SECTION 1

Let's Get Started!

Demo: Let's See AWS in Action!

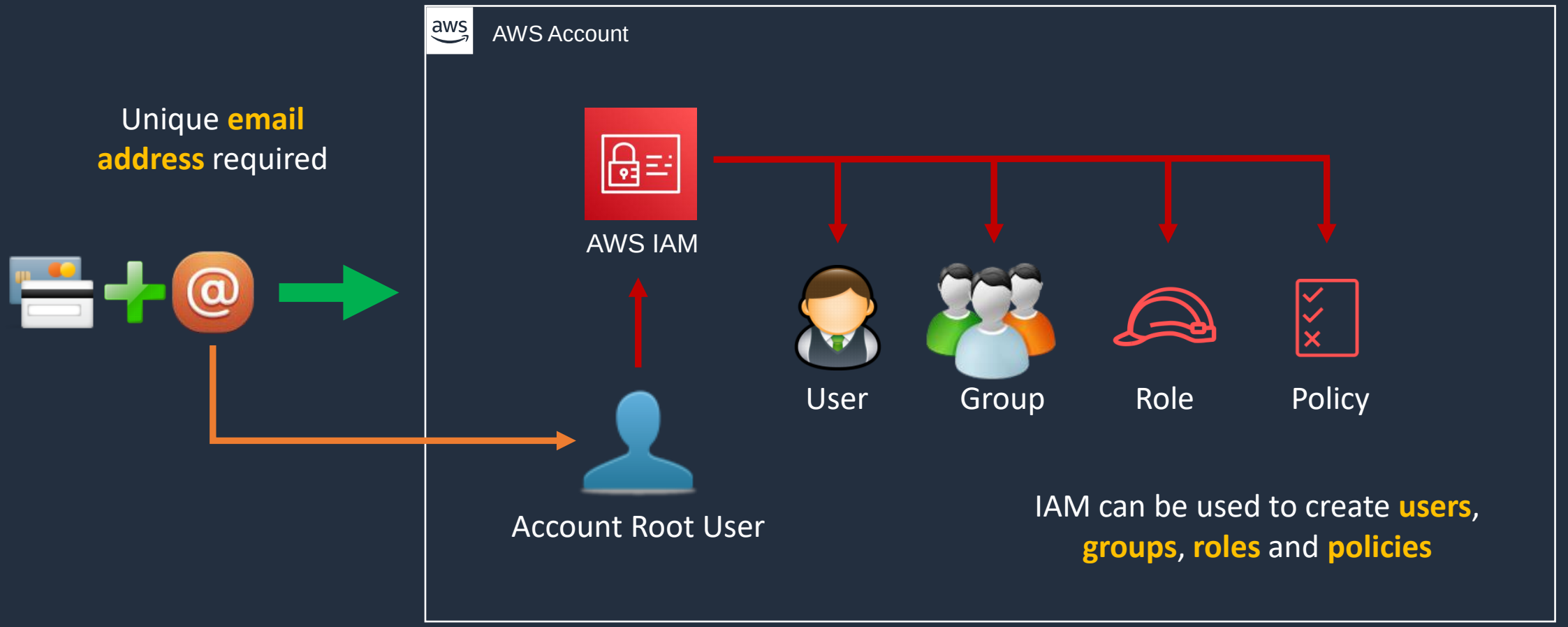
SECTION 2

Create a Free Tier Account on AWS

AWS Account Overview

AWS Account Overview

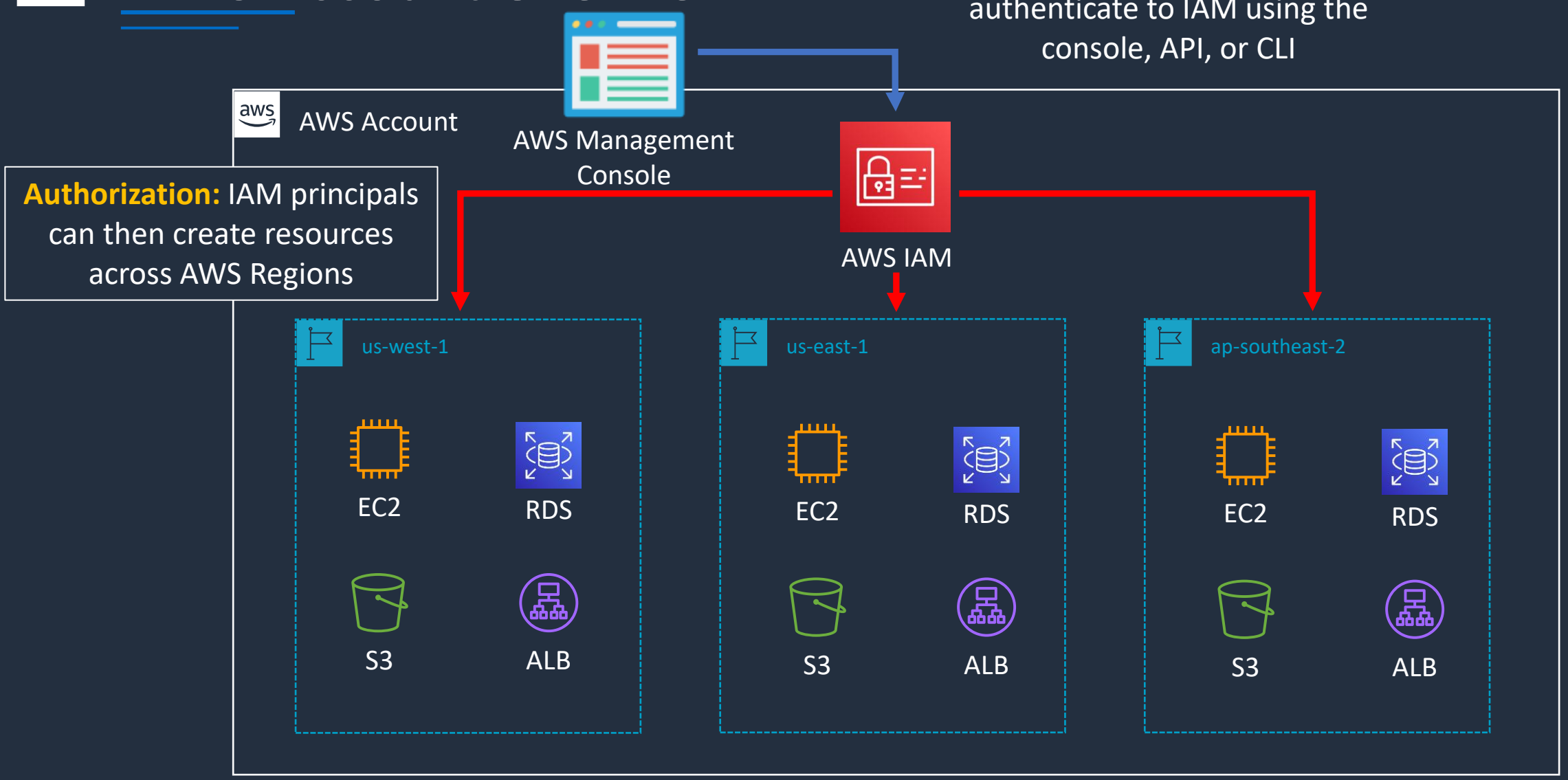
It's an IAM best practice to create **individual users** and to avoid using the **Root** account



The Root user has **full control** over the account

AWS Account Overview

Authentication: IAM principals authenticate to IAM using the console, API, or CLI



All AWS **identities** and **resources** are created within the AWS account

Create your AWS Free Tier Account

What you need...

Credit card for setting up the account and paying any bills

Unique email address for this account

Check if you can use a **dynamic alias** with an existing email address

john@gmail.com

john+ACCOUNT-ALIAS-1@gmail.com

john+ACCOUNT-ALIAS-2@gmail.com

AWS account name / alias

Phone to receive an **SMS** verification code

Configure Account and Create a Budget and Alarm

DigitalCloud TRAINING

Account Configuration

- Configure **Account Alias**
- Enable access to billing for **IAM users**
- Update **billing preferences**
- Create a **budget and alarm**

Install Tools

SECTION 3

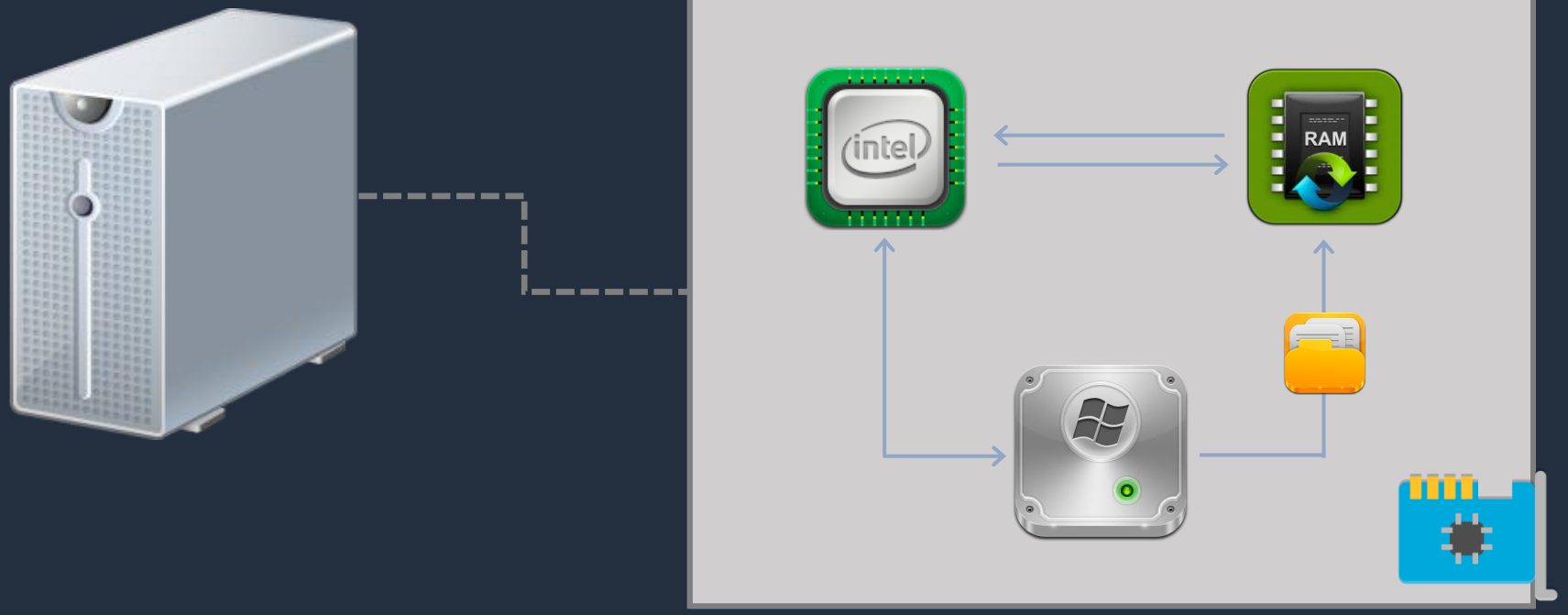
IT Fundamentals

Client - Server Computing

Basic Architecture of a Computer

Central Processing Unit (CPU)

RAM is **non-persistent** storage or “memory”



Network Interface Cards (NICs) connect computers to networks

Hard Disk Drives (HDDs) offer **persistent** storage

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Measurements for Components

Component	Unit of Measurement
Central Processing Unit (CPU)	Gigahertz (GHz)
Random Access Memory (RAM)	Gigabytes (GB)
Hard Disk Drive (HDD) / Solid State Drive (SSD)	Gigabytes (GB)
Network Interface Card (NIC)	Megabits per second (Mbps) Gigabits per second (Gbps)

Servers vs Desktops/Laptops

Server

Laptop

Desktop

Server Hardware Build:

- Hardware is more specialized
- Much higher prices compared to desktops / laptops
- Includes redundancy

Servers can be used by many users over a network

DigitalCloud TRAINING

Clients and Servers

Cloud Computing

Servers

Client devices are connected via the **Internet**

Cloud Networking

Client Devices

Client devices require connectivity via **wired**, **wireless** or **cellular** networks

Servers running in the cloud offer **services** which include the **application**, **processing** and **data storage**

DigitalCloud TRAINING

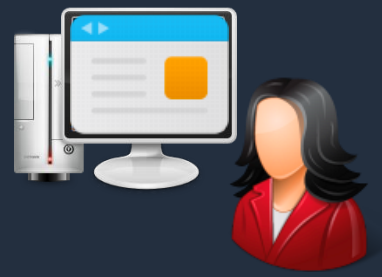
Connecting to Services

The client application finds the server by **IP address**

Web Server

Port: 80

Protocol: HTTP



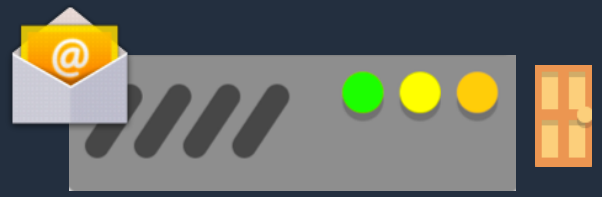
A **port** is like a door into the server

File Server

Port: 445

Protocol: SMB

SMB/CIFS is used by Microsoft file servers and clients



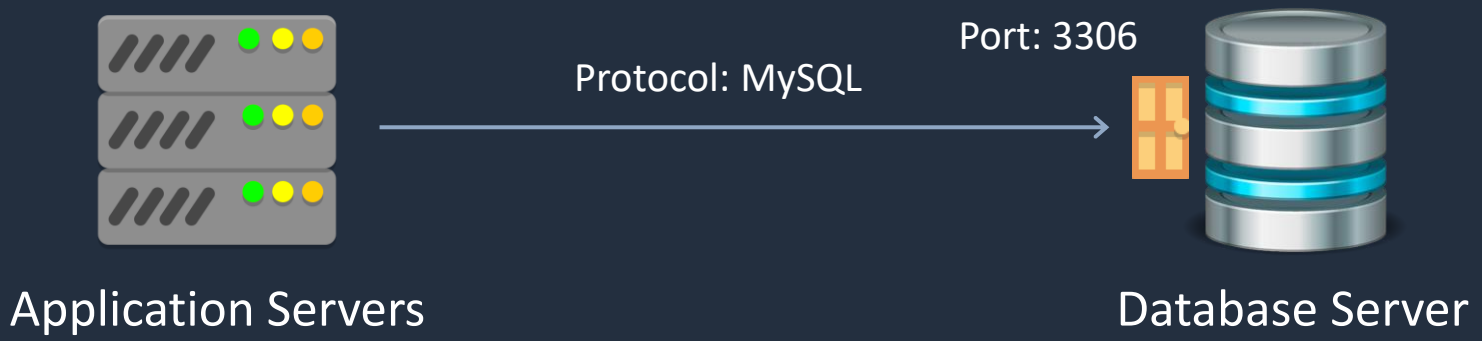
Email Server

Port: 25

Protocol: SMTP

DigitalCloud TRAINING

Server to Server Connectivity



Storage - Block vs File vs Object

Hard Drives

Hard Disk Drive (HDD)

- Also known as magnetic drives
- Older technology
- Much slower than SSD
- Much cheaper than SSD

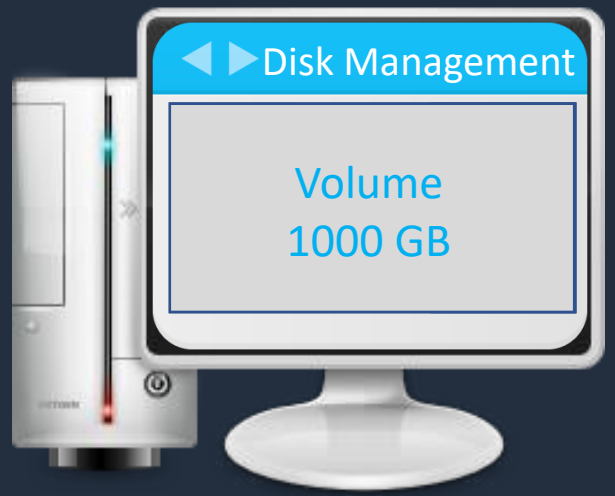
Solid State Drive (SSD)

- Uses flash memory
- Newer technology
- MUCH faster than HDD
- More expensive than HDD

DigitalCloud TRAINING

Hard Drives

Hard drives are block-based storage systems

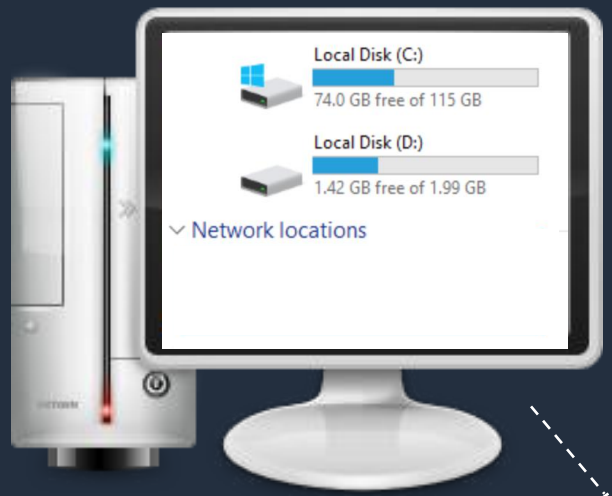


The Operating System (OS) sees a volume. A volume can be partitioned and formatted

Hard drives are block-based storage systems

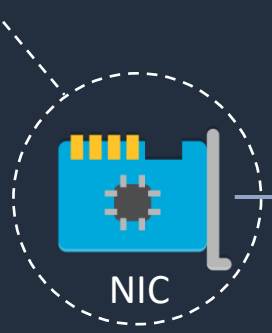
DigitalCloud TRAINING

Network Attached Storage



The Operating System (OS) sees a filesystem that is mapped to a local drive letter

The NAS "shares" filesystems over the network



NIC

Network Switch

Network Attached Storage Server (NAS)

NAS devices are file-based storage systems

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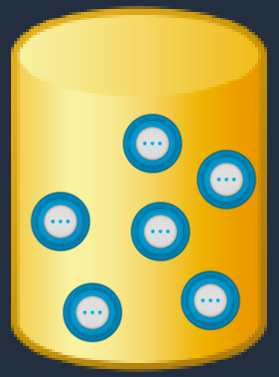
Object Storage Systems

User uploads **objects** using a web browser

There is no hierarchy of objects in the container



Objects can be files, videos, images etc.

