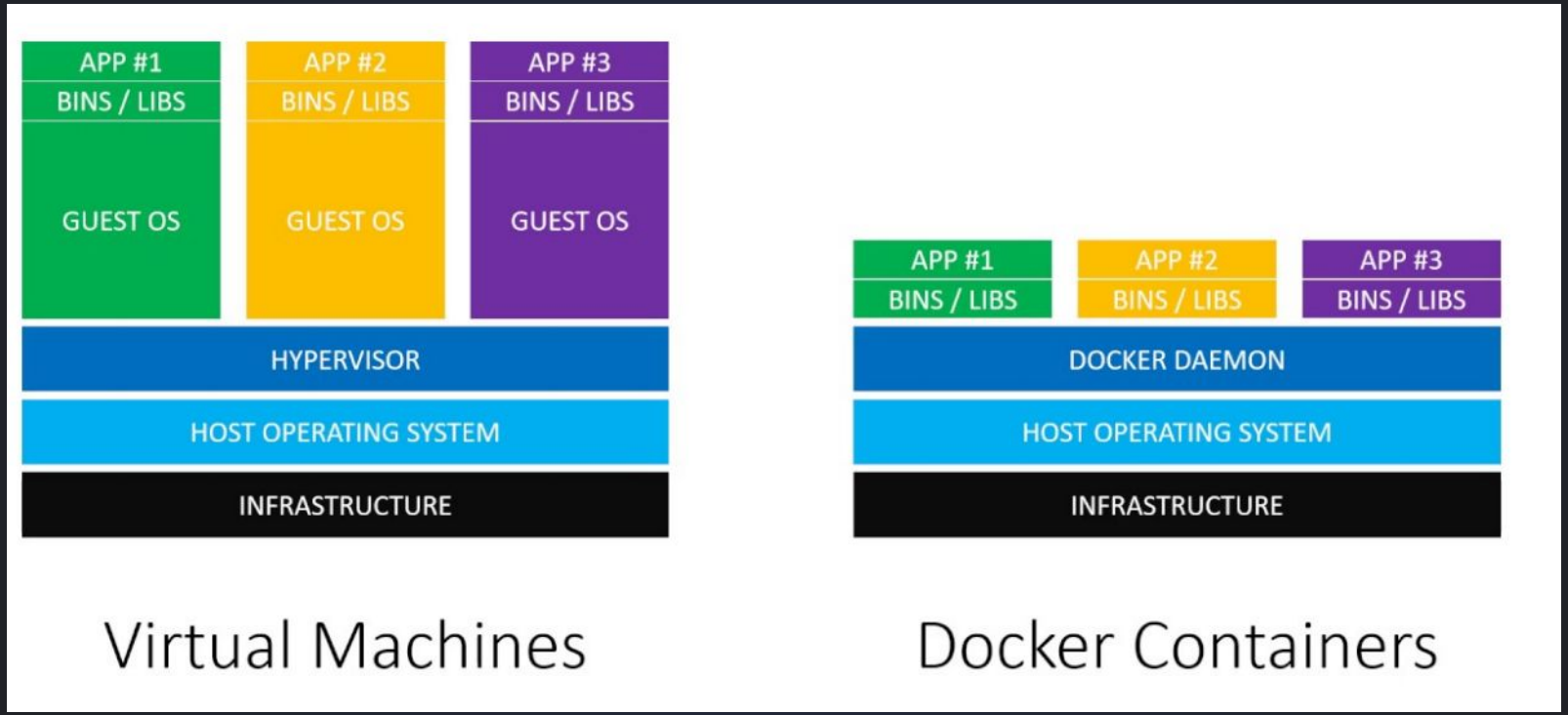
Тусдаа ус, шугам,
цахилгаан



Дундын цэвэр бохир усны
шугам, цахилгааны оролт

Architecture

FIBO CLOUD EDUCATION



Container technologies

FIBO CLOUD EDUCATION

- FreeBSD Jails
- Rkt from CoreOS
- LXD
- Linux VServer
- Window Containers & Hyper-V Container
- Docker

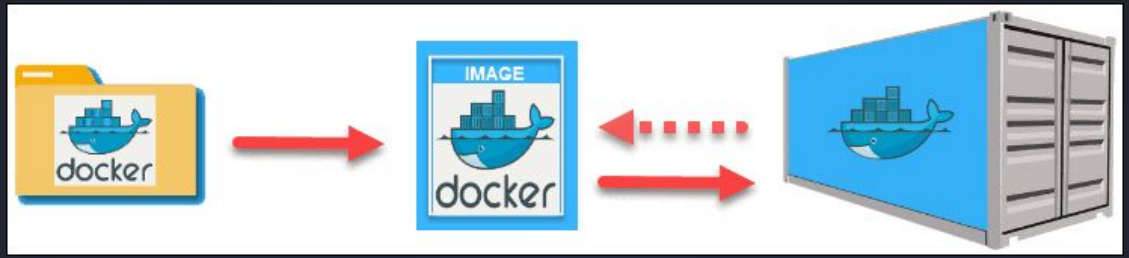
Docker

FIBO
CLOUD
EDUCATION

- Developer friendly Linux Container Engine
- Image based container engine
- Rapid deployment
- CI/CD friendly

Container vs Image

FIBO CLOUD EDUCATION



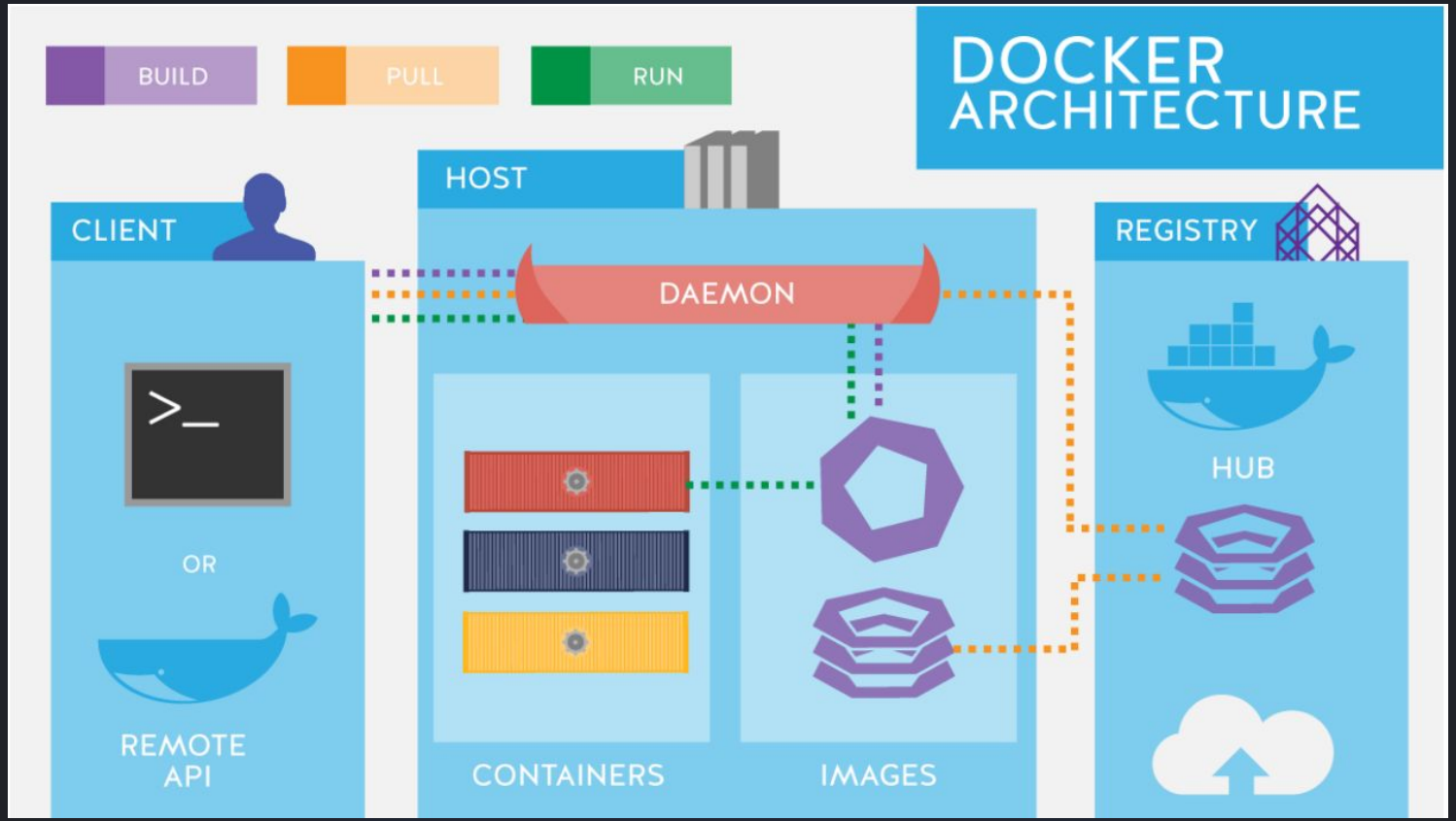
Dockerfile – Instructions to build a docker image