The **HTTP protocol** is used with a **REST API** (e.g. GET, PUT, POST, SELECT, DELETE)

Object Storage Container

Block vs File vs Object Storage

The OS sees **volumes** that can be partitioned and formatted

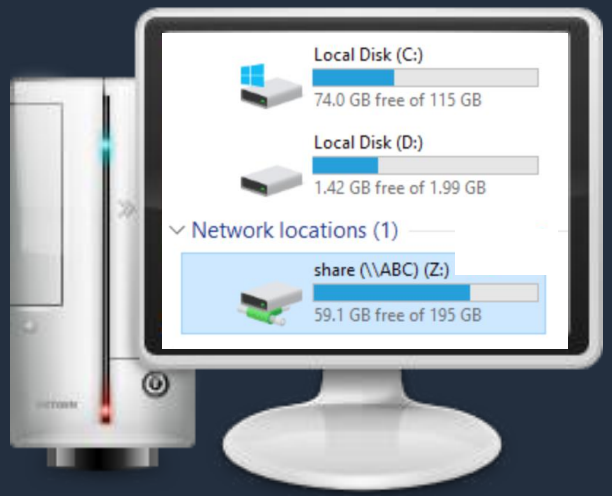
A filesystem can be shared by many users

Massively scalable and low cost

Block Storage

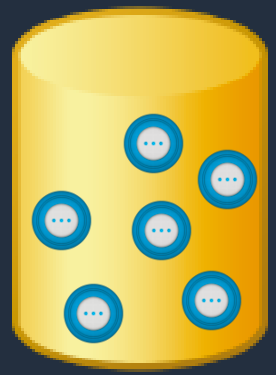
The OS reads/writes at the **block level**. Disks can be internal, or network attached

File Storage



A filesystem is "**mounted**" to the OS using a network share

Object Storage



Object Storage Container

There is **no hierarchy** of objects in the container

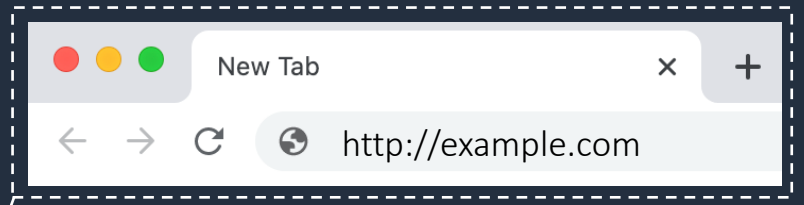
Uses a **REST API**

DigitalCloud TRAINING

IP Addresses and DNS

What is an IPv4 address?

IP addresses are the addresses computers use to communicate



52.134.26.12

Web Server

Connection is made using **IP address**

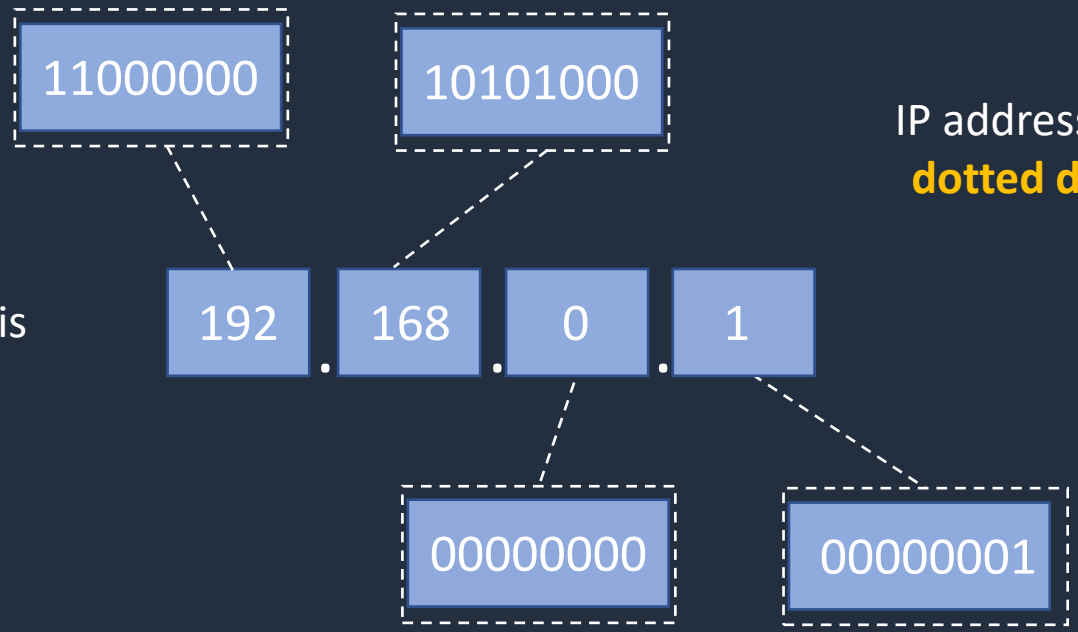
What's the **IP address** for example.com?

DNS Server

Name	Type	Value
example.com	A	52.134.26.12
test.com	A	137.10.47.51

DNS Zone File

Structure of an IPv4 Address



IP addresses are written in **dotted decimal notation**

Each part of the address is a **binary octet**

Most significant bit ⟶

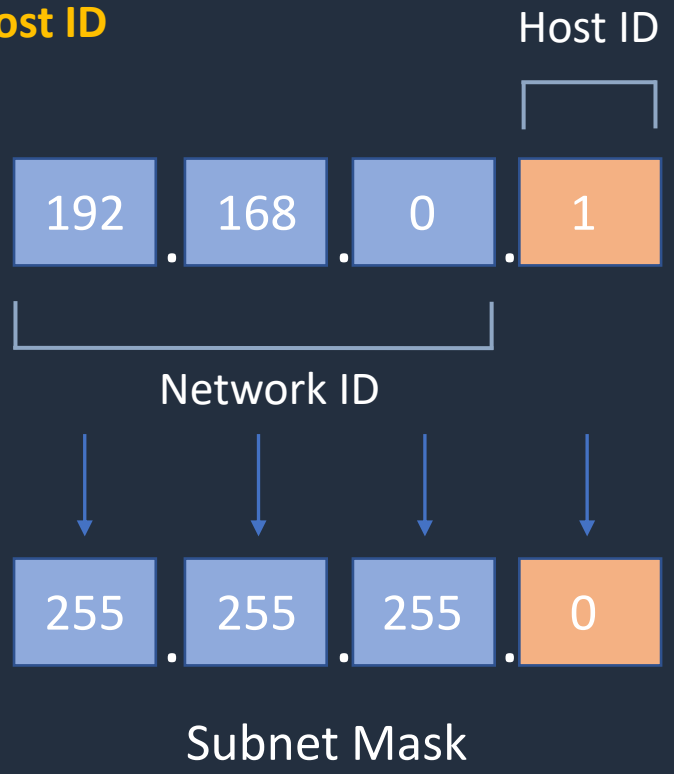
1	1	1	1	1	1	1	1
128	64	32	16	8	4	2	1

⟵ Least significant bit

Binary Values

Networks and Hosts

An IPv4 address has a **network** and **host ID**



The **subnet mask** is used to define the **network** and **host ID**

Networks and Hosts

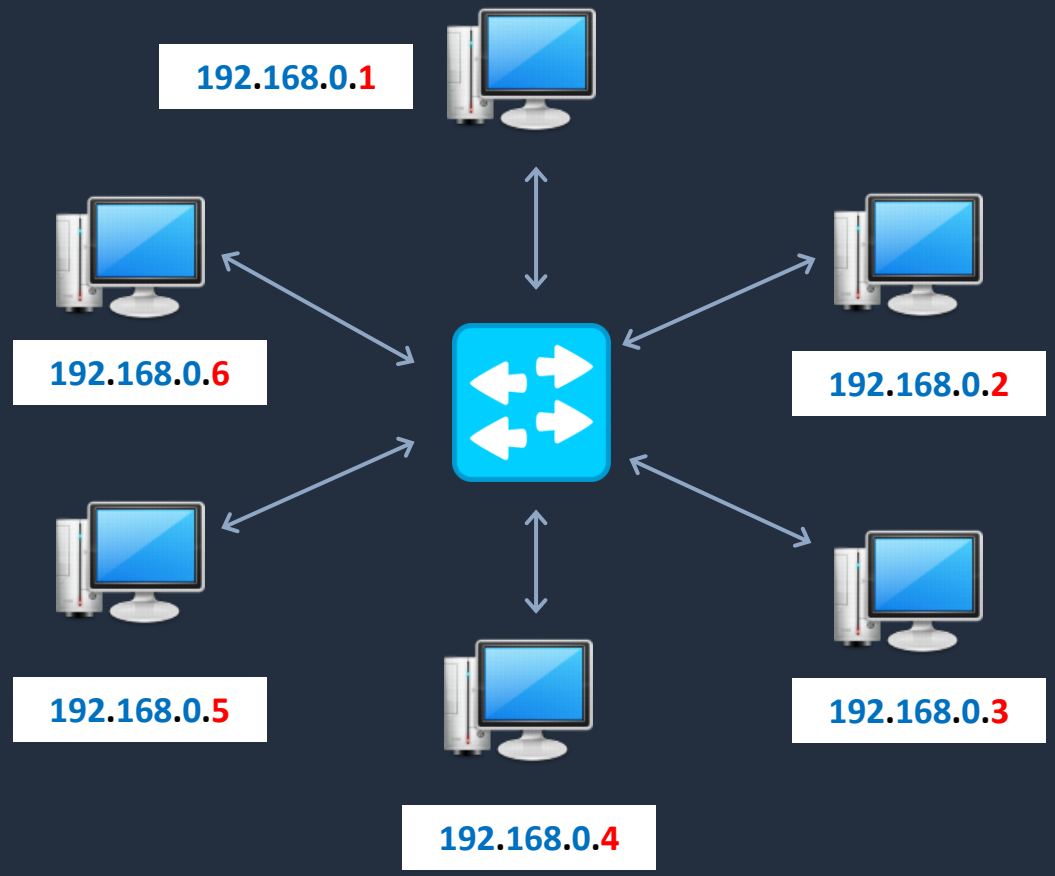
Network	192	168	0	0
Subnet Mask	255	255	255	0

24 bits

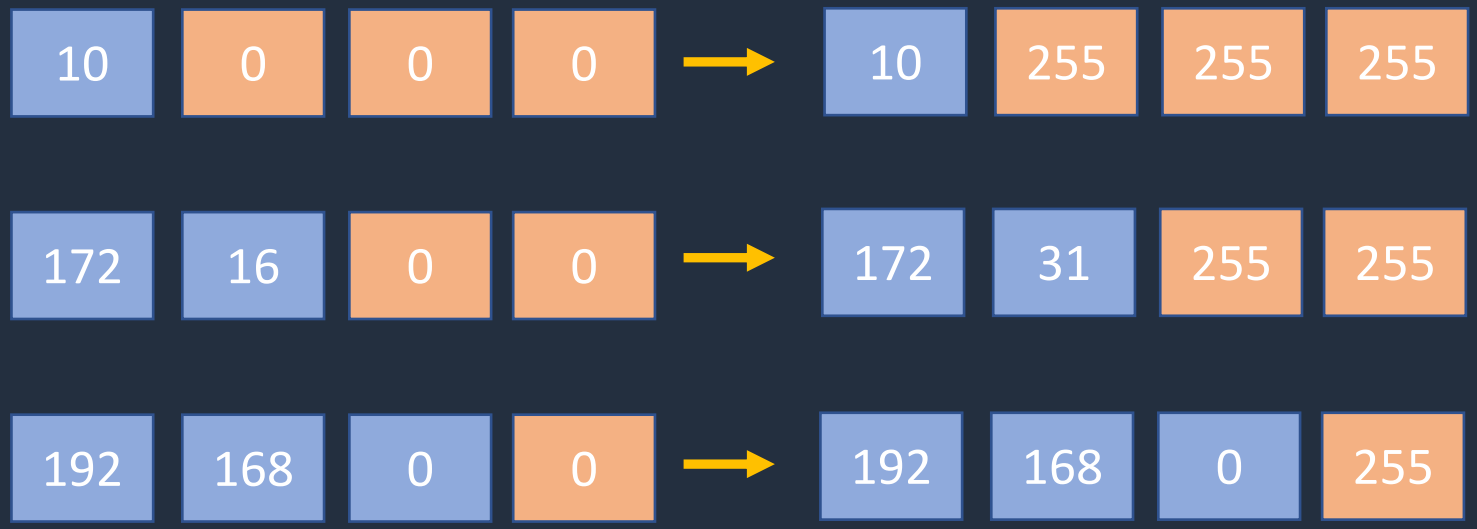
192.168.0.0/24

A **network** and **subnet mask** can also be written in this format

All computers share the same **network ID** and have a unique **host ID**

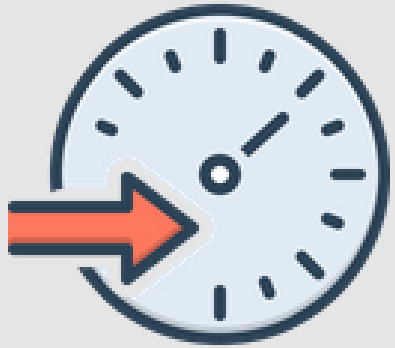


Private IP Address Ranges



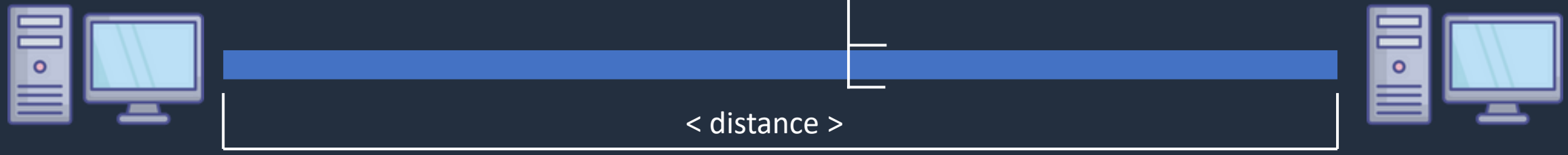
These addresses are reserved for **private use** according to IETF RFC-1918

Bandwidth and Latency



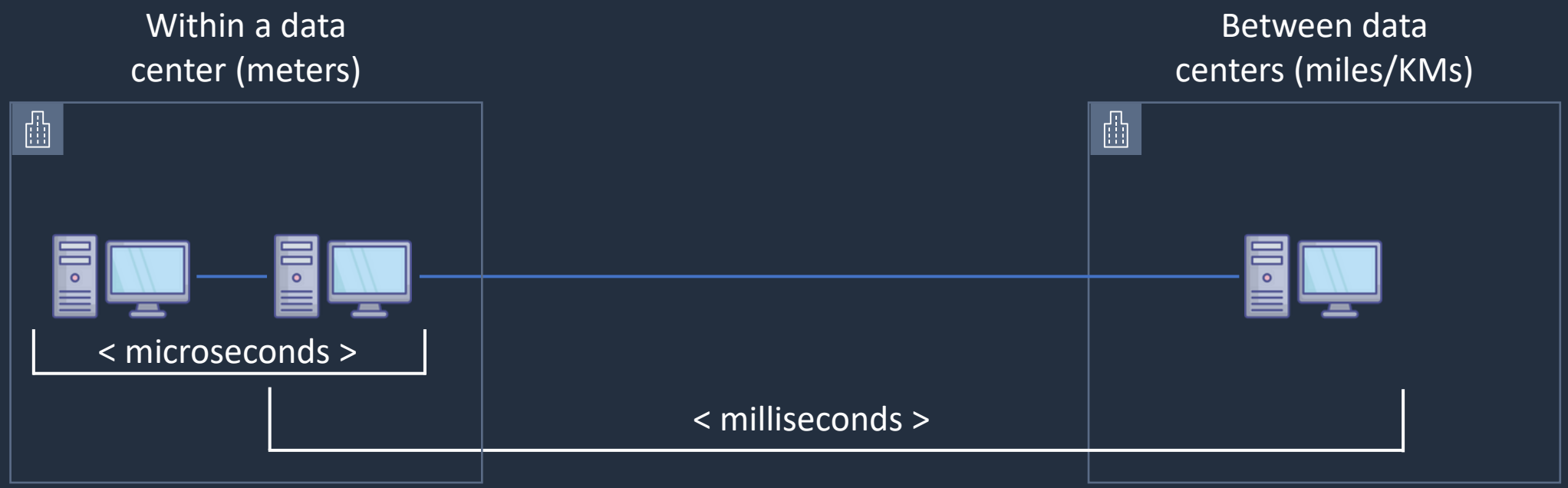
Bandwidth and Latency

Bandwidth is the **rate** of data transfer for a **fixed period of time** measured in **Gbps**