Docker Image – A package or a template of given application with its environment

Docker Container - Running instance of an docker image

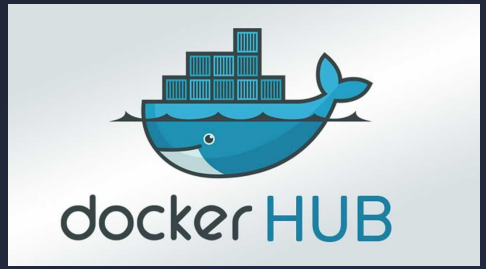
Lifecycle

FIBO CLOUD EDUCATION



Docker hub

FIBO
CLOUD
EDUCATION



Public Docker Registry – a cloud repository in which Docker users create, store and distribute container images

Docker Containers Management on AWS

- Amazon Elastic Container Service (Amazon ECS)
  - Amazon's own container platform
- Amazon Elastic Kubernetes Service (Amazon EKS)
  - Amazon's managed Kubernetes (open source)
- AWS Fargate
  - Amazon's own Serverless container platform
  - Works with ECS and with EKS
- Amazon ECR:
  - Store container images

Amazon ECS

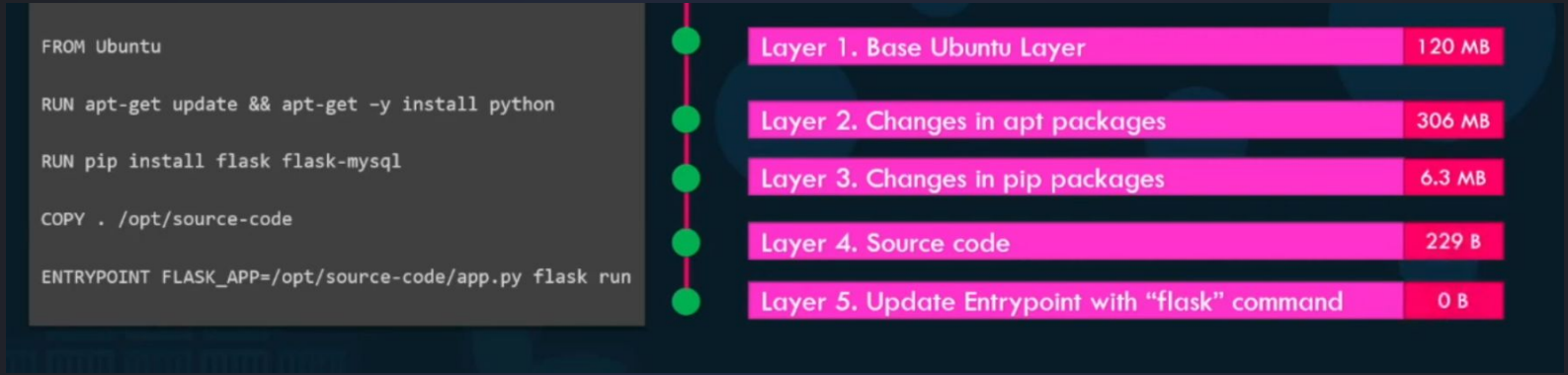
Amazon EKS

AWS Fargate

Amazon ECR

Layers

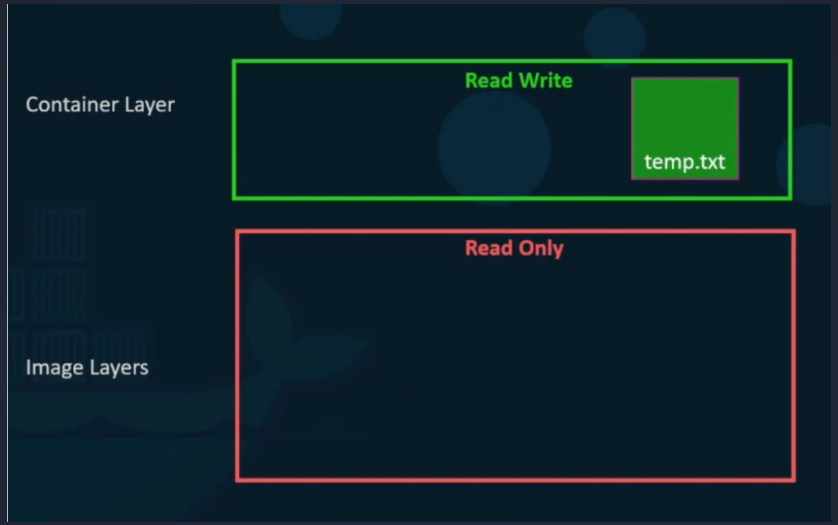
FIBO CLOUD EDUCATION



- Each Layer only store the changes from the previous layer
- Docker history <image_name>

Storage in docker

FIBO CLOUD EDUCATION



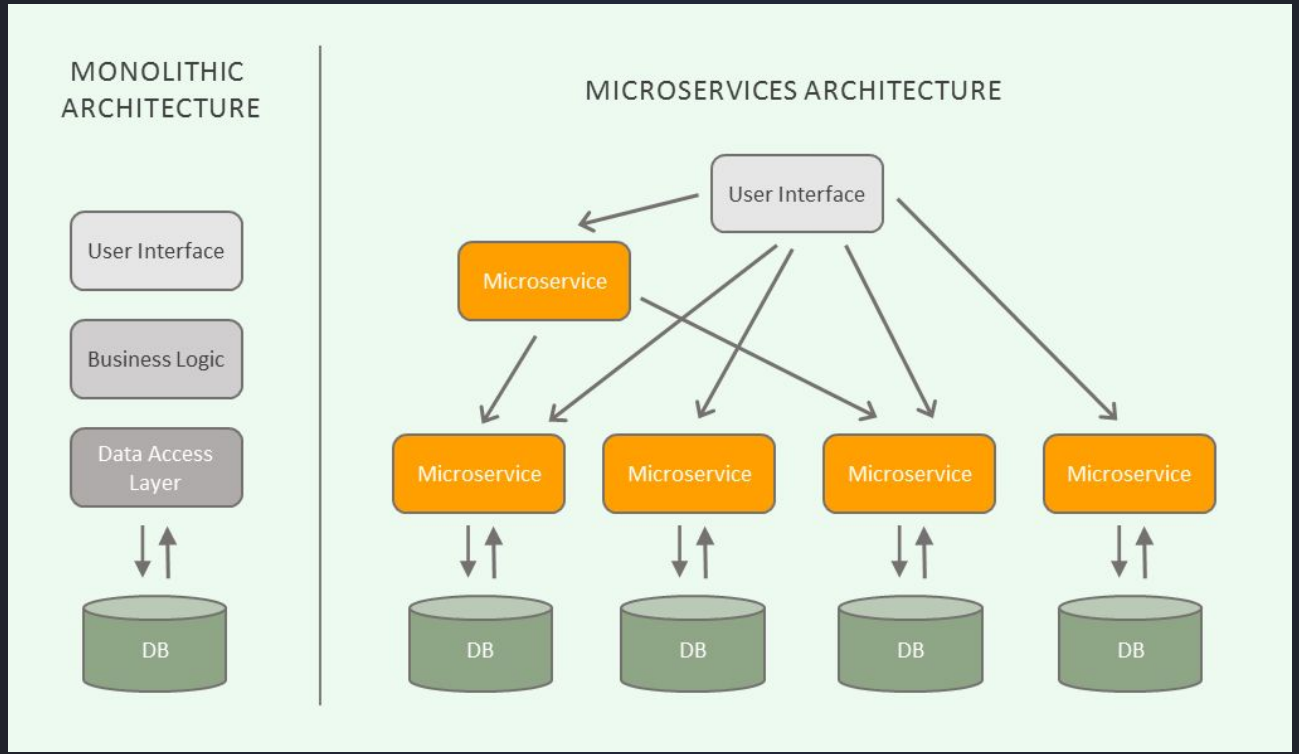
When the container is stopped, the container layer is destroyed.

FIBO
CLOUD
EDUCATION

Orchestration

Microservices

FIBO CLOUD EDUCATION



Challenges

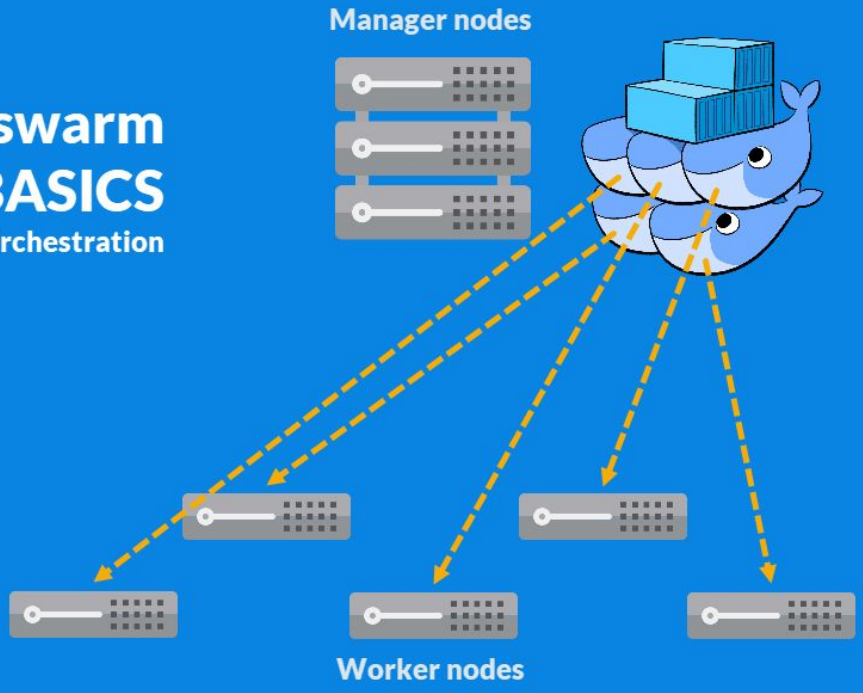
FIBO CLOUD EDUCATION

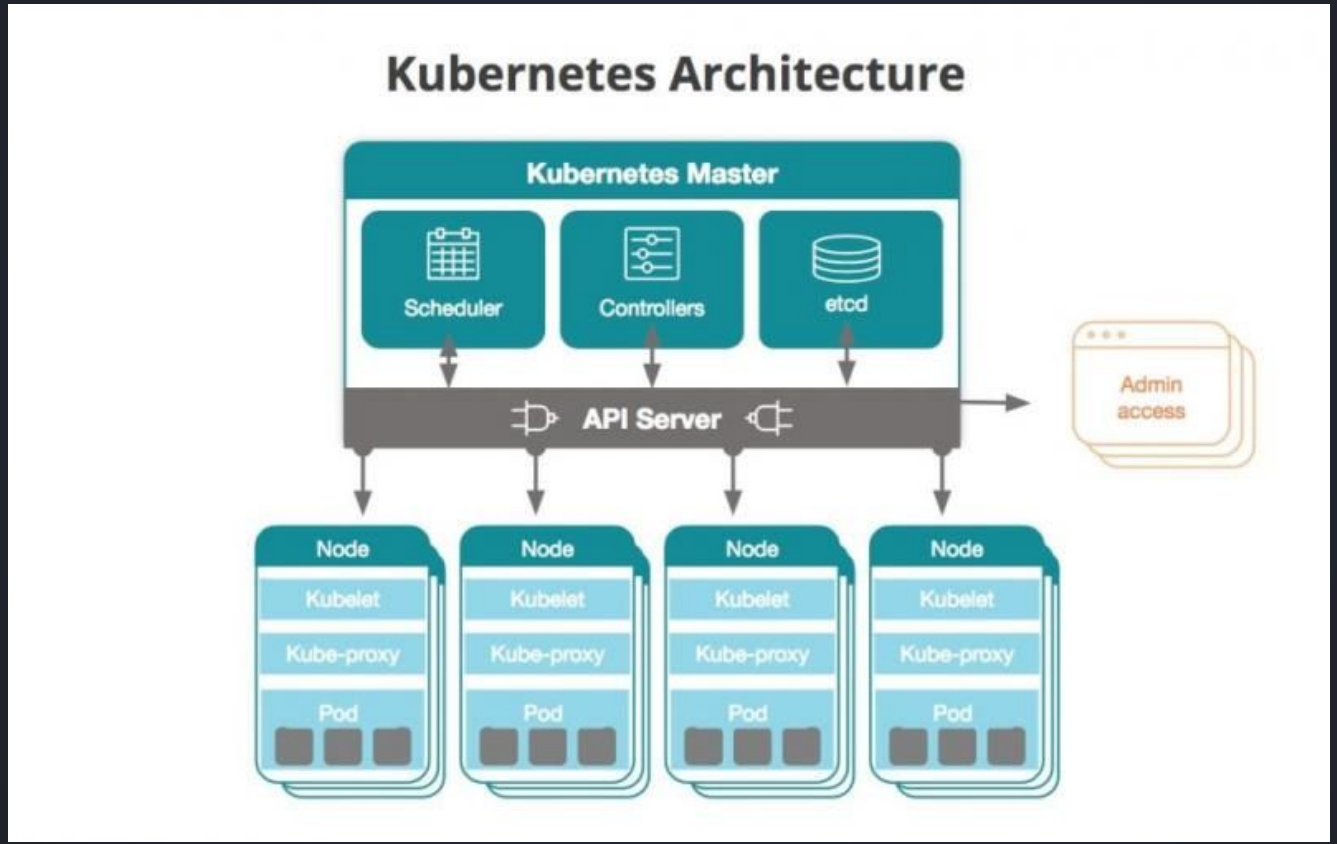
- Service Discovery
- Load Balancing
- Secrets/configuration/storage management
- Health checks
- Auto-[scaling/restart/healing] of containers and nodes
- Zero-downtime deploys
- Highly Availability

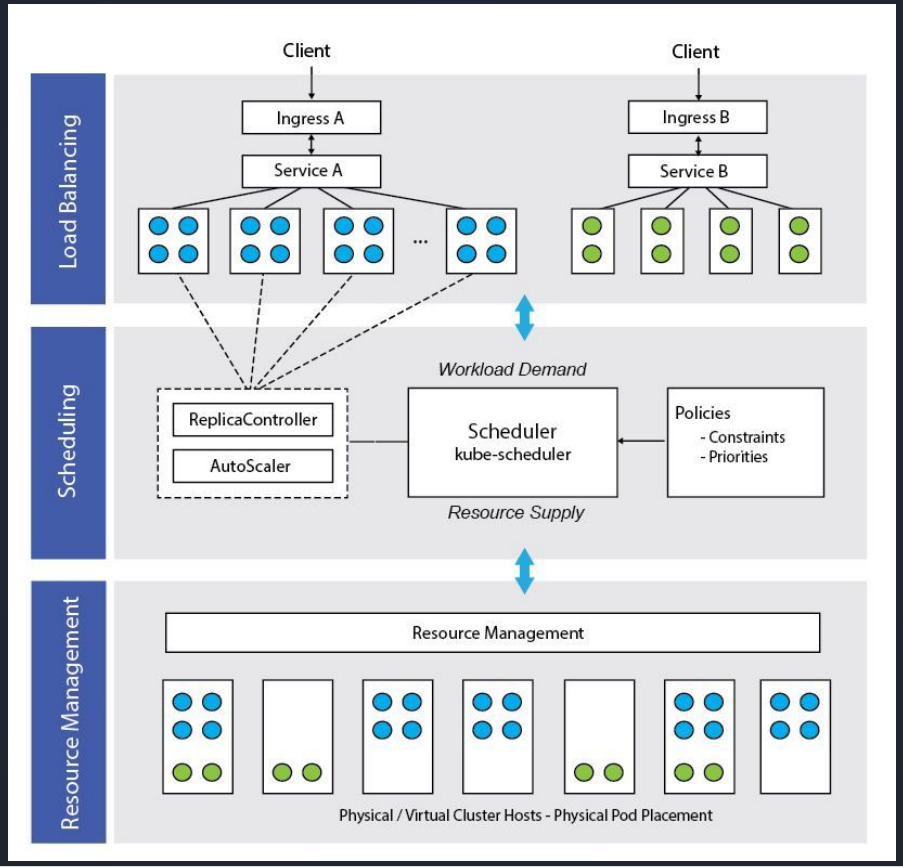
FIBO
CLOUD
EDUCATION

docker swarm BASICS

Container Orchestration




Kubernetes Architecture
Kubernetes Master
Scheduler
Controllers
etcd
API Server
Admin access
Node
Kubelet
Kube-proxy
Pod
Node
Kubelet
Kube-proxy
Pod
Node
Kubelet
Kube-proxy
Pod
Node
Kubelet
Kube-proxy
Pod


Client
Client
Load Balancing
Ingress A
Service A
Ingress B
Service B
...
Scheduling
Workload Demand
ReplicaController
AutoScaler
Scheduler
kube-scheduler
Policies
- Constraints
- Priorities
Resource Supply
Resource Management
Resource Management
Physical / Virtual Cluster Hosts - Physical Pod Placement