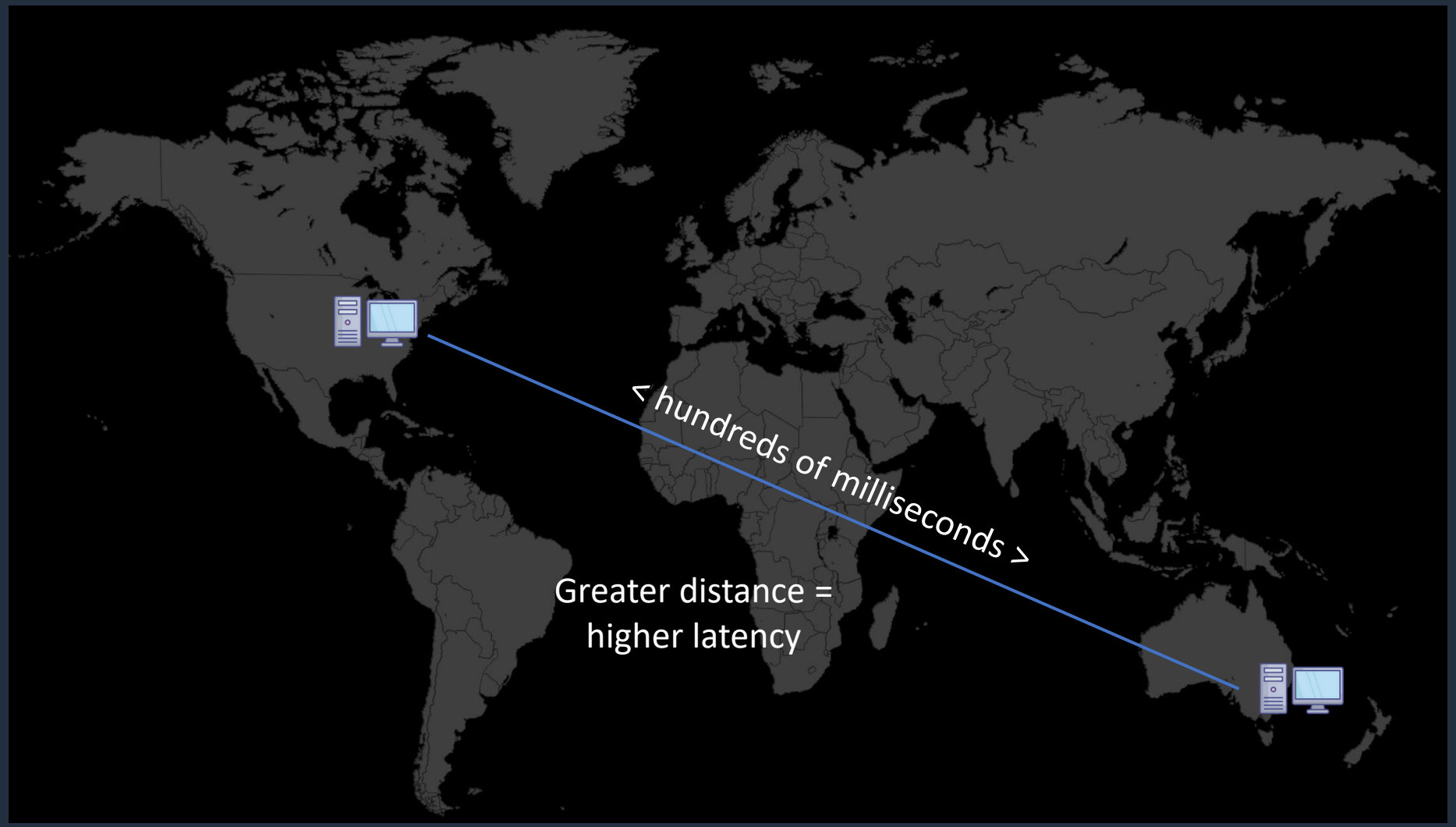


Latency is the amount of time it takes to send data from one point to another measured in **microseconds** or **milliseconds**

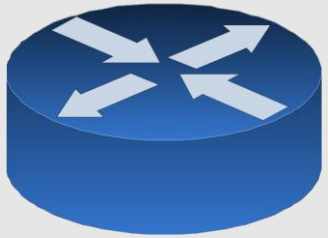
Bandwidth and Latency



Bandwidth and Latency



Networking – Routers, Switches and Firewalls



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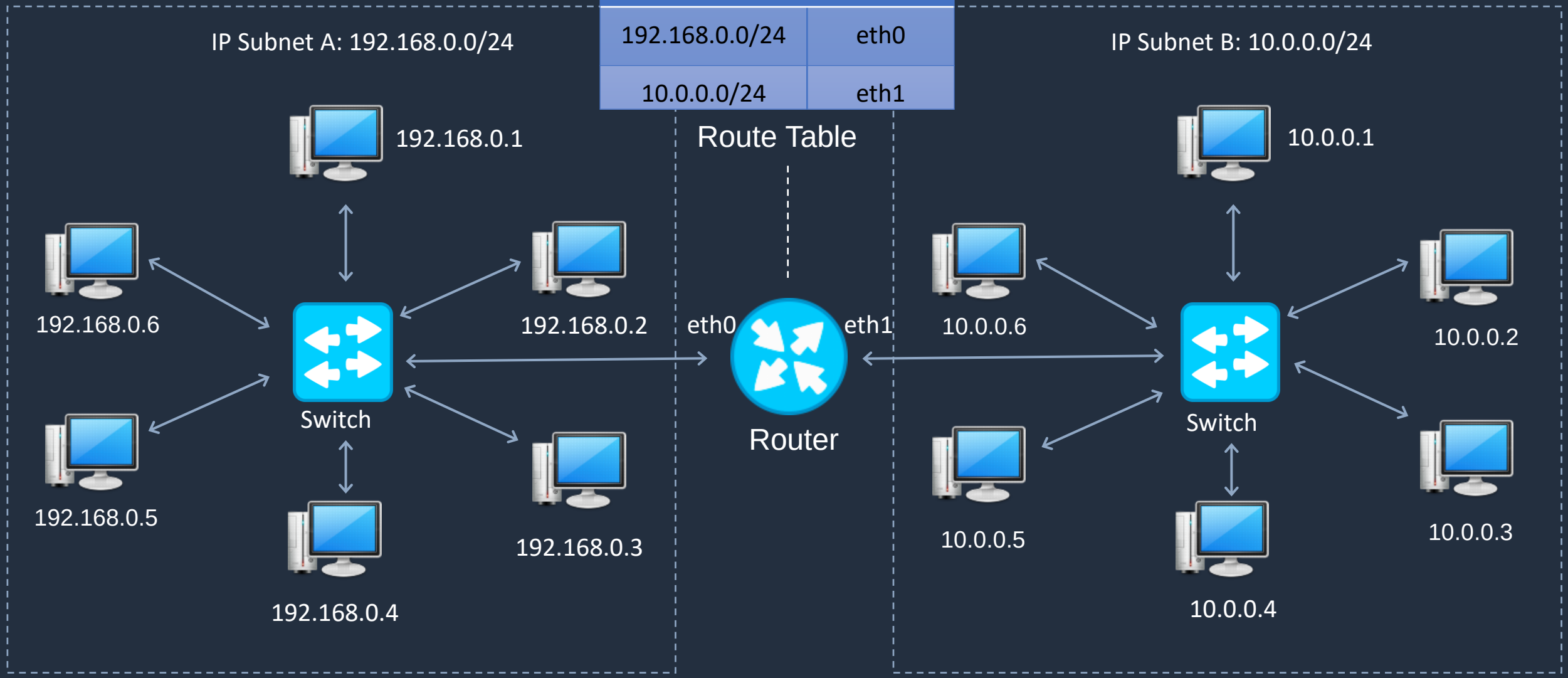
Routers and Switches

Destination	Interface
192.168.0.0/24	eth0
10.0.0.0/24	eth1

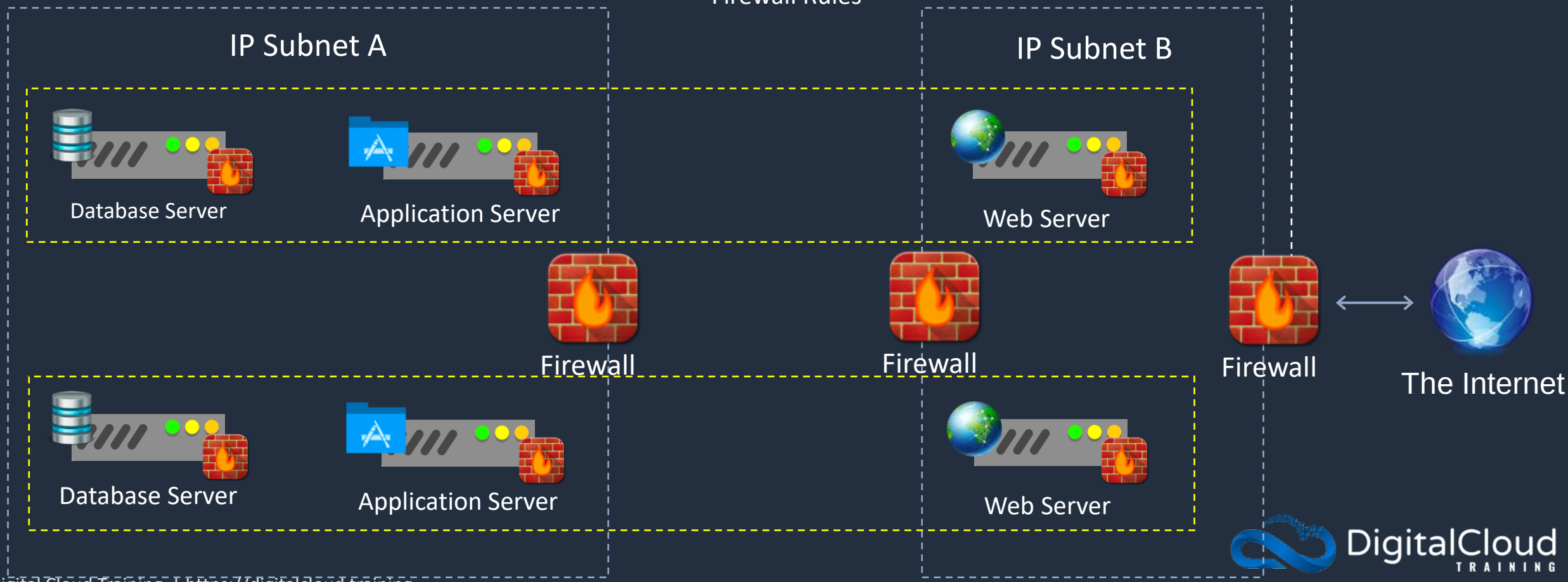
Route Table



Firewalls

POLICY	PROTOCOL	PORT	DESTINATION	SOURCE
ALLOW	HTTP	80	INTERNAL	ANY
ALLOW	HTTPS	443	INTERNAL	ANY
DENY	ANY	ANY	INTERNAL	ANY

Firewall Rules



Server Virtualization and Containers

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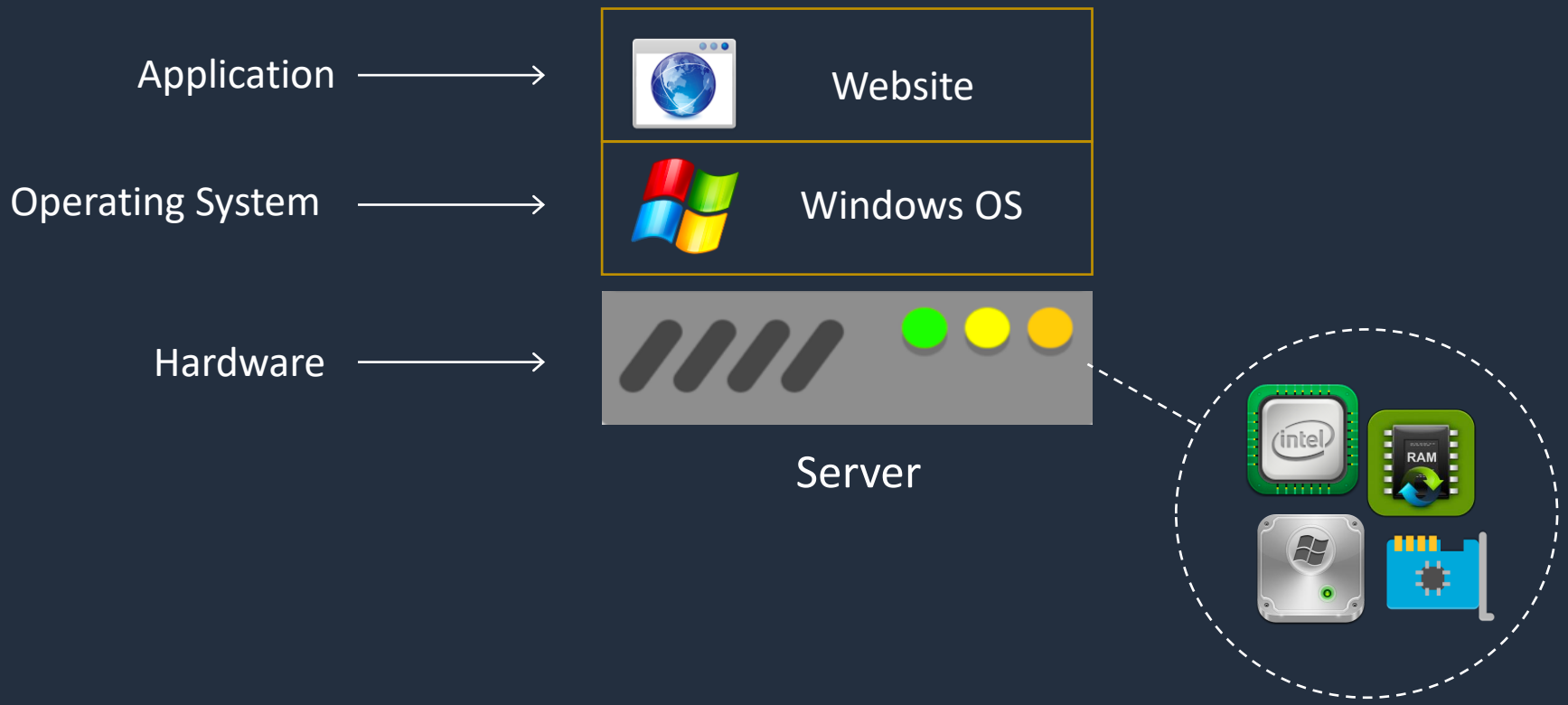
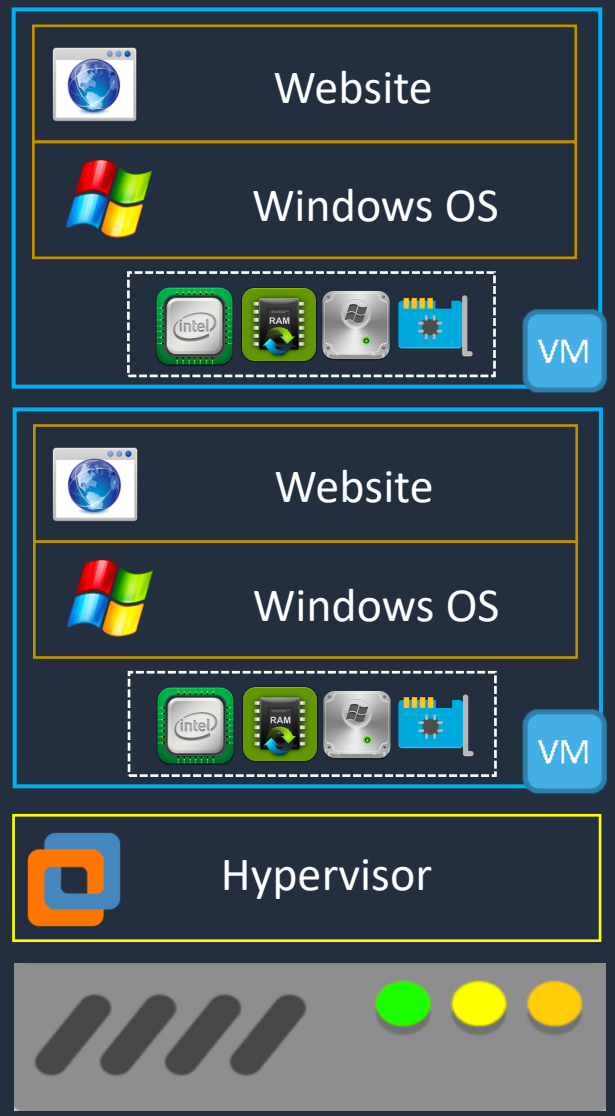
Server without Virtualization

Limitations:

- OS is tied to hardware (no portability)
- Hardware resources may be underutilized