FIBO
CLOUD
EDUCATION

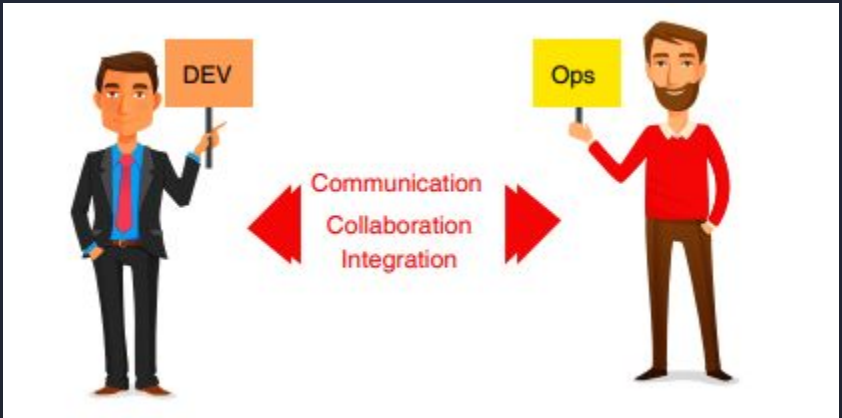
DevOps

Example

FIBO CLOUD EDUCATION

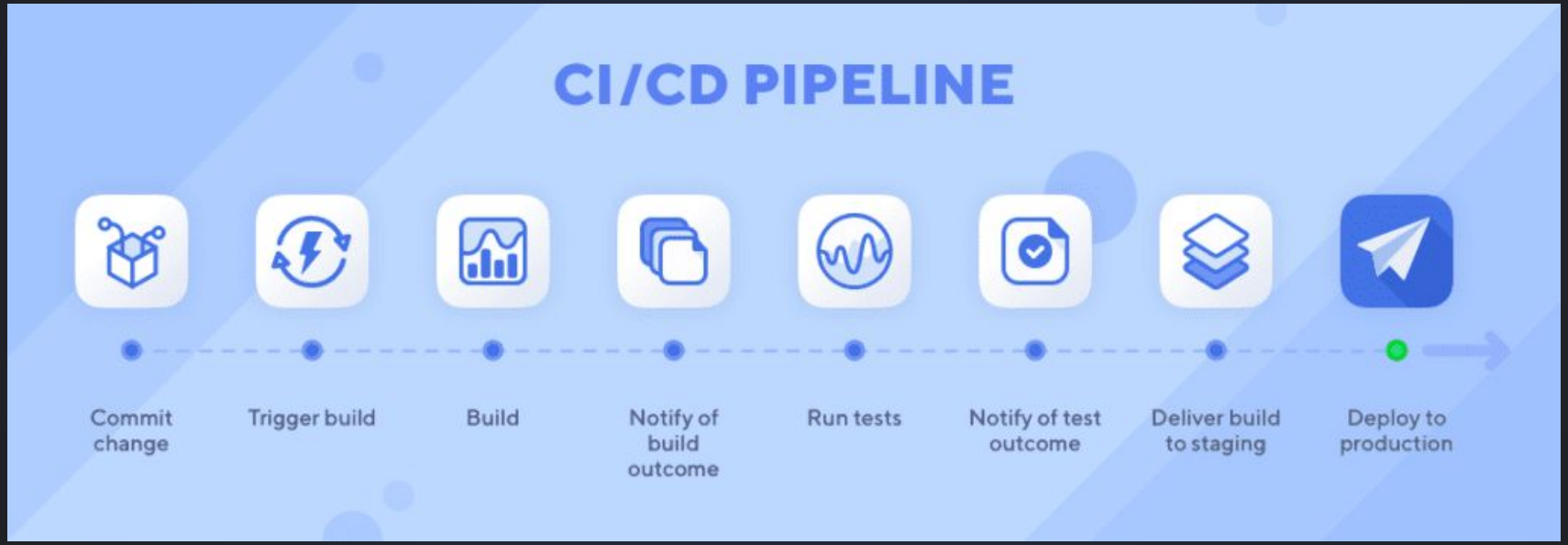
Waterfall -> Agile

DevOps = Developer + Operation



CI/CD

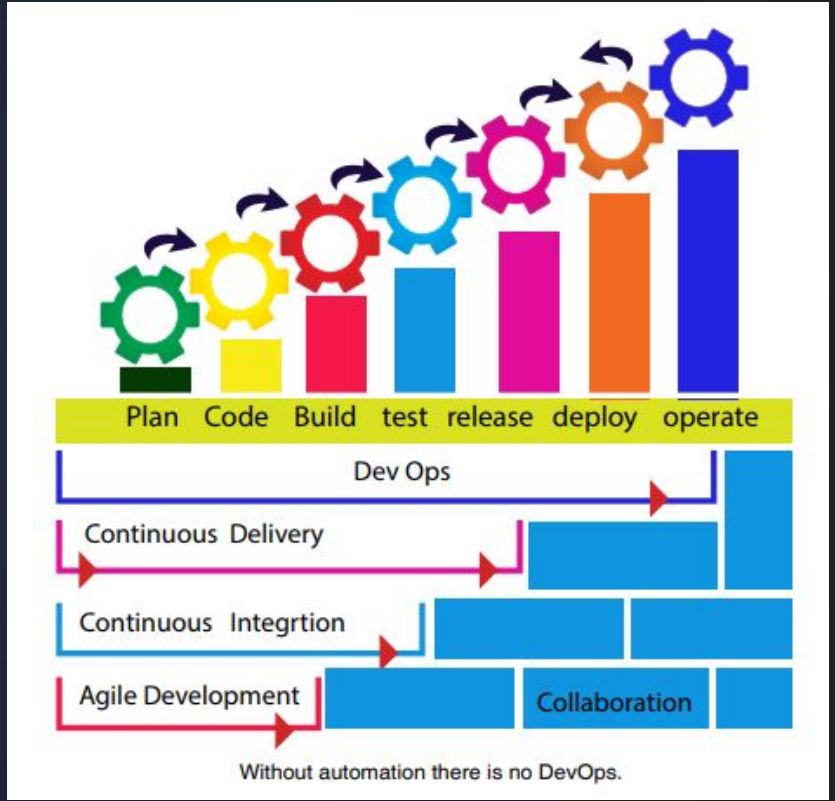
FIBO CLOUD EDUCATION



CI/CD

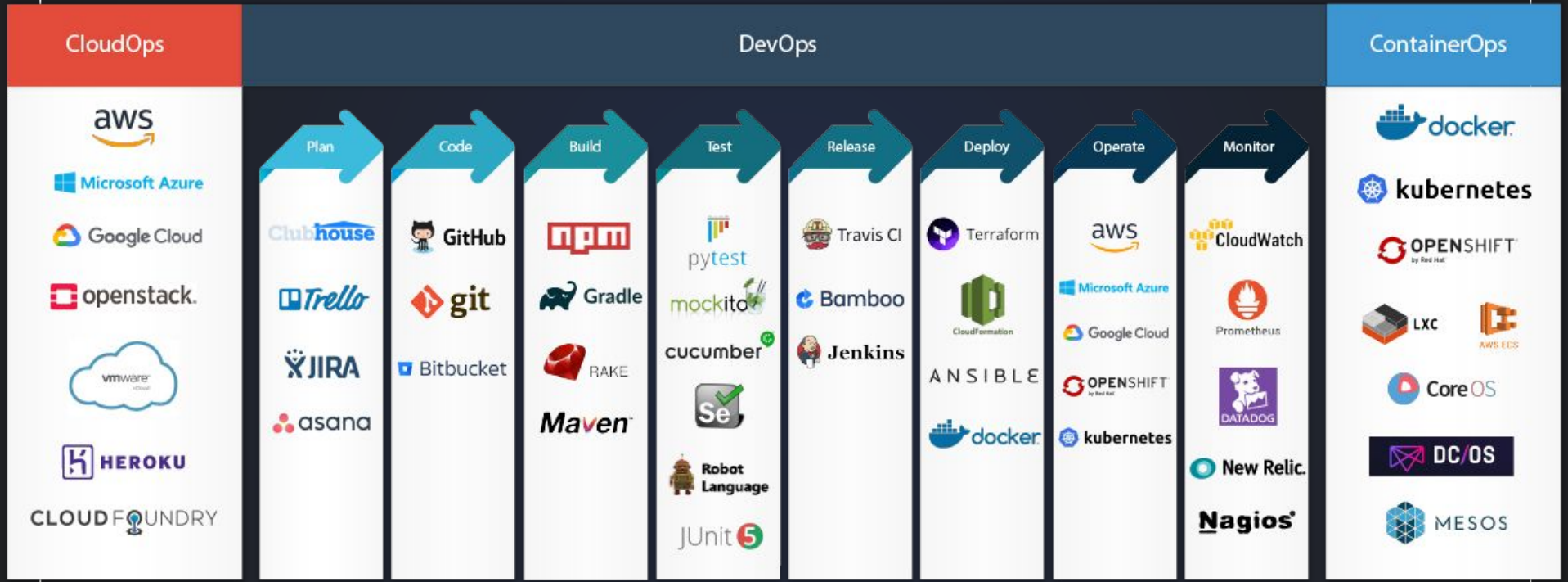
FIBO CLOUD EDUCATION

- **Automate Provisioning** - Infrastructure as Code
- **Automate Builds** – Continuous Integration
- **Automate Deployments** – Defined Deployment Pipeline and Continuous Deployments with appropriate configurations for the environments
- **Automate Testing** – Continuous Testing, Automated tests after each deployment
- **Automate Monitoring** – Proper monitors in place sending alerts
- **Automate Metrics** – Performance Metrics, Logs



DevOps tools

FIBO CLOUD EDUCATION



CI/CD definition

FIBO CLOUD EDUCATION

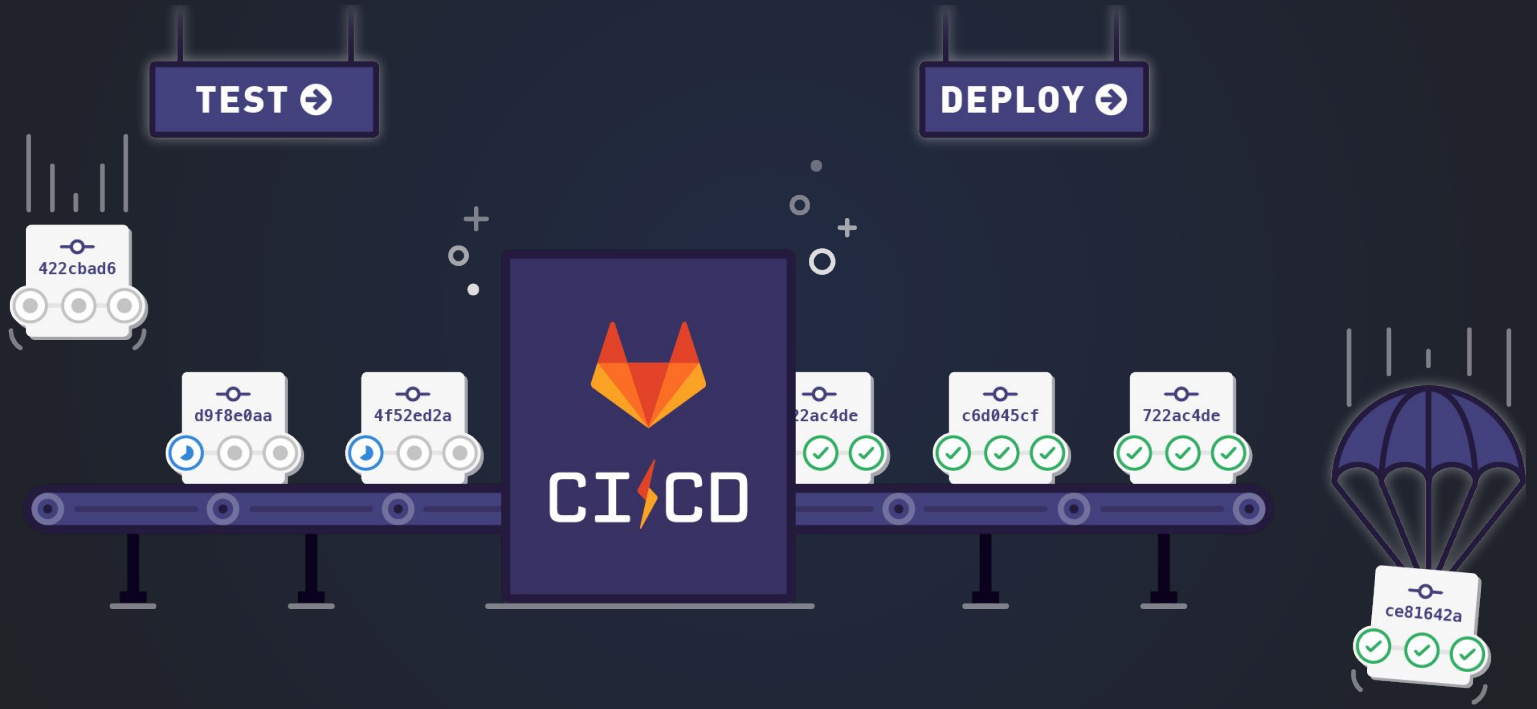
Continuous Integration is the practice of integrating code into a shared repository and building/testing each change automatically, as early as possible - usually several times a day.

Continuous Delivery adds that the software can be released to production at any time, often by automatically pushing changes to a staging system.

Continuous Deployment goes further and pushes changes to production automatically.

Pipeline

FIBO CLOUD EDUCATION



SRE

FIBO CLOUD EDUCATION

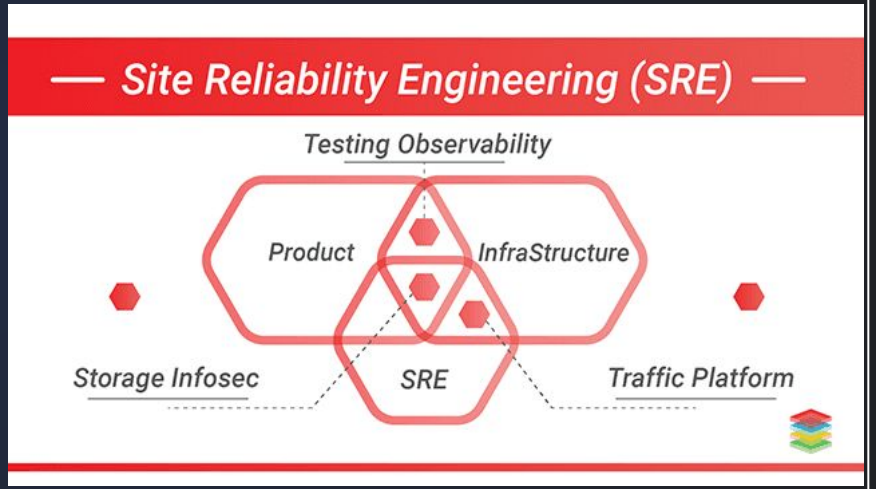
SRE vs DevOps?

SRE

- Operations
- Incident response
- Post Mortems
- Monitoring, Events, Alertings
- Capacity planning
- Primary focus: Reliability

DevOps

- Delivery
- Release automation
- Environment builds
- Config management
- Infrastructure as code
- Primary focus: Delivery Speed