Server with Virtualization



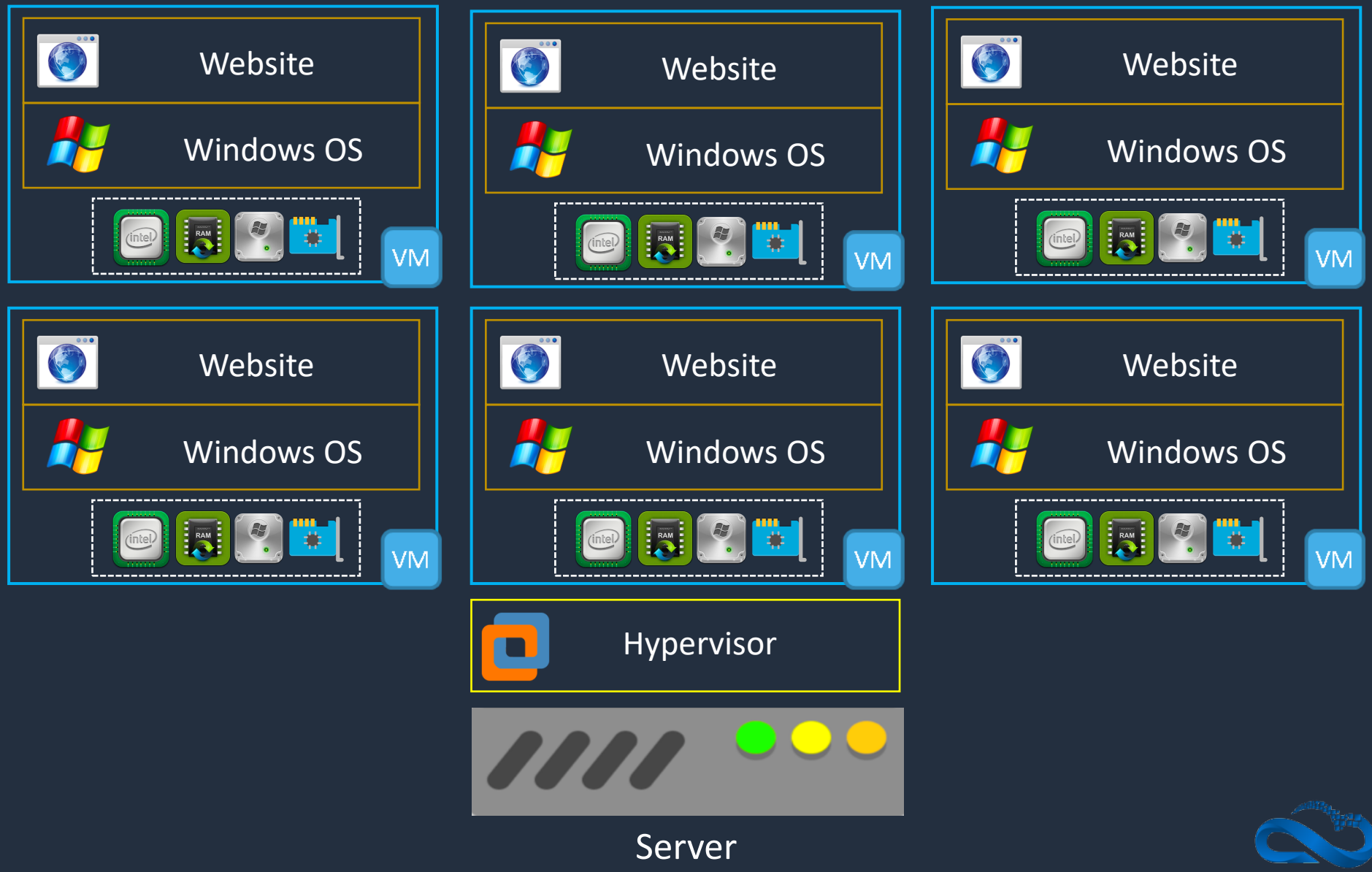
Many VMs can run on the same **physical hardware**

This is known as a **virtual server** or ”virtual machine”

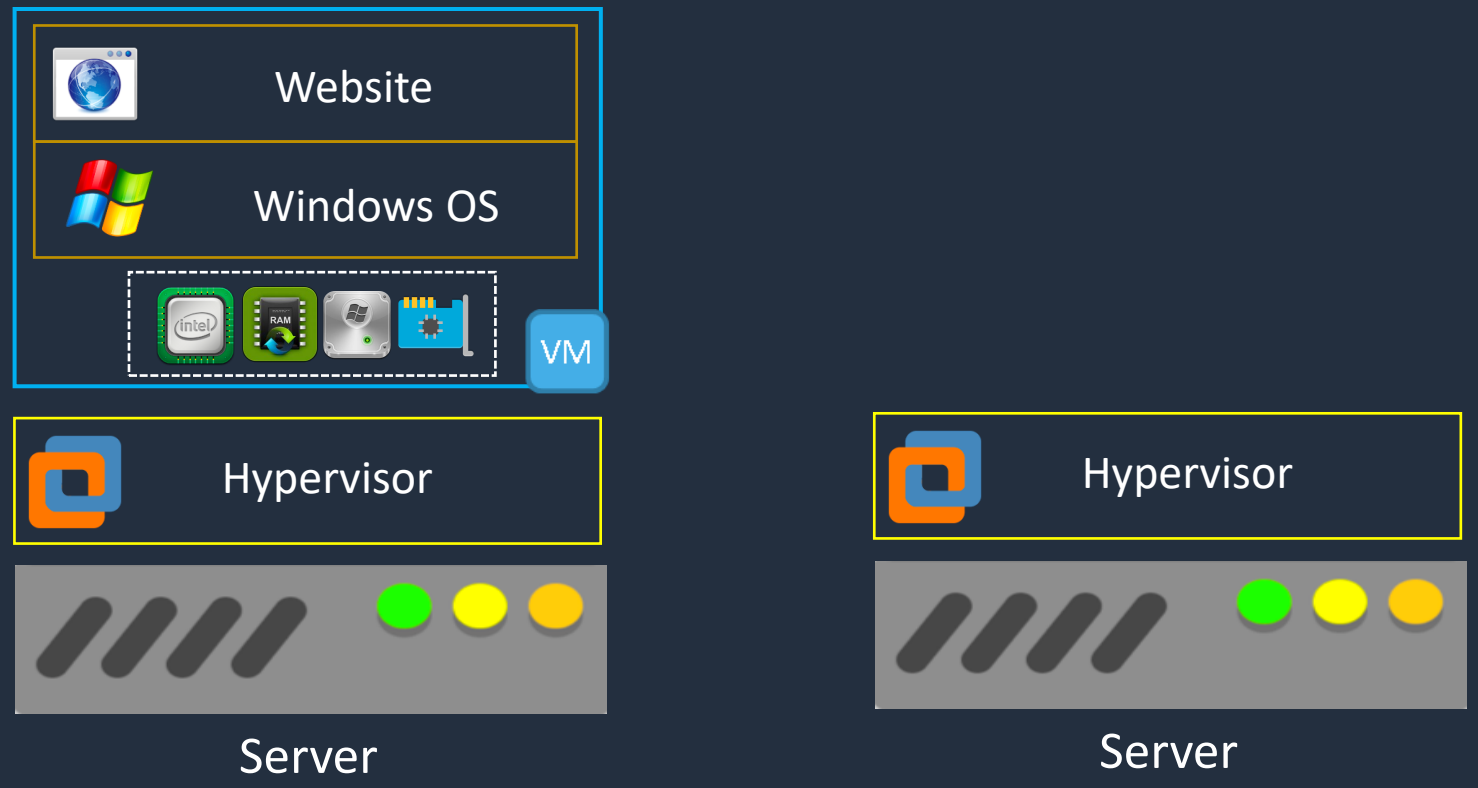
Virtual hardware is presented to the OS

The **hypervisor** creates a layer of abstraction

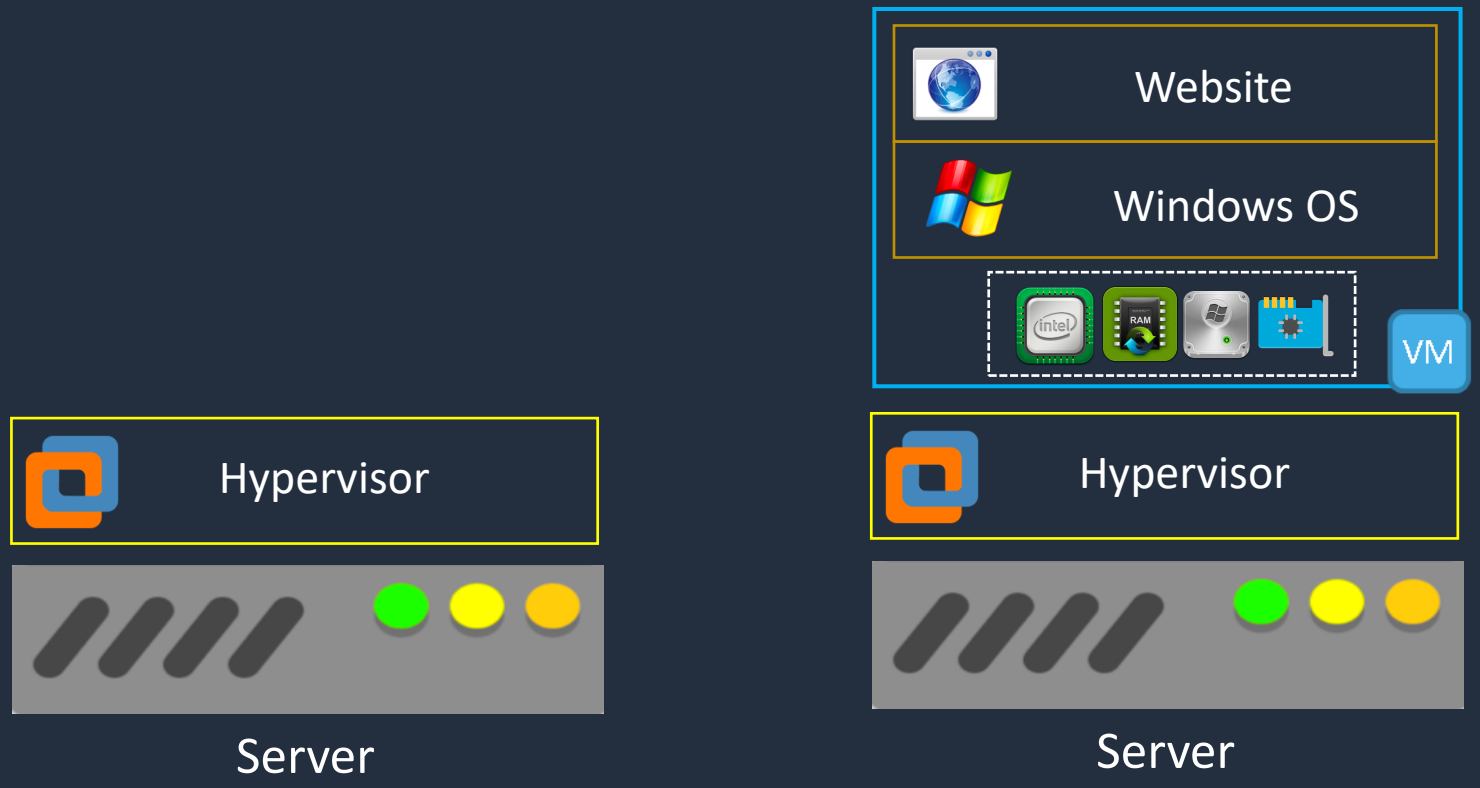
Server with Virtualization



Server Virtualization: Portability

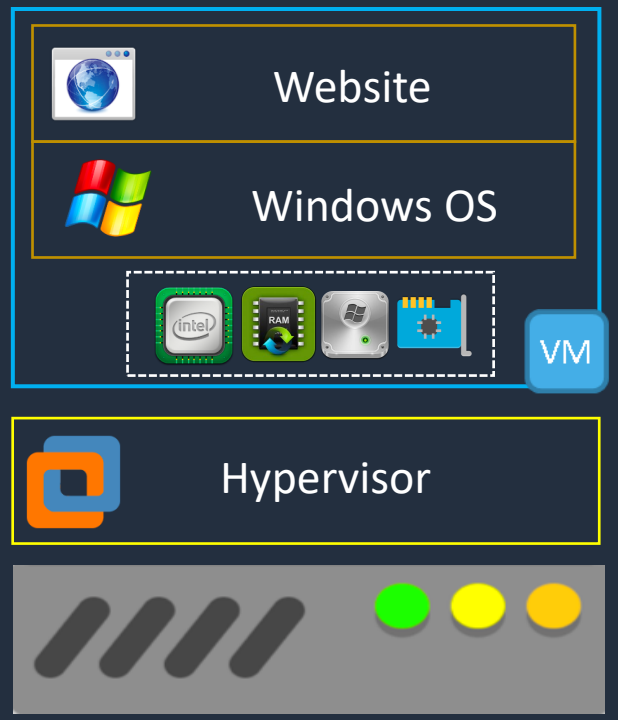


Server Virtualization: Portability



Docker Containers

Every VM needs an operating system which uses significant resources



Docker Containers

Containers start up very **quickly**

A container includes all the code, settings, and dependencies for running the application

Containers are very **resource efficient**

Each container is **isolated** from other containers

Application Programming Interfaces (APIs)

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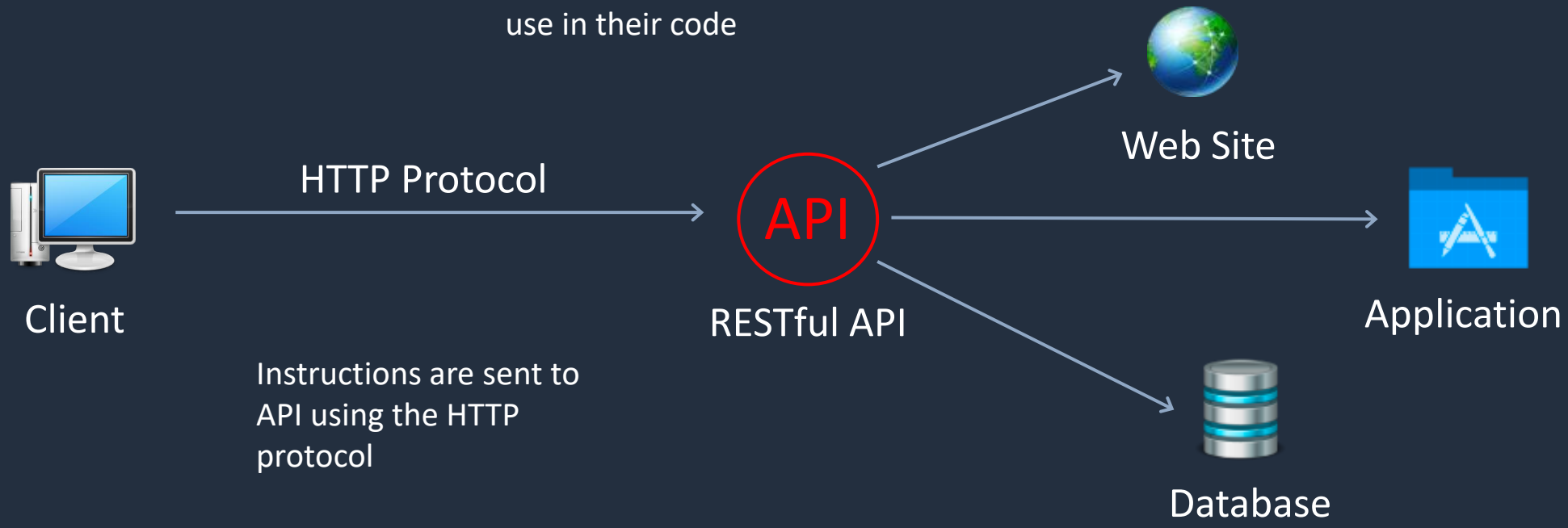
Application Programming Interfaces (APIs)