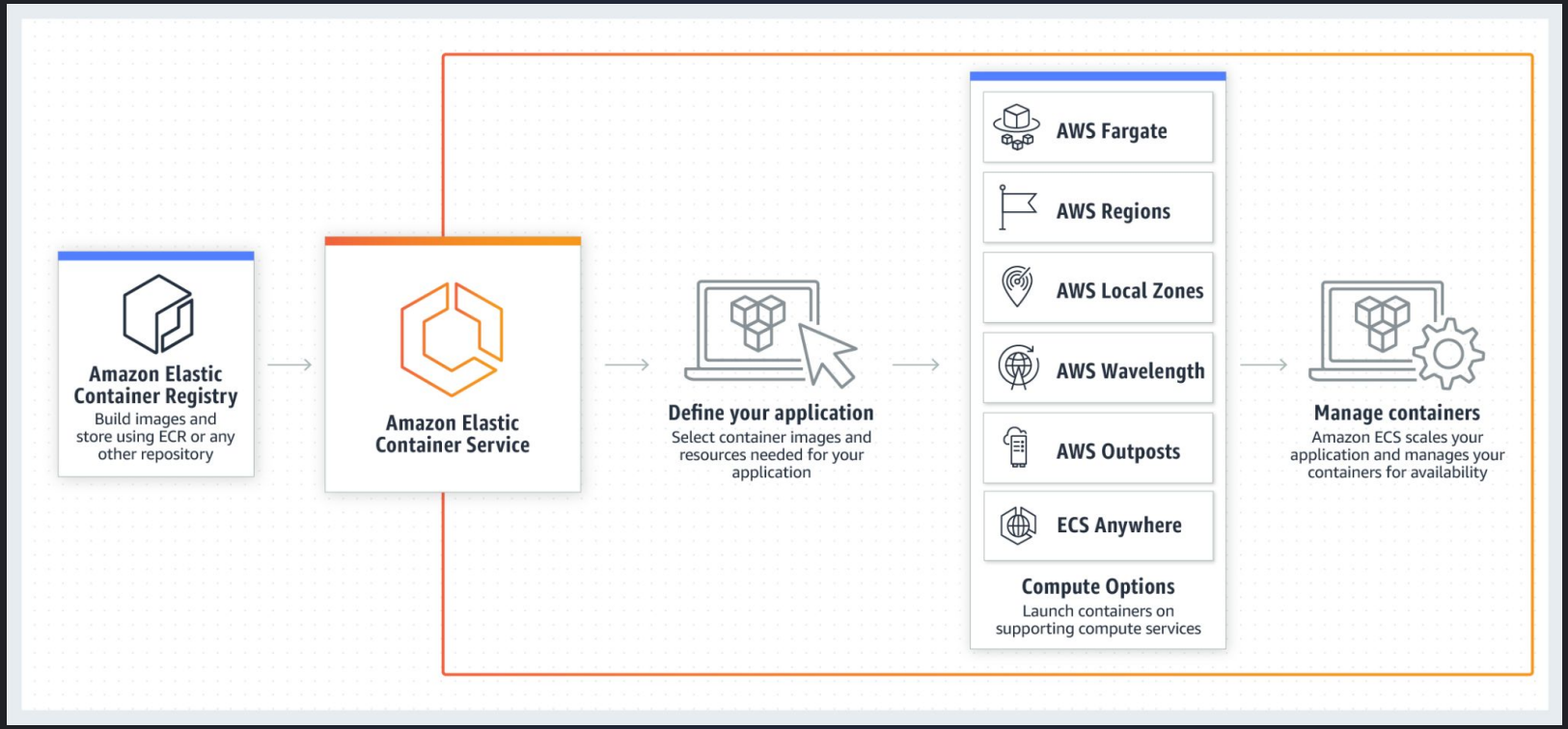


FIBO
CLOUD
EDUCATION

AWS Container services

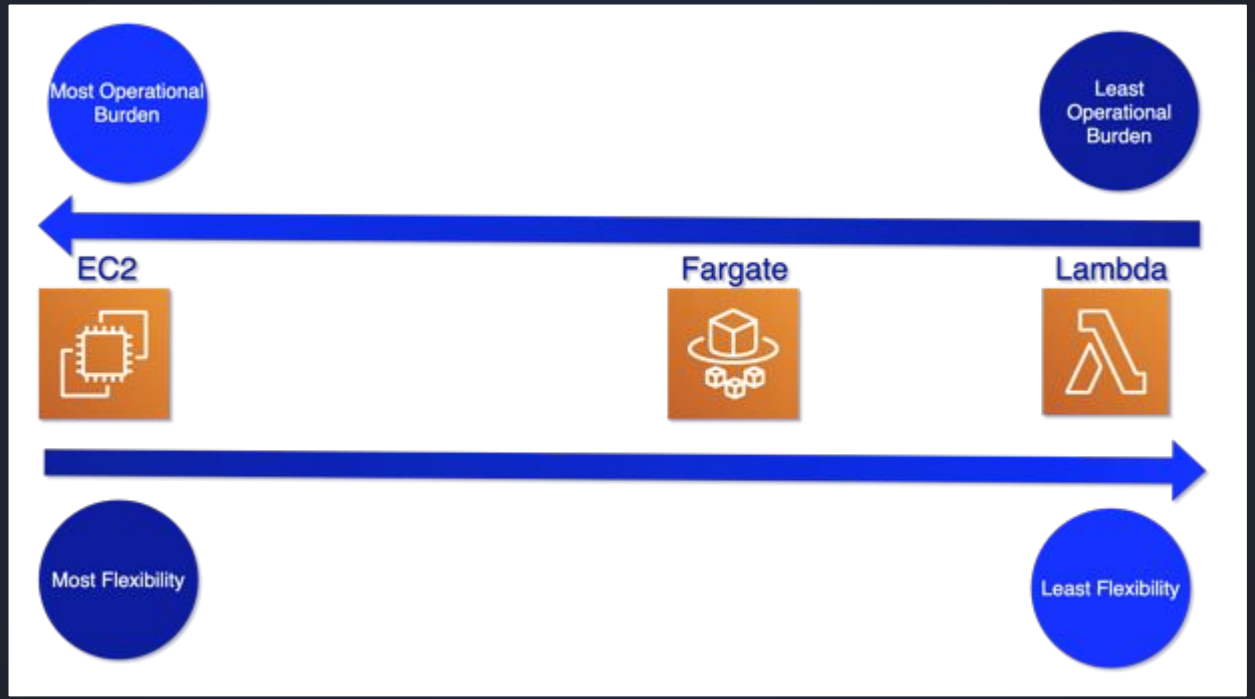
ECS

FIBO CLOUD EDUCATION



ECS Fargate - Serverless container

FIBO CLOUD EDUCATION



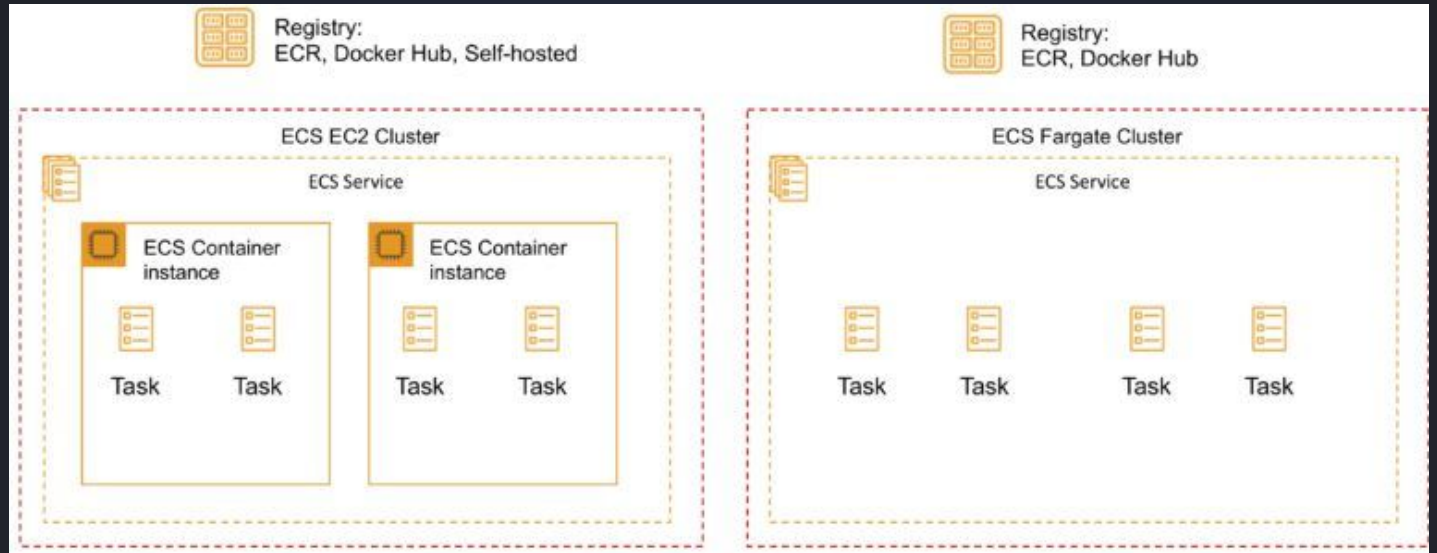
ECS Fargate - Serverless container

FIBO CLOUD EDUCATION

Amazon EC2	Amazon Fargate
You explicitly provision EC2 instances	The control plane asks for resources and Fargate automatically provisions
You're responsible for upgrading, patching, care of EC2 pool	Fargate provisions compute as needed
You must handle cluster optimization	Fargate handles cluster optimization
More granular control over infrastructure	Limited control, as infrastructure is automated

ECS Fargate - Serverless container

FIBO CLOUD EDUCATION



EC2 Launch Type

- You explicitly provision EC2 instances
- You're responsible for managing EC2 instances
- Charged per running EC2 instance
- EFS and EBS integration
- You handle cluster optimization
- More granular control over infrastructure

Fargate Launch Type

- Fargate automatically provisions resources
- Fargate provisions and manages compute
- Charged for running tasks
- No EFS and EBS integration
- Fargate handles cluster optimization
- Limited control, infrastructure is automated

ECS

FIBO CLOUD EDUCATION

Elastic Container Service (ECS) Term	Description
Cluster	Logical grouping of EC2 instances
Container instance	EC2 instance running the ECS agent
Task Definition	Blueprint that describes how a docker container should launch
Task	A running container using settings in a Task Definition
Service	Defines long running tasks – can control task count with Auto Scaling and attach an ELB

EKS

FIBO CLOUD EDUCATION

Amazon ECS	Amazon EKS
Managed, highly available, highly scalable container platform	
AWS-specific platform that supports Docker containers	Compatible with upstream Kubernetes so it's easy to lift and shift from other Kubernetes deployments
Considered simpler to learn and use	Considered more feature-rich and complex with a steep learning curve
Leverages AWS services like Route 53, ALB, and CloudWatch	A hosted Kubernetes platform that handles many things internally
"Tasks" are instances of containers that are run on underlying compute but more or less isolated	"Pods" are containers collocated with one another and can have shared access to each other
Limited extensibility	Extensible via a wide variety of third-party and community add-ons

FIBO
CLOUD
EDUCATION

Deployment Types

1. Basic deployments

FIBO CLOUD EDUCATION

Basic deployments update everything at once, which can cause problems and make it hard to undo changes. They're fast and cheap but risky, so they're best for non-important stuff or when not many people are using the service.

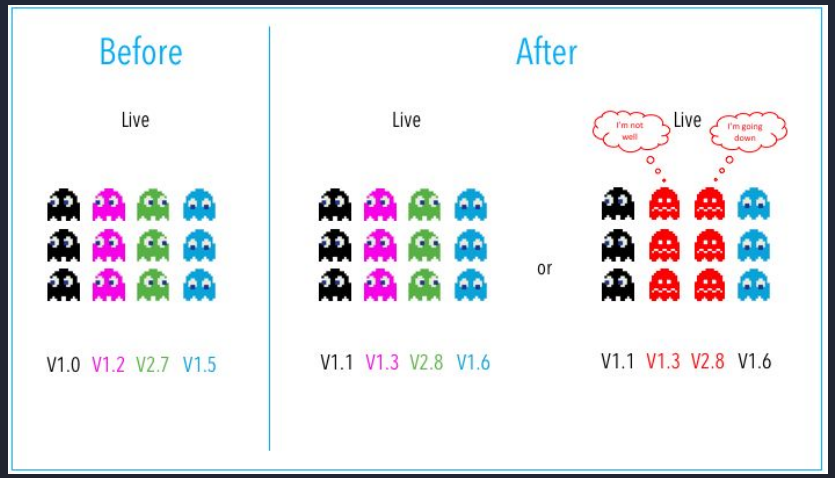
2. Multi service deployment

FIBO CLOUD EDUCATION

In multi-service deployment, all parts of the system get updated together. It's good for apps with linked parts or when updating unused resources.

Pros: It's simple, quick, and less risky than basic deployment.

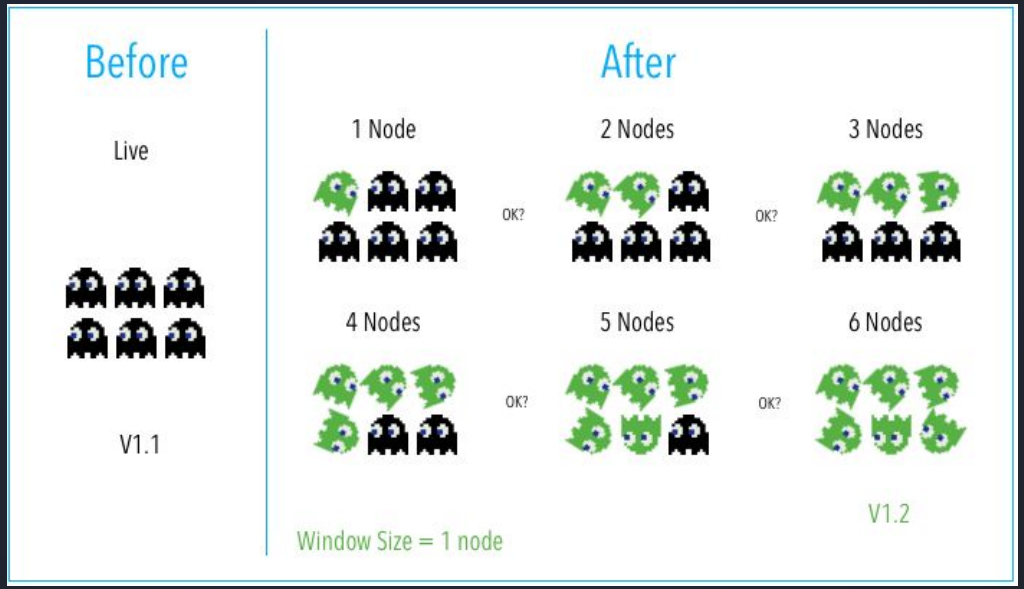
Cons: It's hard to undo changes and can cause problems if something goes wrong. It's also tough to manage and test all the connected parts.



3. Rolling update

FIBO CLOUD EDUCATION

A rolling deployment updates parts of the application one by one, in batches. It's easier to undo changes compared to basic deployment and less risky. But because it updates in batches, it needs support for both old and new versions, and it can be slower.



4. Blue/Green deployment

FIBO CLOUD EDUCATION

Blue-green deployment has two identical environments, blue (testing) and green (production), each with different app versions. Testing is done in blue, then traffic shifts from green to blue after testing. It's simple, fast, and easy to switch back if there are problems.

Pros: Simple, fast, easy to switch back.

Cons: Costly, some issues may be missed in testing, and switching all traffic at once can be risky.

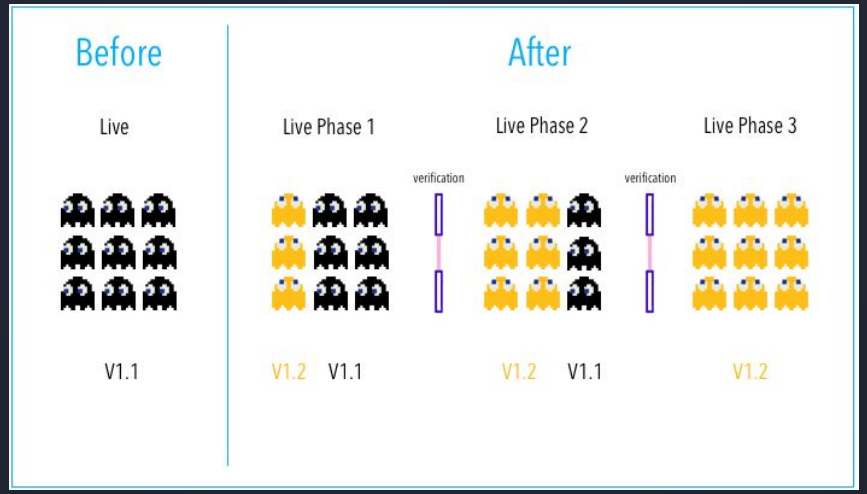
5. Canary deployment

FIBO CLOUD EDUCATION

A canary deployment releases updates gradually to a small group of users, minimizing risk.

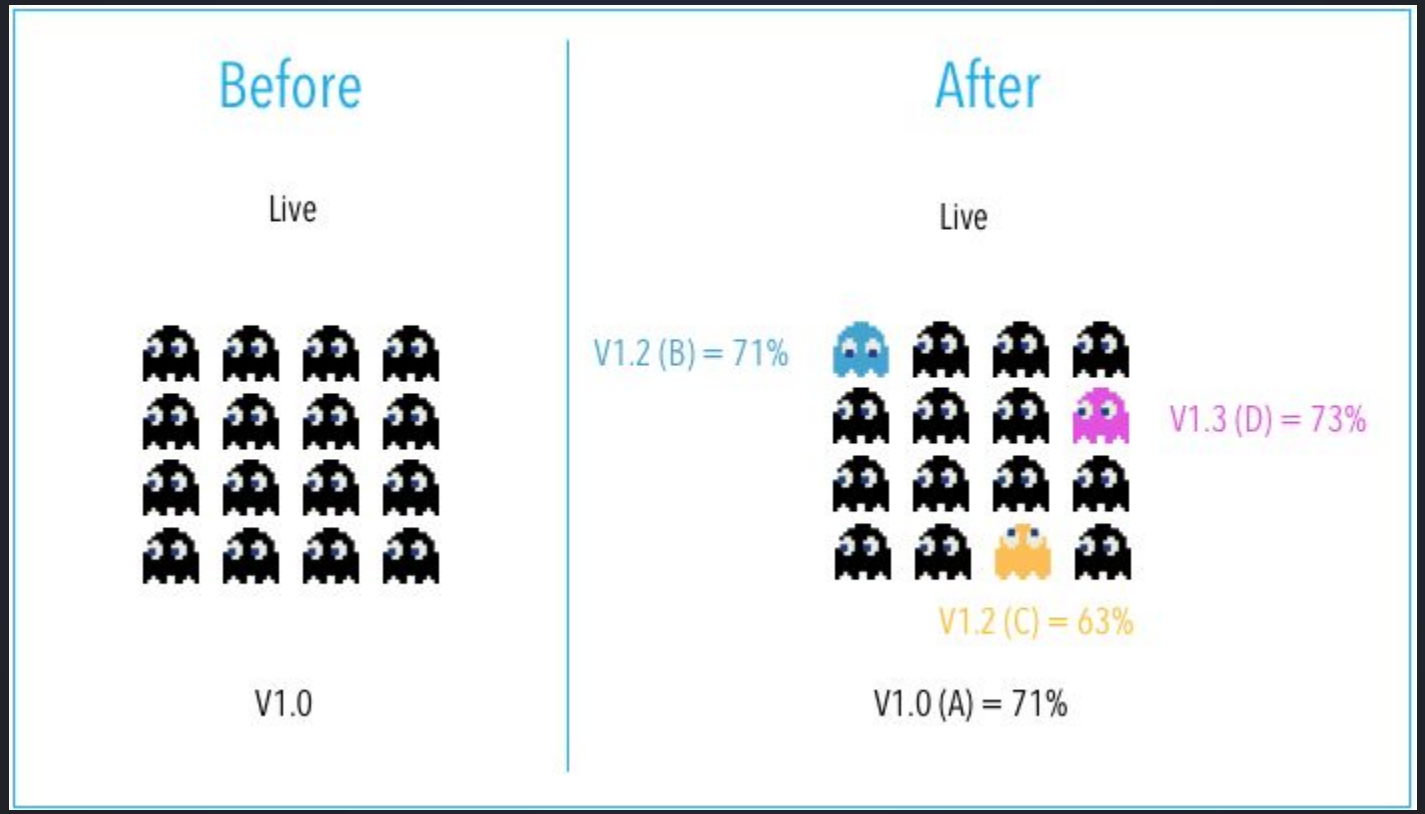
Pros: Real user testing, cheaper than blue-green deployment, fast rollback.

Cons: Testing in production, complex scripting, monitoring challenges.