The API provides the instructions developers use in their code

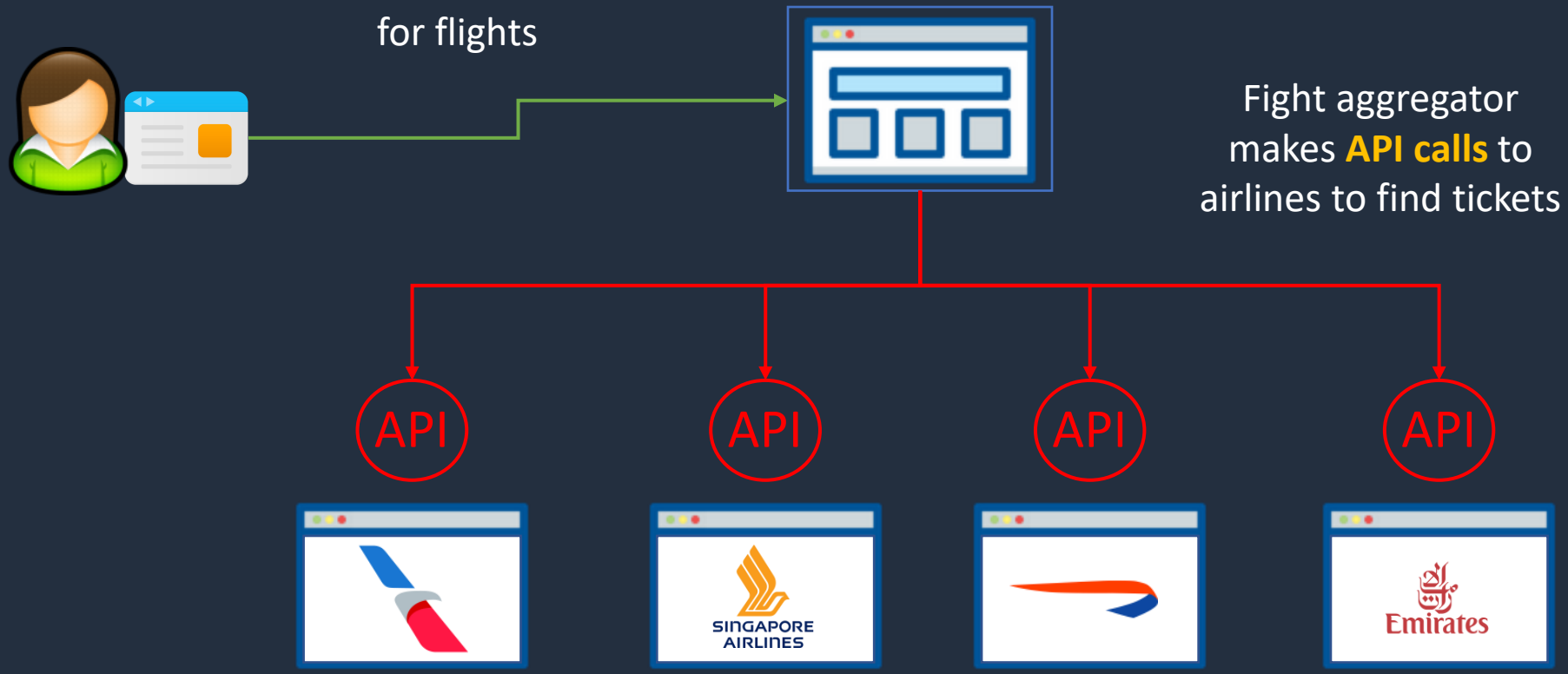


Instructions are sent to API using the HTTP protocol

Flight Aggregator Example

Fight aggregator such as Momondo or Skyscanner

User searches for flights

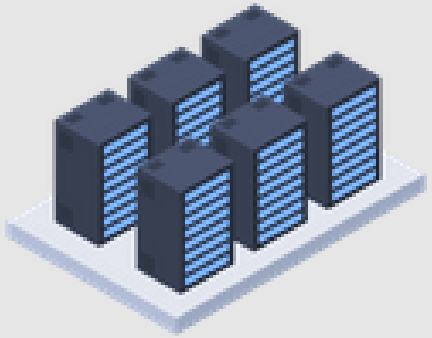


Fight aggregator makes **API calls** to airlines to find tickets

SECTION 4

Cloud Computing Concepts

Legacy IT / Traditional IT

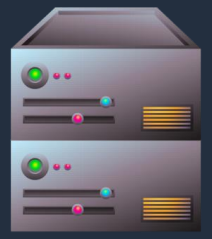


Traditional IT

This model is very **capital** intensive

Corporate data center

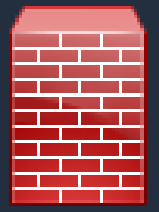
Servers



Storage Servers

Router

Switch



Firewall

Backup System

The IT equipment is **owned** by the company

A company typically leases space in a data center, or may own the whole building

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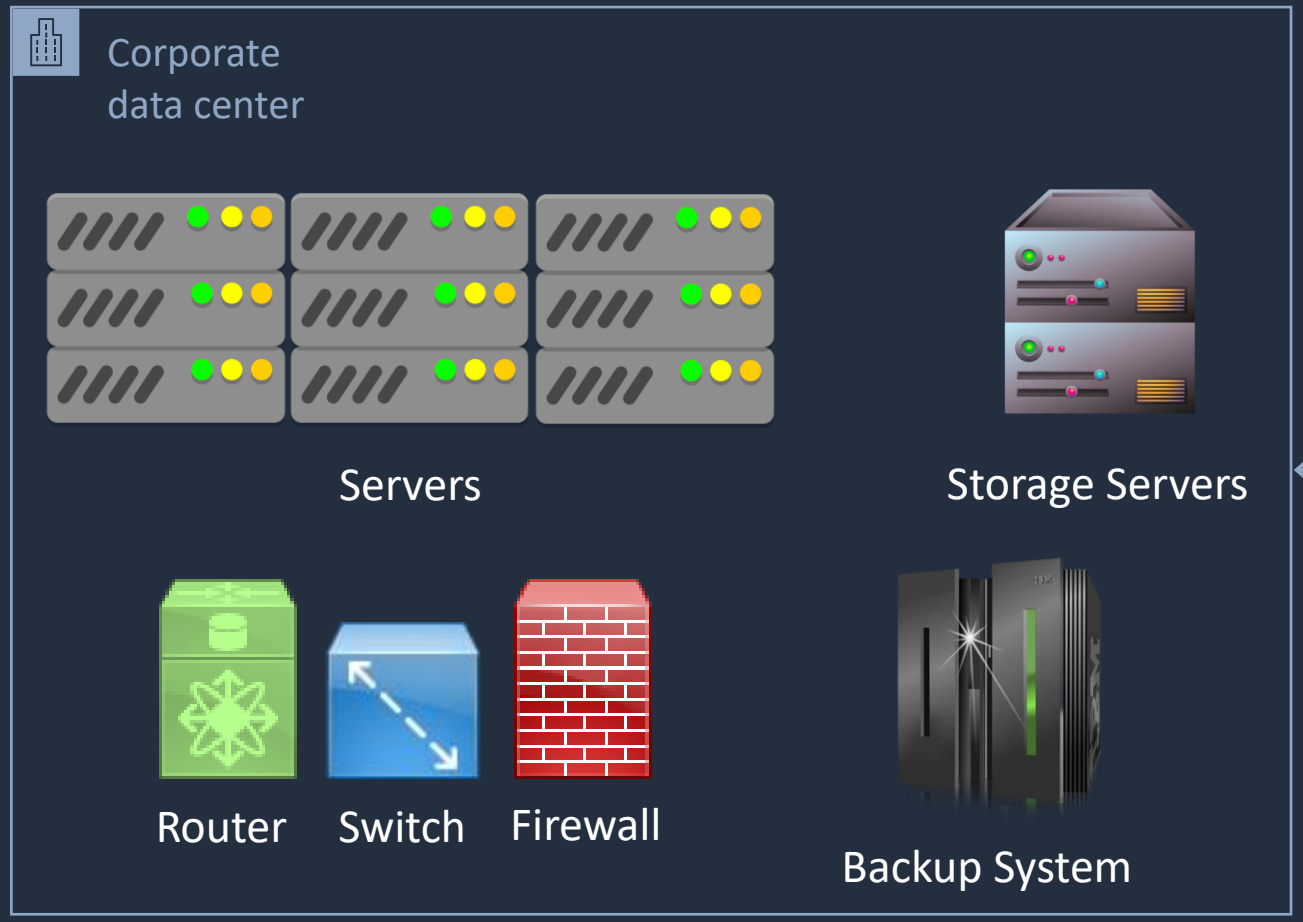
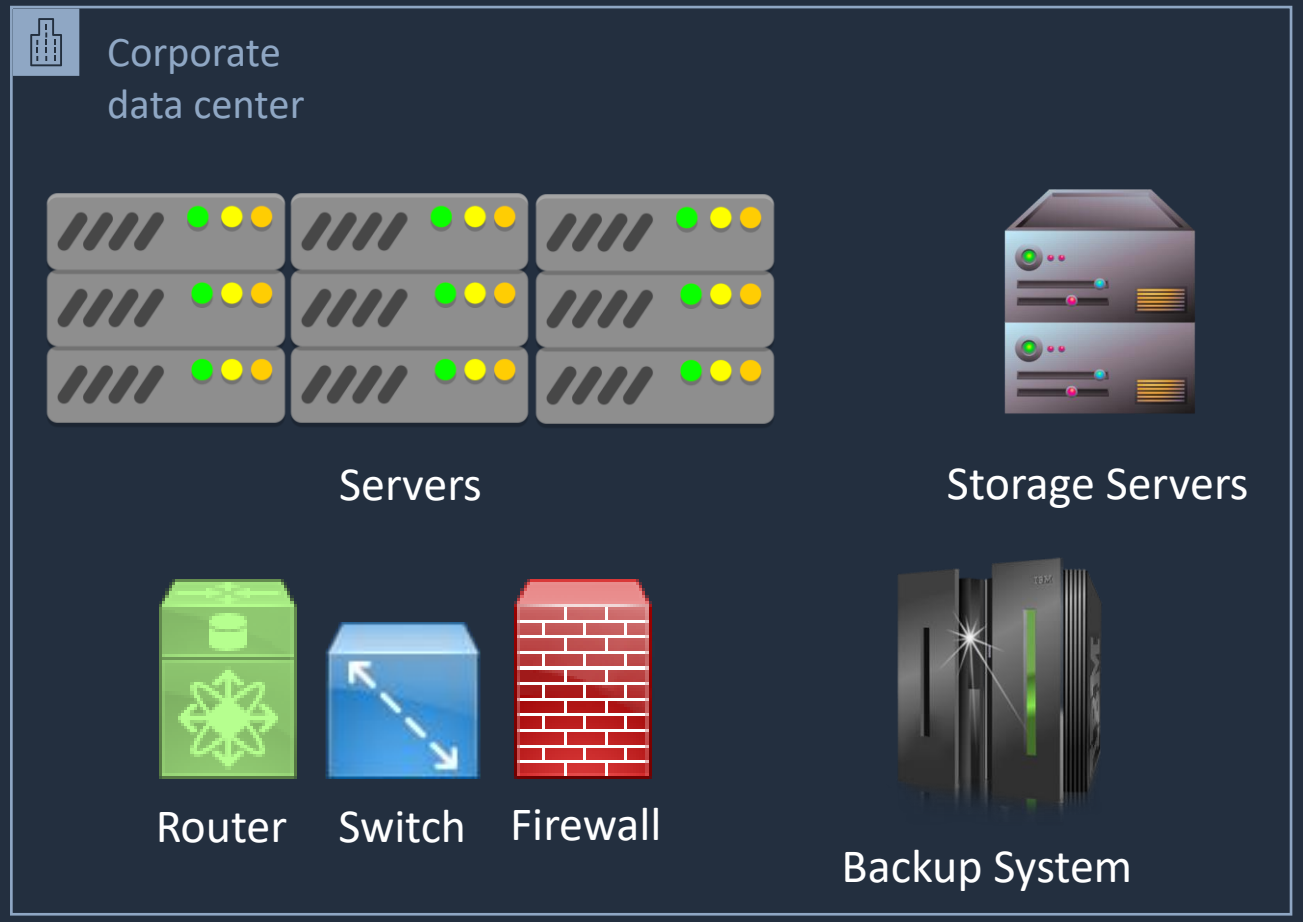
Traditional IT



IT staff must design, build, operate, and manage equipment

Traditional IT



Costs:

- Data center building
- Data center security
- Physical IT hardware
- Software licensing costs
- Maintenance contracts
- Power
- Internet connectivity
- Staff wages (design, build, operations, maintenance)

What is Cloud Computing?

What is Cloud Computing? Well-known examples

Non-Cloud Services:

Email Server

File Server

Customer Relationship Management (CRM)

Cloud Services:

Gmail

Dropbox

Salesforce

You don't own or manage the infrastructure on which the service runs

Cloud services are offered on a subscription / consumption model

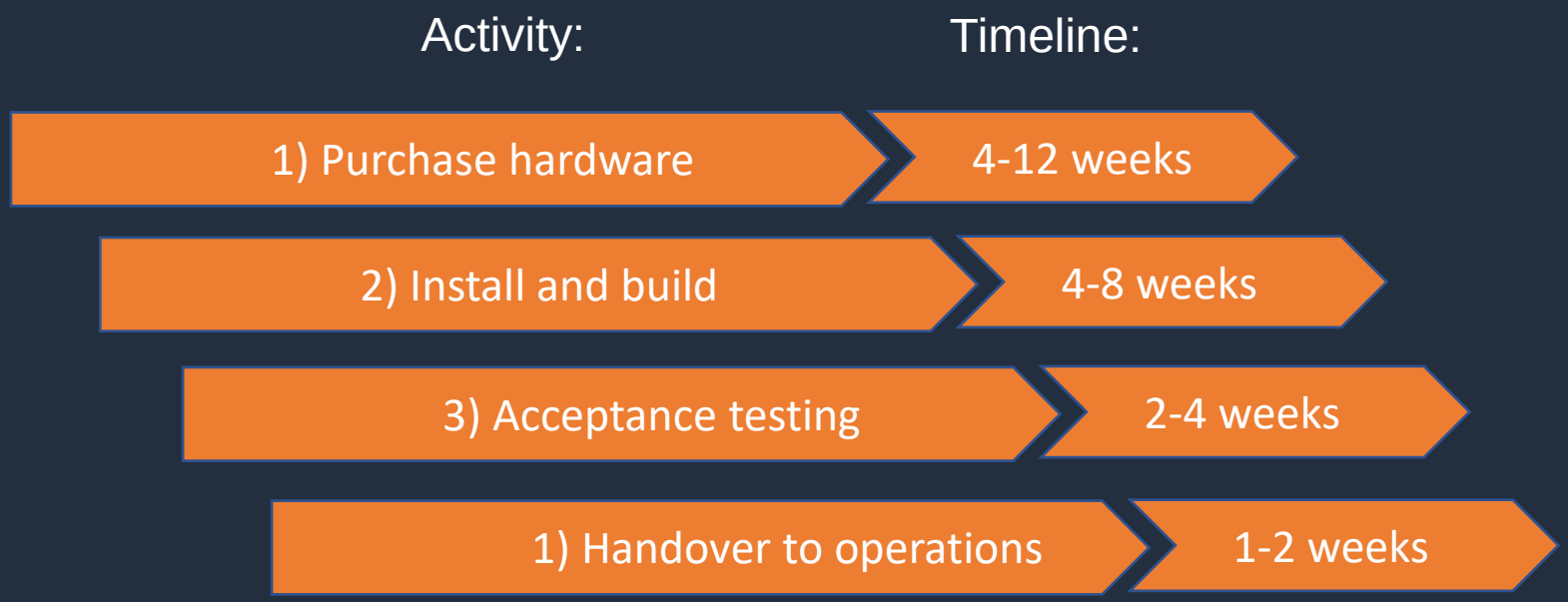
The service scales as demand changes

What is Cloud Computing? The Key Characteristics

Name	Description
On-demand, self-service	A user can consume cloud resources, as needed, automatically, and without human interaction
Broad network access	Capabilities are available over the network using standard mechanisms. Can be the Internet or a Wide Area Network (WAN)
Resource pooling	The providers resources are pooled and serve multiple consumers using a multi-tenant model
Rapid elasticity	Capabilities can scale “elastically” based on demand
Measured service	Resource usage is monitored and metered

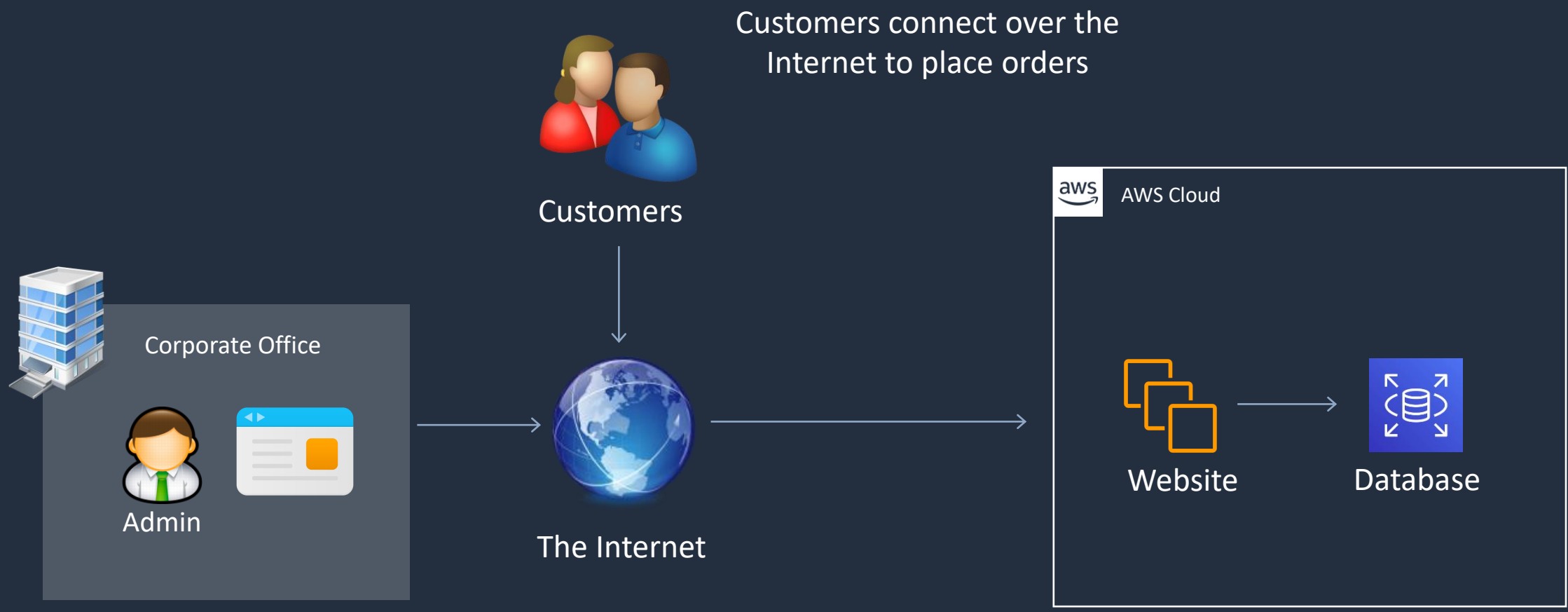
DigitalCloud TRAINING

Deploying an eCommerce Website on-premises (aka the old way)



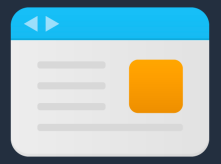
3-6 months

Deploying an eCommerce Website in the Cloud



The admin deploys an eCommerce website / database to AWS using the AWS Management Console

Launching Cloud Services: Management Console



Management Console

A web-based console accessed through a standard web browser

Compute
- EC2
- Lightsail
- Lambda
- Batch
- Elastic Beanstalk
- Serverless Application Repository
- AWS Outposts
- EC2 Image Builder

Storage
- S3
- EFS
- FSx
- S3 Glacier
- Storage Gateway
- AWS Backup

Database
- RDS
- DynamoDB
- ElastiCache
- Neptune
- Amazon Redshift
- Amazon QLDB

Blockchain
- Amazon Managed Blockchain

Satellite
- Ground Station

Quantum Technologies
- Amazon Braket

Management & Governance
- AWS Organizations
- CloudWatch
- AWS Auto Scaling
- CloudFormation
- CloudTrail
- Config
- OpsWorks
- Service Catalog
- Systems Manager
- AWS AppConfig
- Trusted Advisor
- Control Tower
- AWS License Manager
- AWS Well-Architected Tool

Analytics
- Athena
- EMR
- CloudSearch
- Elasticsearch Service
- Kinesis
- QuickSight
- Data Pipeline
- AWS Data Exchange
- AWS Glue
- AWS Lake Formation
- MSK

Security, Identity, & Compliance
- IAM
- Resource Access Manager
- Cognito
- Secrets Manager
- GuardDuty
- Inspector
- Amazon Macie
- AWS Single Sign-On
- Certificate Manager
- Key Management Service
- CloudHSM
- Directory Service

Business Applications
- Alexa for Business
- Amazon Chime
- WorkMail
- Amazon Honeycode

End User Computing
- WorkSpaces
- AppStream 2.0
- WorkDocs
- WorkLink

Internet Of Things
- IoT Core
- FreeRTOS
- IoT 1-Click
- IoT Analytics
- IoT Device Defender
- IoT Device Management
- IoT Events
- IoT Greengrass
- IoT SiteWise
- IoT Things Graph

Launching Cloud Services: Command Line

Command Line

This command launches a **virtual server** (EC2 instance) on Amazon Web Services

```
aws ec2 run-instances --image-id ami-xxxxxxxx --count 1 --instance-type
t2.micro
```

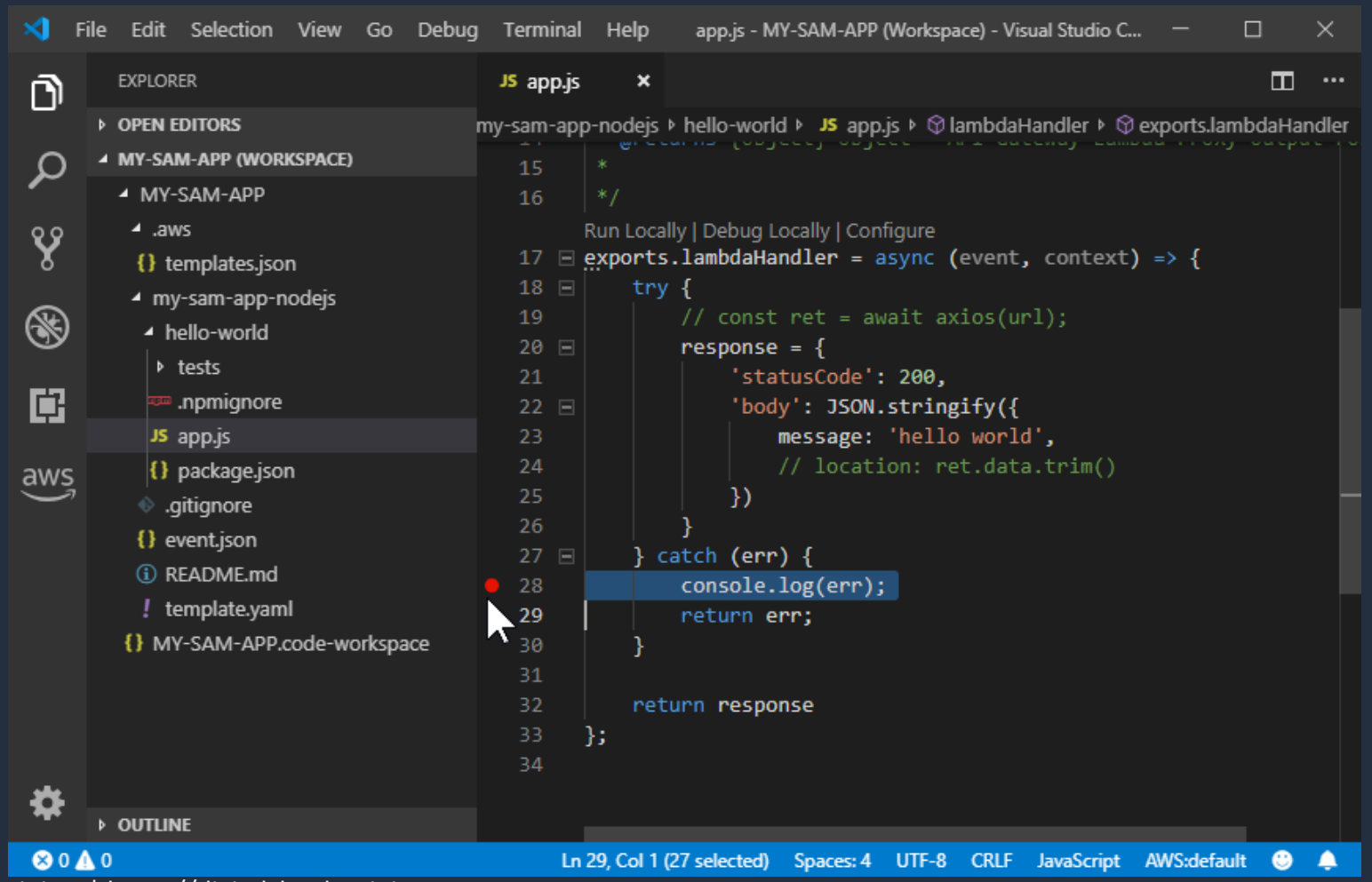
```
aws s3 ls s3://mys3databucket
```

This command lists the contents of a storage container (bucket) on **Amazon S3**

Launching Cloud Services: Software Development Kit

Code (SDK)

A developer writes code in an integrated development environment (IDE)



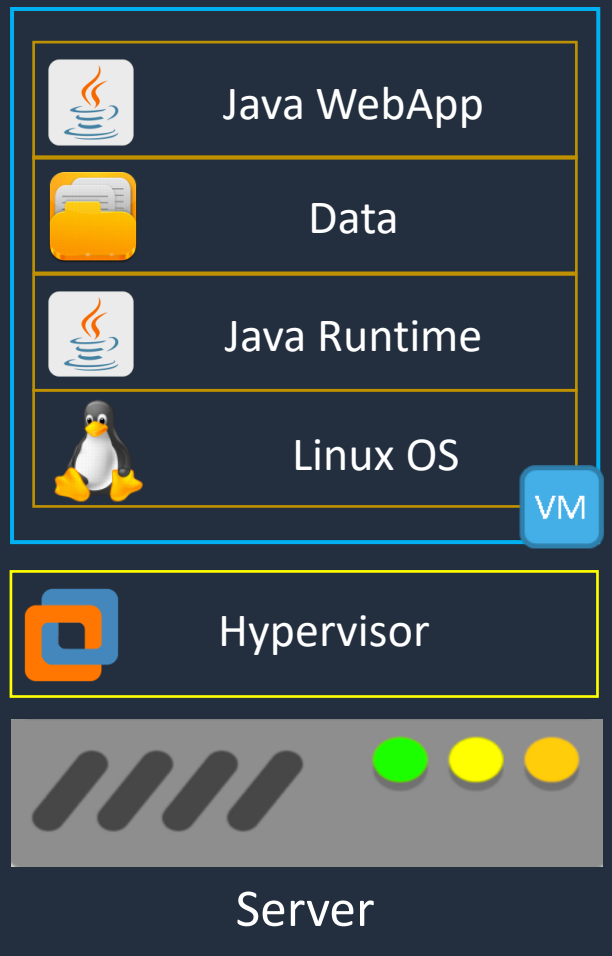
The code leverages the SDK to work with cloud services

Cloud Computing Service Models

DigitalCloud TRAINING

Cloud Service Models: Private Cloud

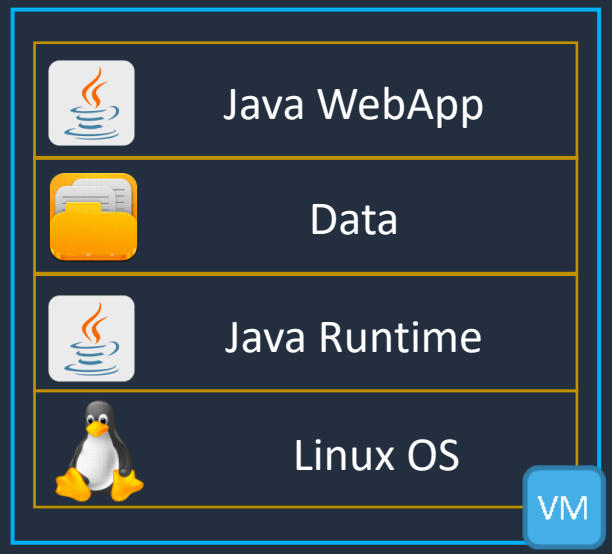
Managed by **you**



A **private cloud** must also include self-service, multi-tenancy, metering, and elasticity

Cloud Service Models: Infrastructure as a Service (IaaS)

Managed by
you



Examples:

- Amazon Elastic Compute Cloud (EC2)
- Azure Virtual Machines
- Google Compute Engine

Cloud Service Models: Platform as a Service (**P**aaS)

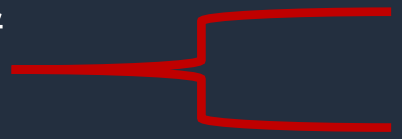
Managed by
you

Examples:

- AWS Elastic Beanstalk
- Azure WebApps
- Compute App Engine

Cloud Service Models: Software as a Service (SaaS)

~~Managed by you~~



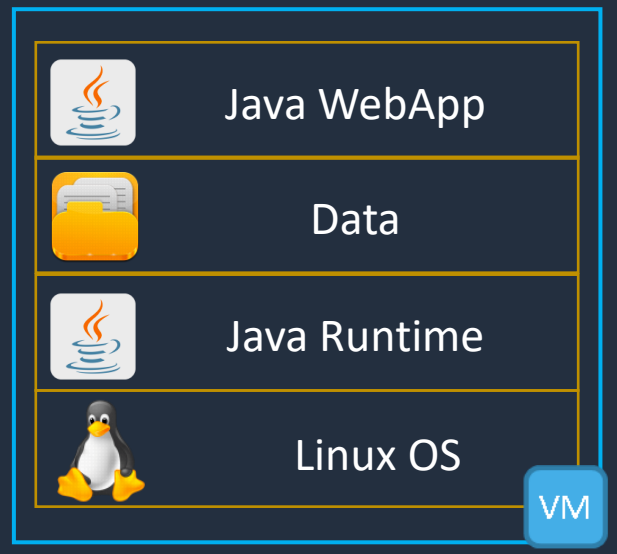
Pure consumption model

Examples:

- Google Apps
- Salesforce.com
- Zoom

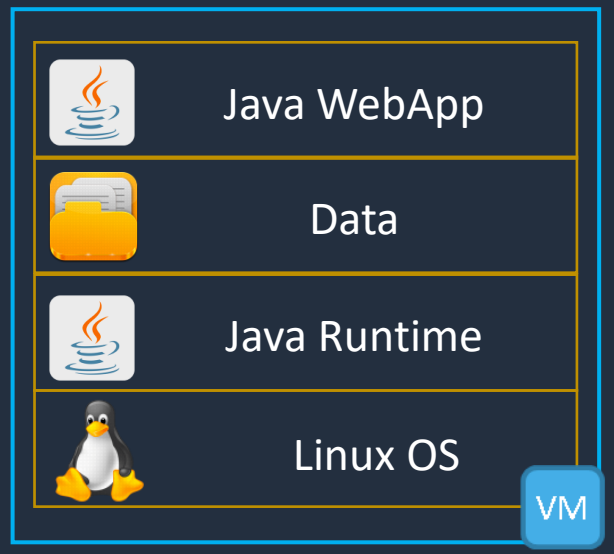
Cloud Service Models: Comparison

Private Cloud



You manage **everything** - greater responsibility + greater control

IaaS



You manage from the **virtual server** upwards

PaaS

You simply upload your **code/data** to create your application

SaaS

You simply **consume** the service - little responsibility + little control

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Cloud Computing Deployment Models

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Cloud Computing Deployment Models

Name	Description	Examples
Private Cloud	An enterprise deploys their own infrastructure and applications into their own data center	VMware, Microsoft, RedHat, OpenStack
Public Cloud	The IT services that you consume are hosted and delivered from a third-party and accessed over the Internet	AWS, Microsoft Azure, Google Cloud Platform
Hybrid Cloud	A combination of on-premises, private cloud, and public cloud services are consumed	
Multicloud	Usage of two or more public clouds at a time, and possibly multiple private clouds	

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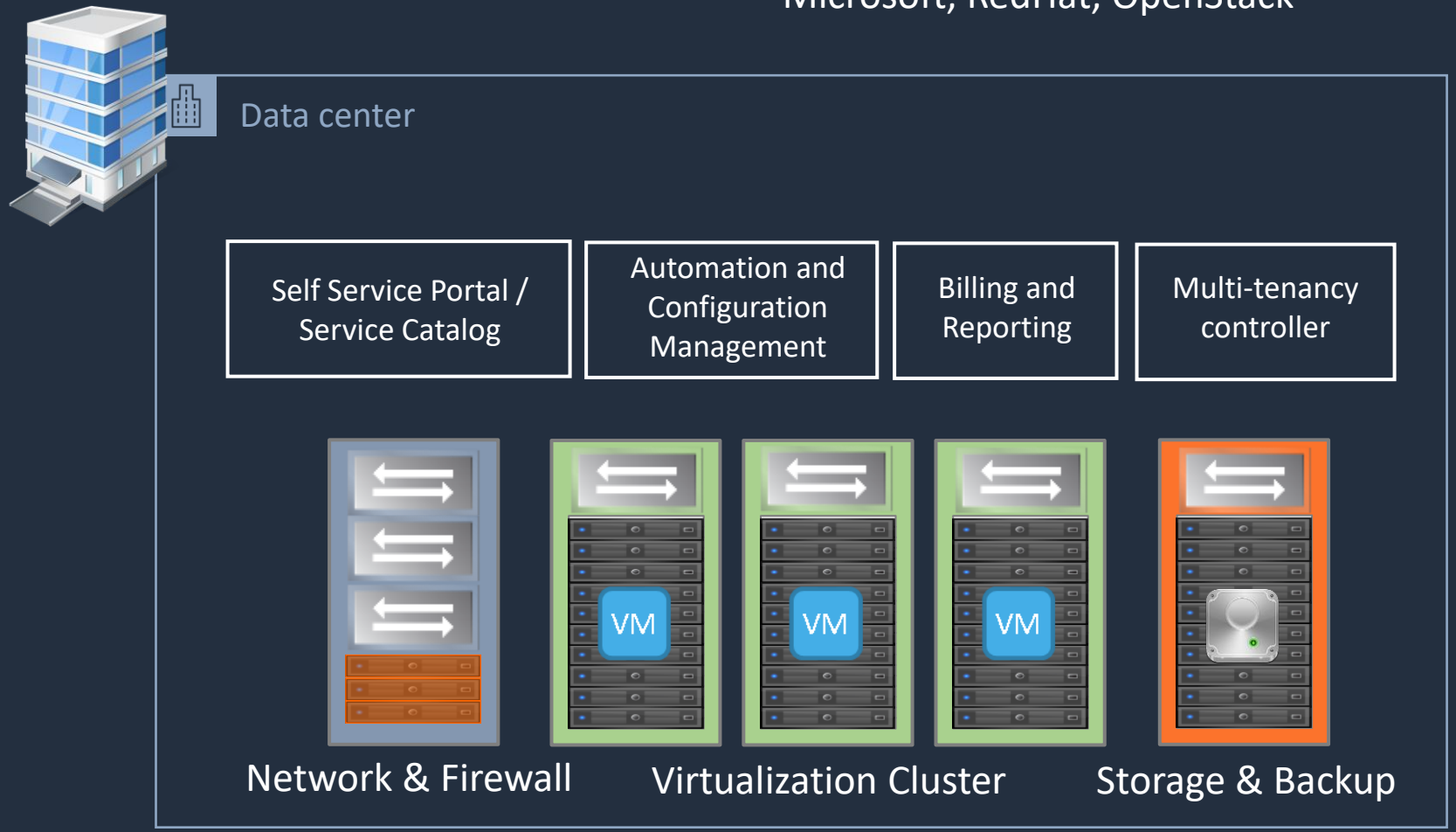
Private Cloud

Examples are VMware, Microsoft, RedHat, OpenStack



Cloud management software layer

Benefits:

- Complete control of the entire stack
- Security – in a few cases, organizations may need to keep all or some of their applications and data in house

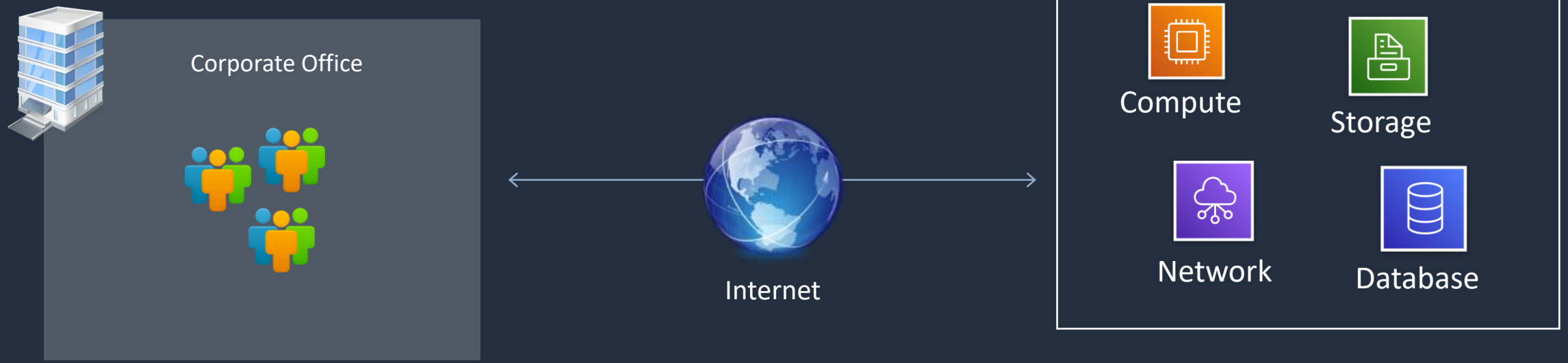
You **build** and **manage** the cloud deployment