6. A/B testing

FIBO CLOUD EDUCATION



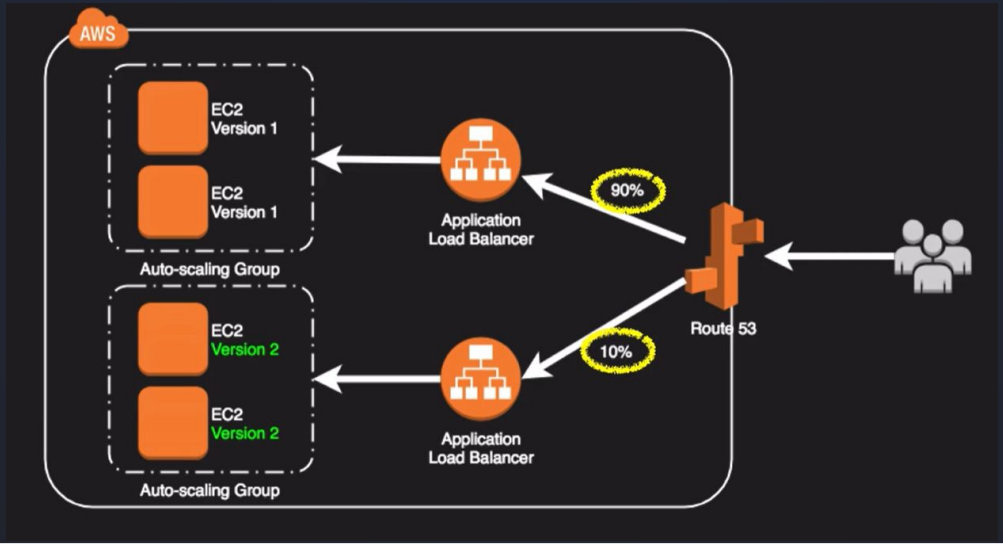
6. A/B testing

FIBO CLOUD EDUCATION

A/B testing involves running different versions of a service simultaneously to test new features or changes. It's focused on experimentation and exploration rather than deploying specific versions. It's standard, easy, and cost-effective for testing in production, but it can sometimes break the application or be complex to script.

Pros: Standard, easy, and cheap for testing new features.

Cons: Experimental nature can break the application or be complex to automate.



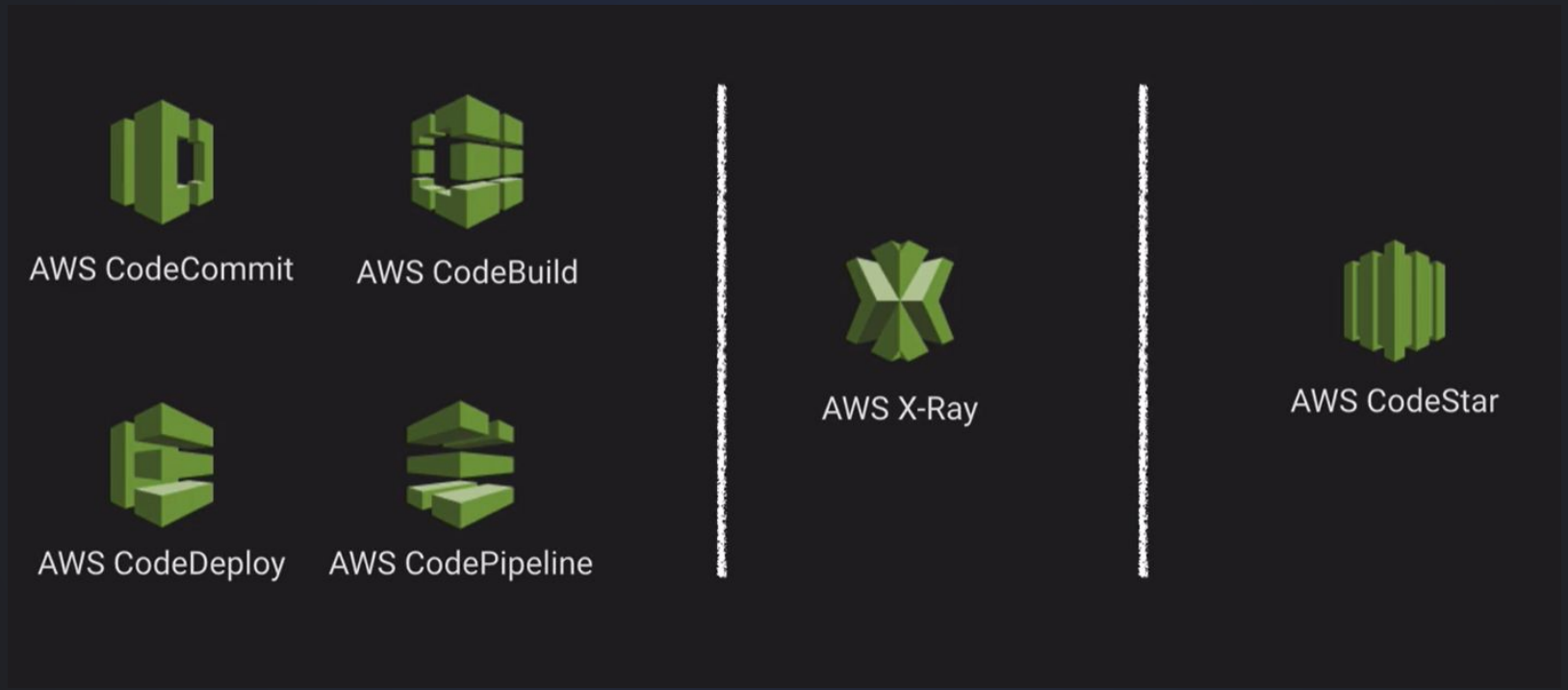
Route53 !!!

FIBO
CLOUD
EDUCATION

Alias (Load balancer)
Weighted routing

AWS Developer tools

FIBO CLOUD EDUCATION



CloudFormation

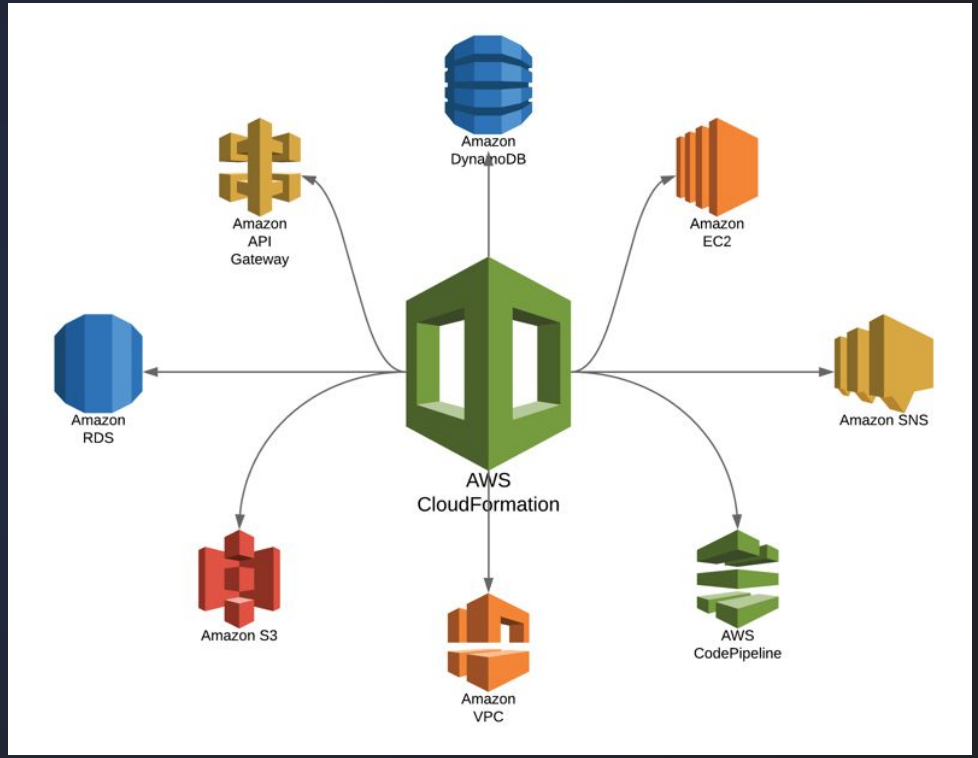
FIBO
CLOUD
EDUCATION

CloudFormation

FIBO CLOUD EDUCATION

Infrastructure as a Code

Provisions the infra



Cloud Formation Template

FIBO CLOUD EDUCATION

JSON
YAML

```yaml
AWSTemplateFormatVersion: 2010-09-09
Description: S3 bucket with default encryption
Resources:
  EncryptedS3Bucket:
    Type: AWS::S3::Bucket
    Properties:
      BucketName: !Sub 'encryptedbucket-${AWS::Region}-${AWS::AccountId}'
      BucketEncryption:
        ServerSideEncryptionConfiguration:
          - ServerSideEncryptionByDefault:
              SSEAlgorithm: AES256
    DeletionPolicy: Delete
```