Cloud Deployment Models - Public Cloud

Examples are AWS, Microsoft Azure, Google Cloud Platform

Benefits:

- Variable expense, instead of capital expense
- Economies of scale
- Massive elasticity

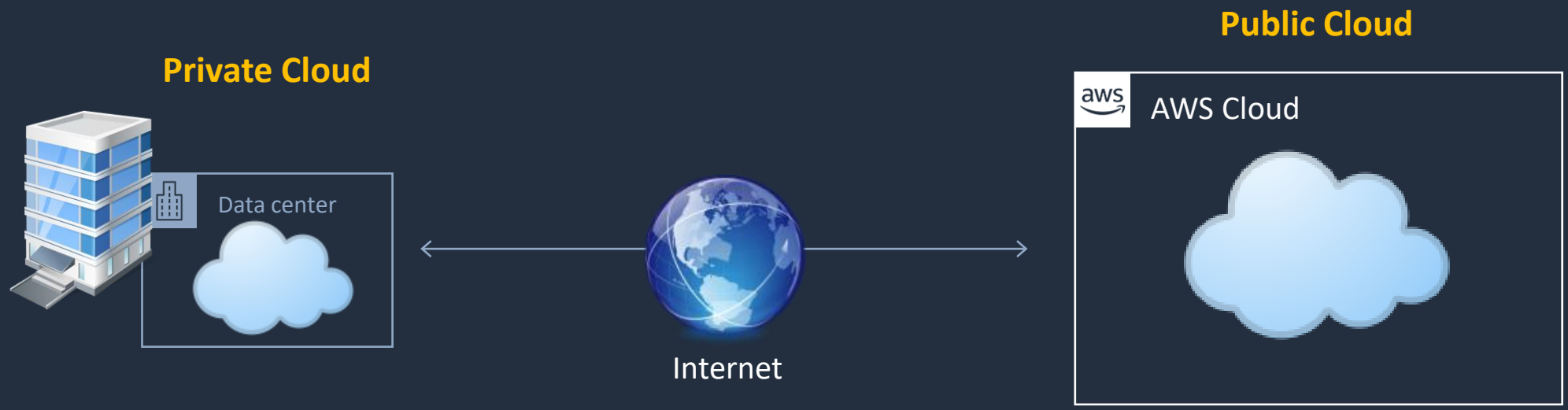


Connected using either the **Internet** or a **private link**

Cloud Deployment Models - Hybrid Cloud

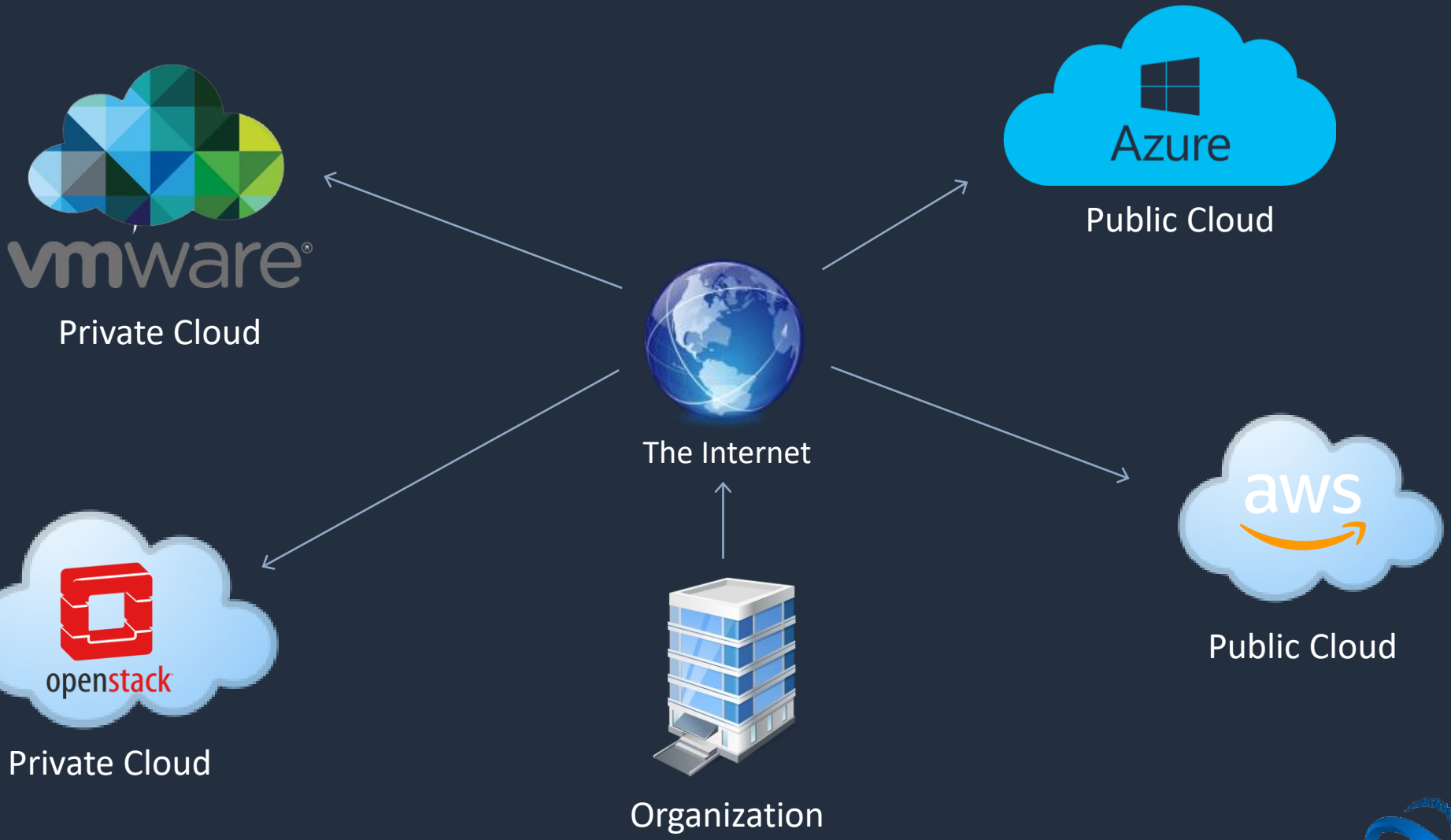
Benefits:

- Allows companies to keep the critical applications and sensitive data in a traditional data center environment or private cloud
- Take advantage of public cloud resources like SaaS, for the latest applications, and IaaS, for elastic virtual resources
- Facilitates portability of data, apps and services and more choices for deployment models



Connected using either the **Internet** or a **private** link

Cloud Deployment Models - Multicloud

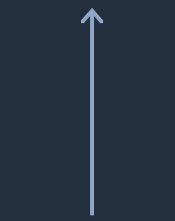


Scaling Up vs Scaling Out

Stateful vs Stateless Applications

Stateless:

No “state” is recorded about the user's session



Person check a news website

Stateful:

Netflix records what has been watched

Person logs into Netflix

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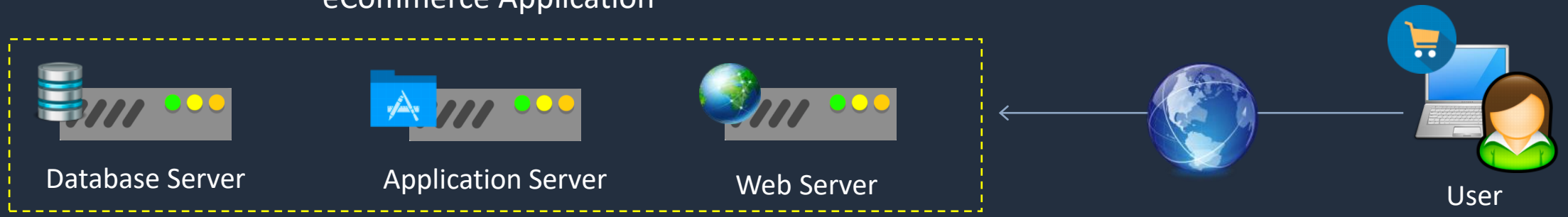
Stateful vs Stateless Applications

No data is stored on the web server, it is stateless

eCommerce Application

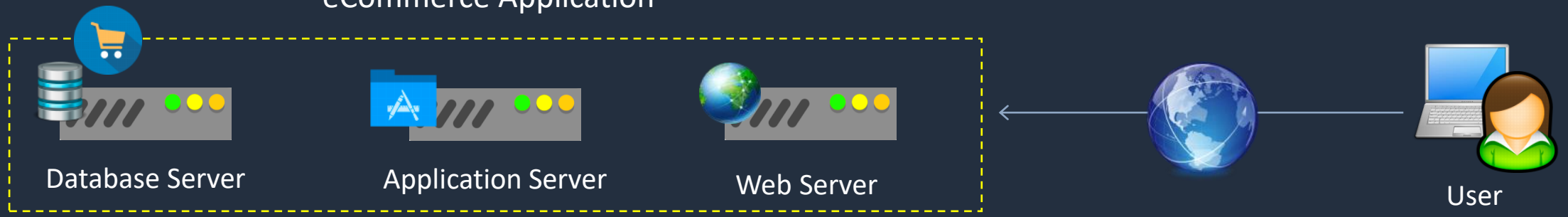


When the user purchases, the application layer processes the order and records the data in the database. This is stateful

The cart items are stored in cookies on the computer

Stateful vs Stateless Applications

No data is stored on the web server, it is stateless



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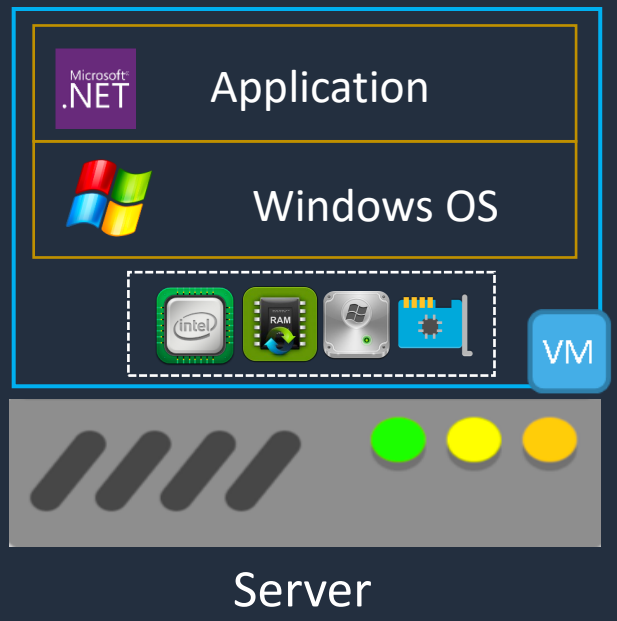
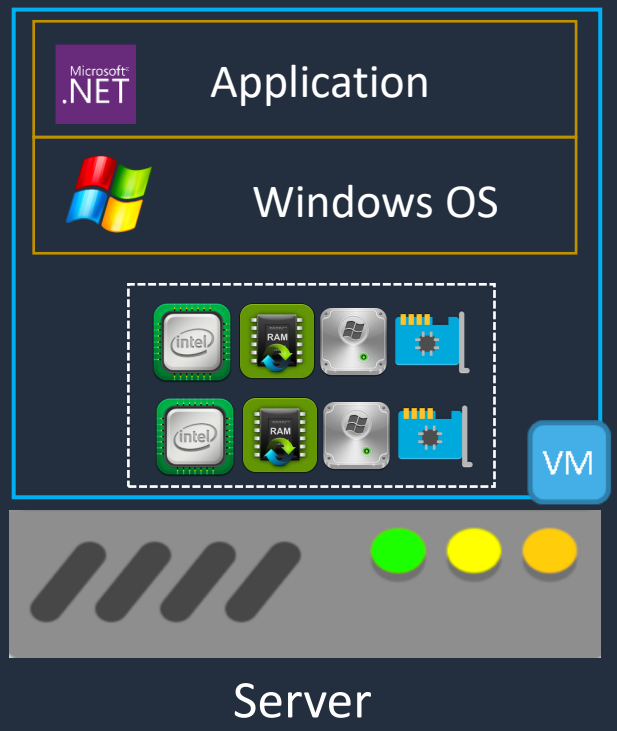
Scalability and Elasticity: Scaling Up



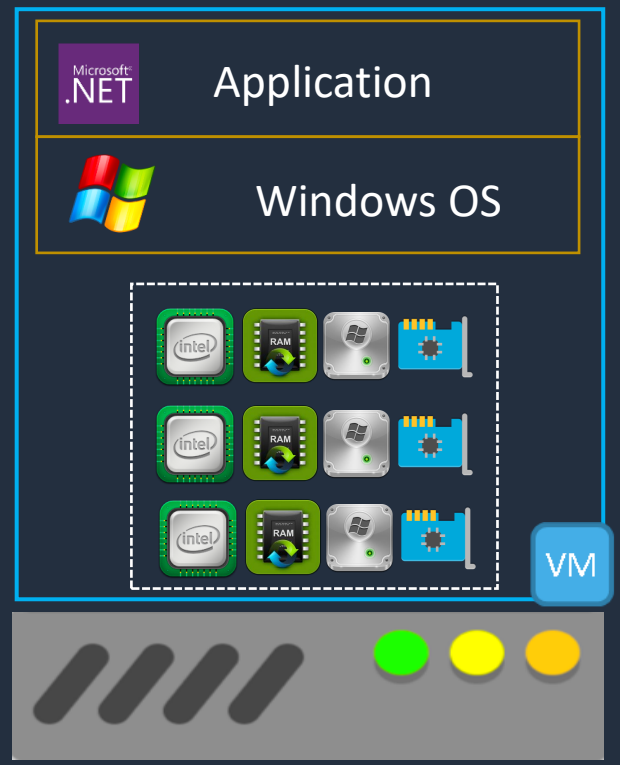
Scalability and Elasticity: Scaling Up

Scaling up means adding resources to the server

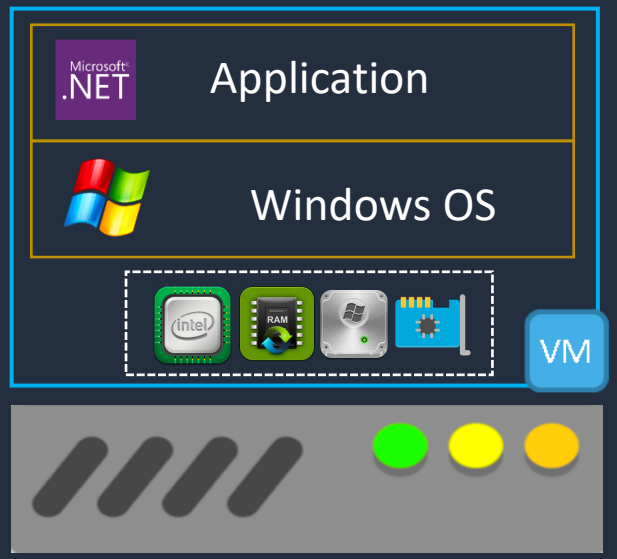


Scalability and Elasticity: Scaling Up

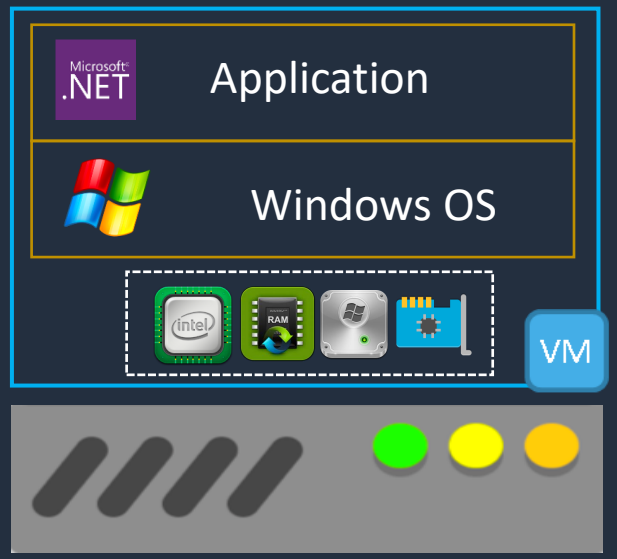
Scaling up means adding resources to the server



Scalability and Elasticity: Scaling Out

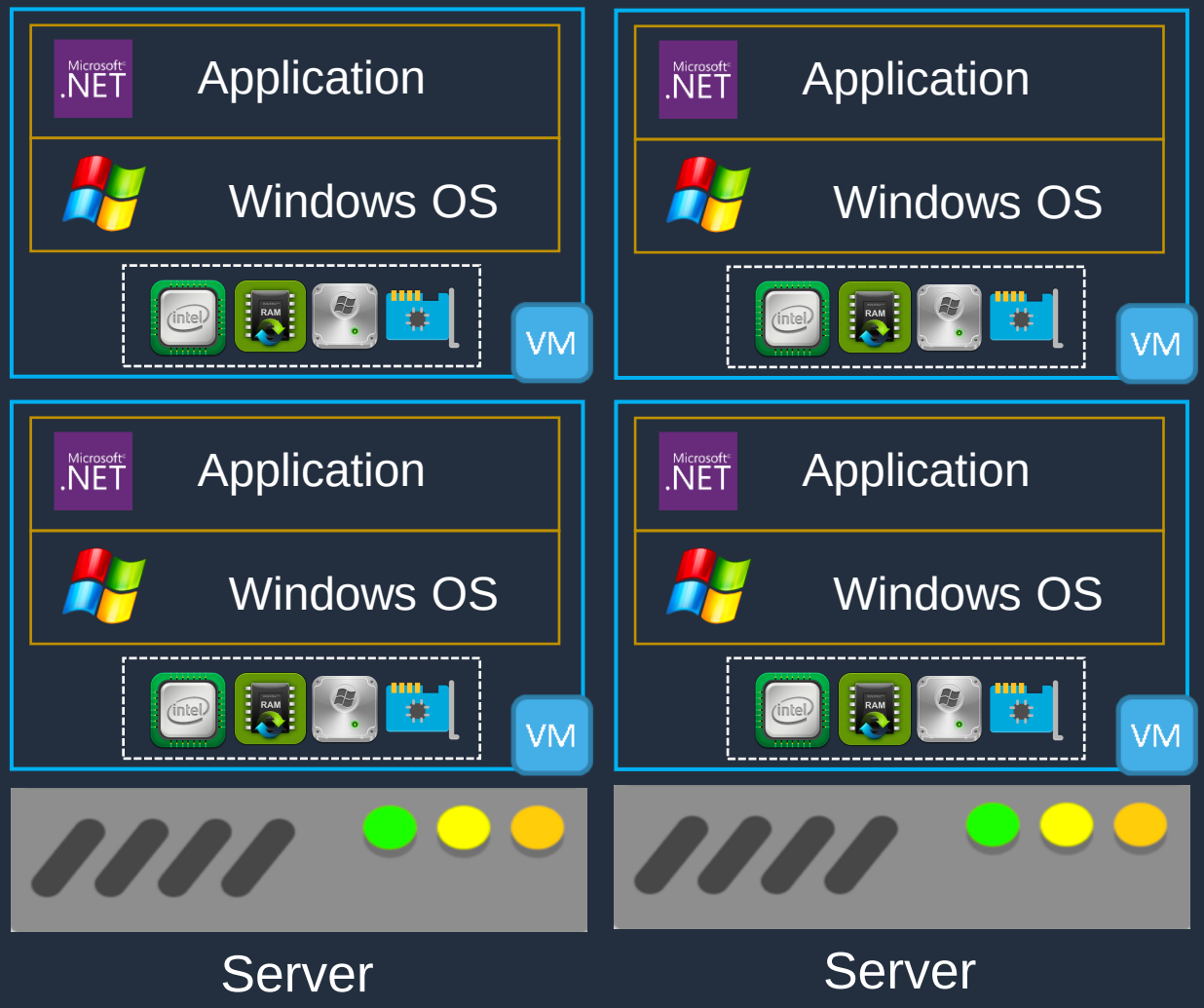


Scalability and Elasticity: Scaling Out



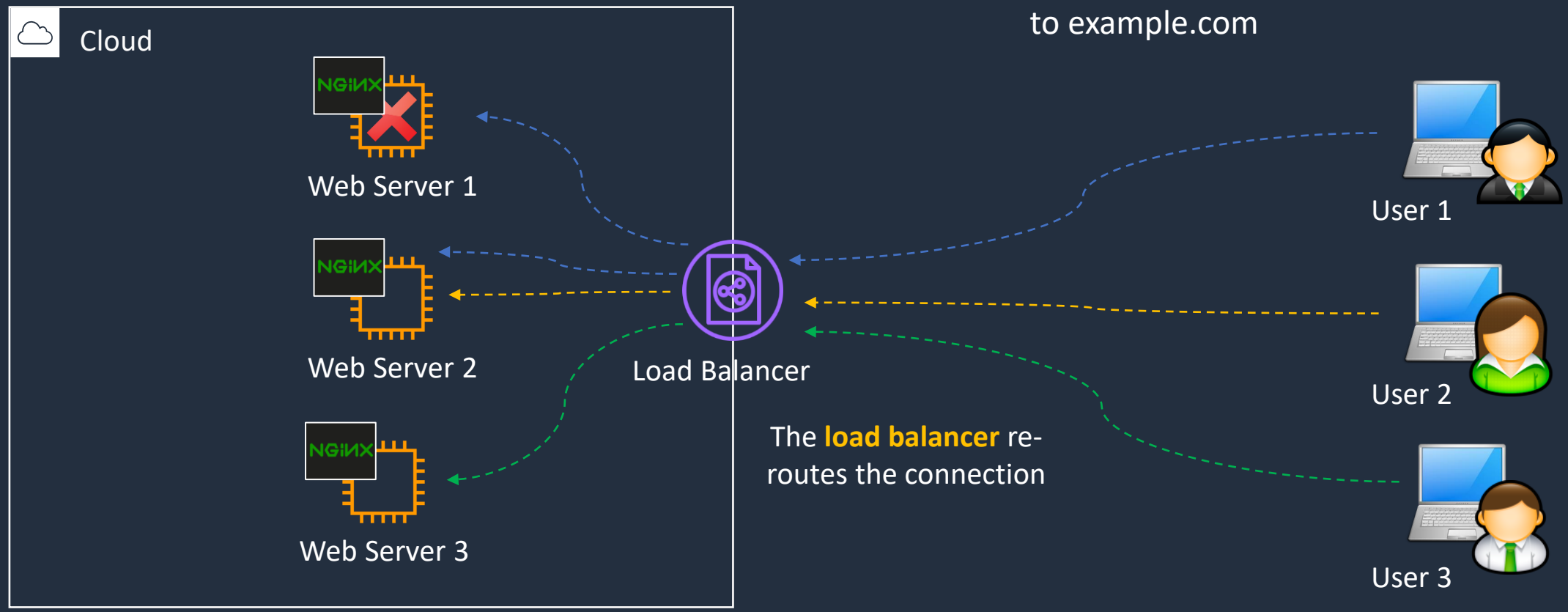
Scalability and Elasticity: Scaling Out

Scaling out means adding additional servers



High Availability and Fault Tolerance

Load Balancing

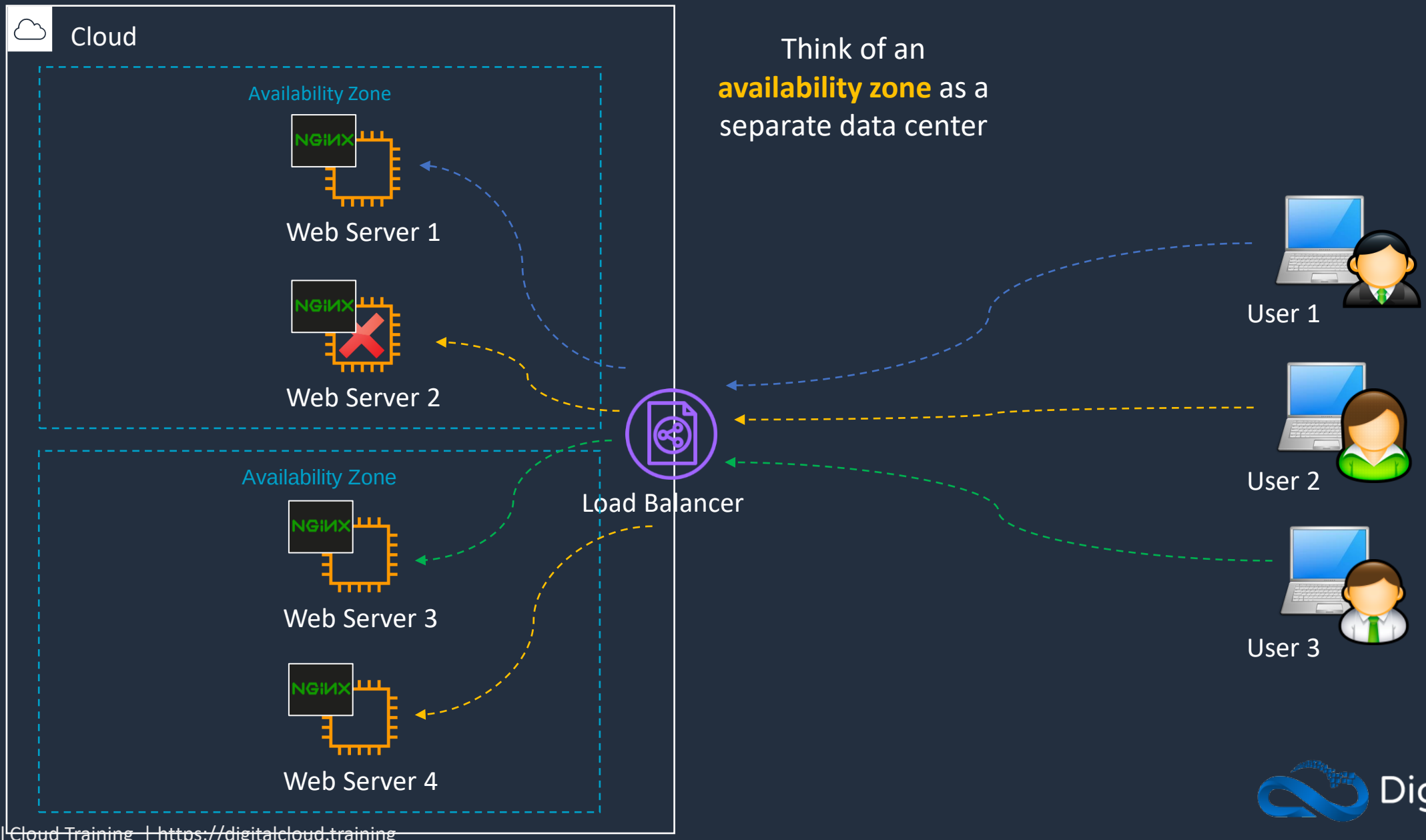


Fault Tolerance

Redundant components allow the system to continue to operate

The system may fail if there is no built-in redundancy

High Availability and Fault Tolerance



Think of an **availability zone** as a separate data center

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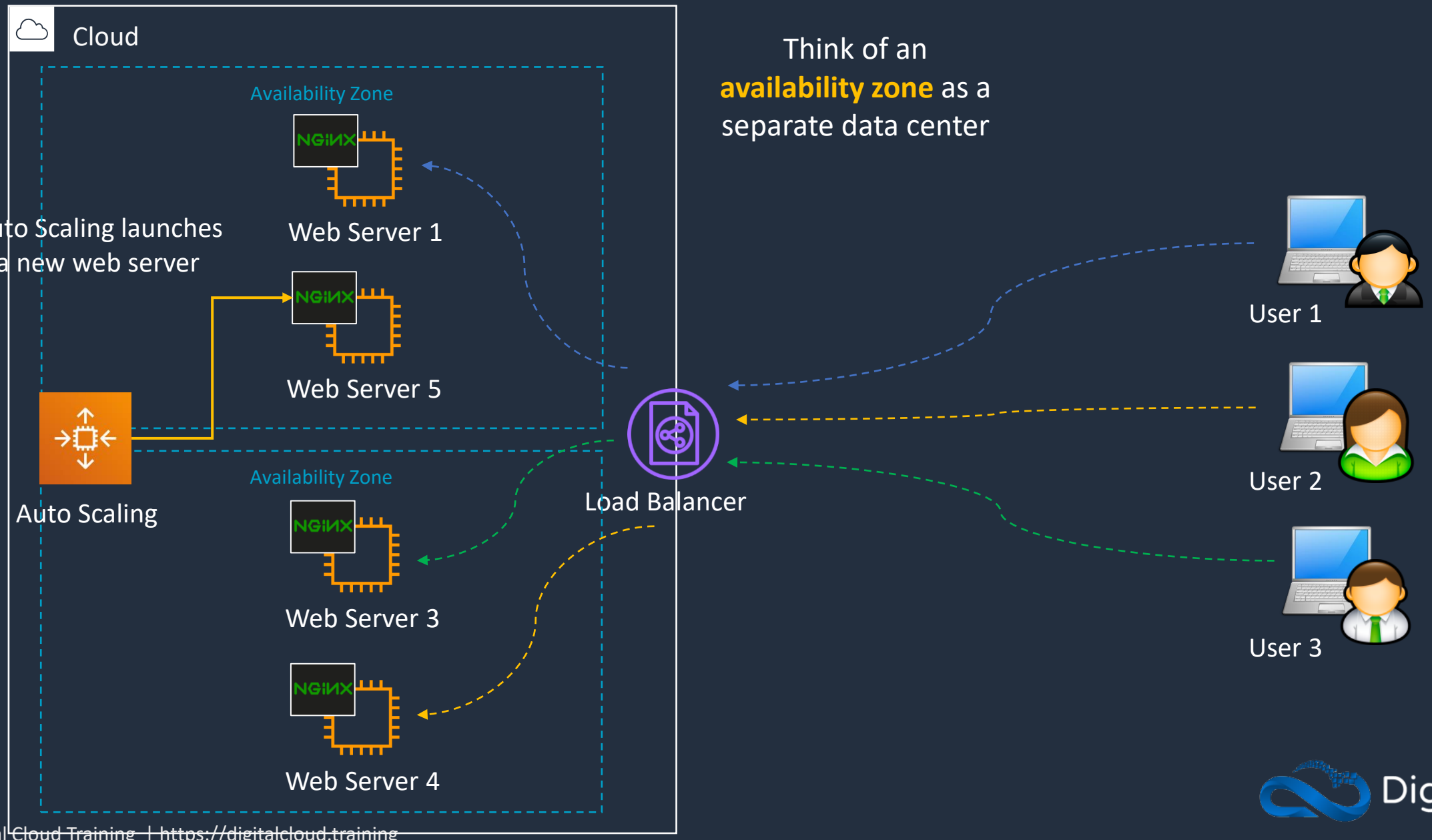
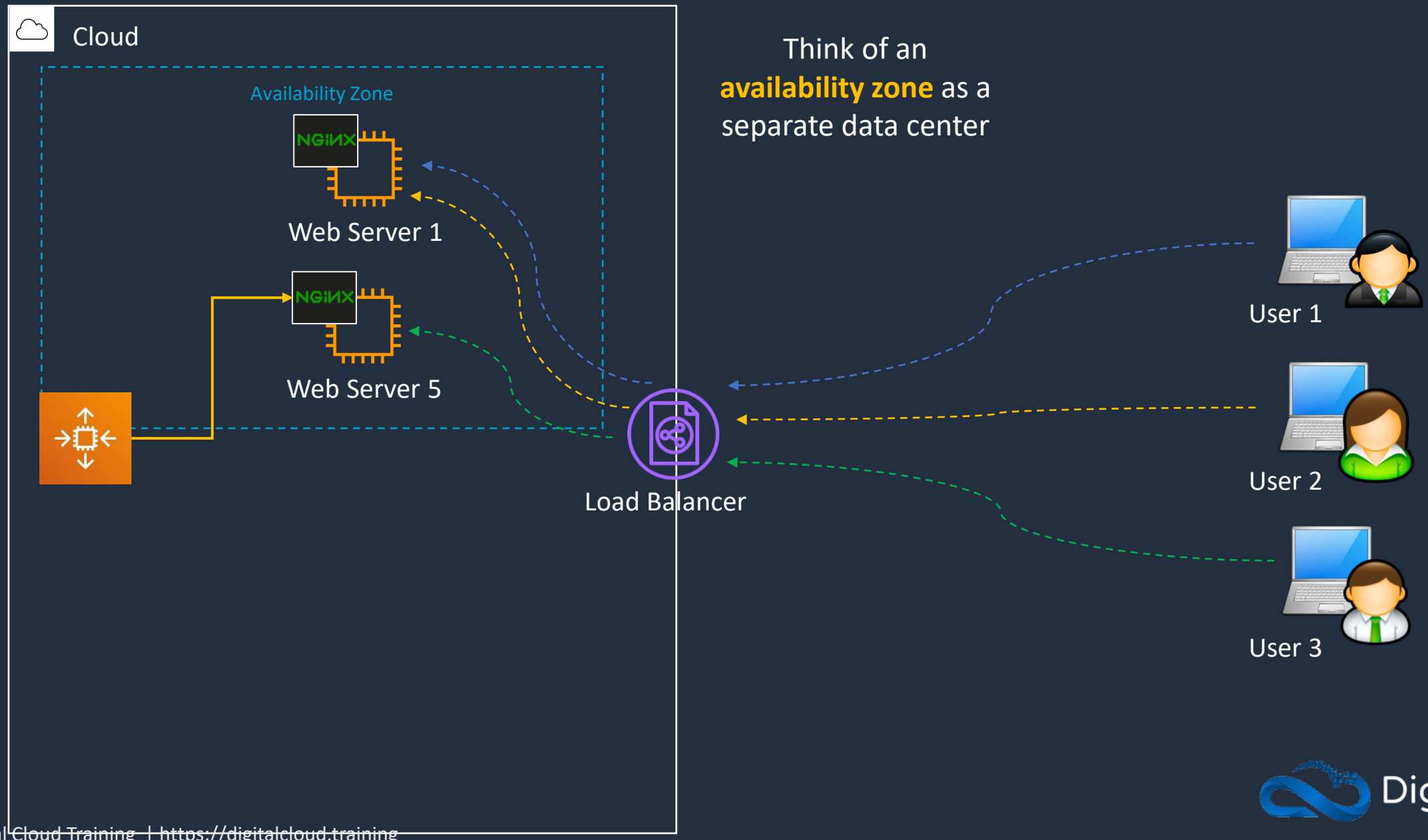
High Availability and Fault Tolerance



High Availability and Fault Tolerance



Think of an **availability zone** as a separate data center

Monolithic and Microservices Architectures

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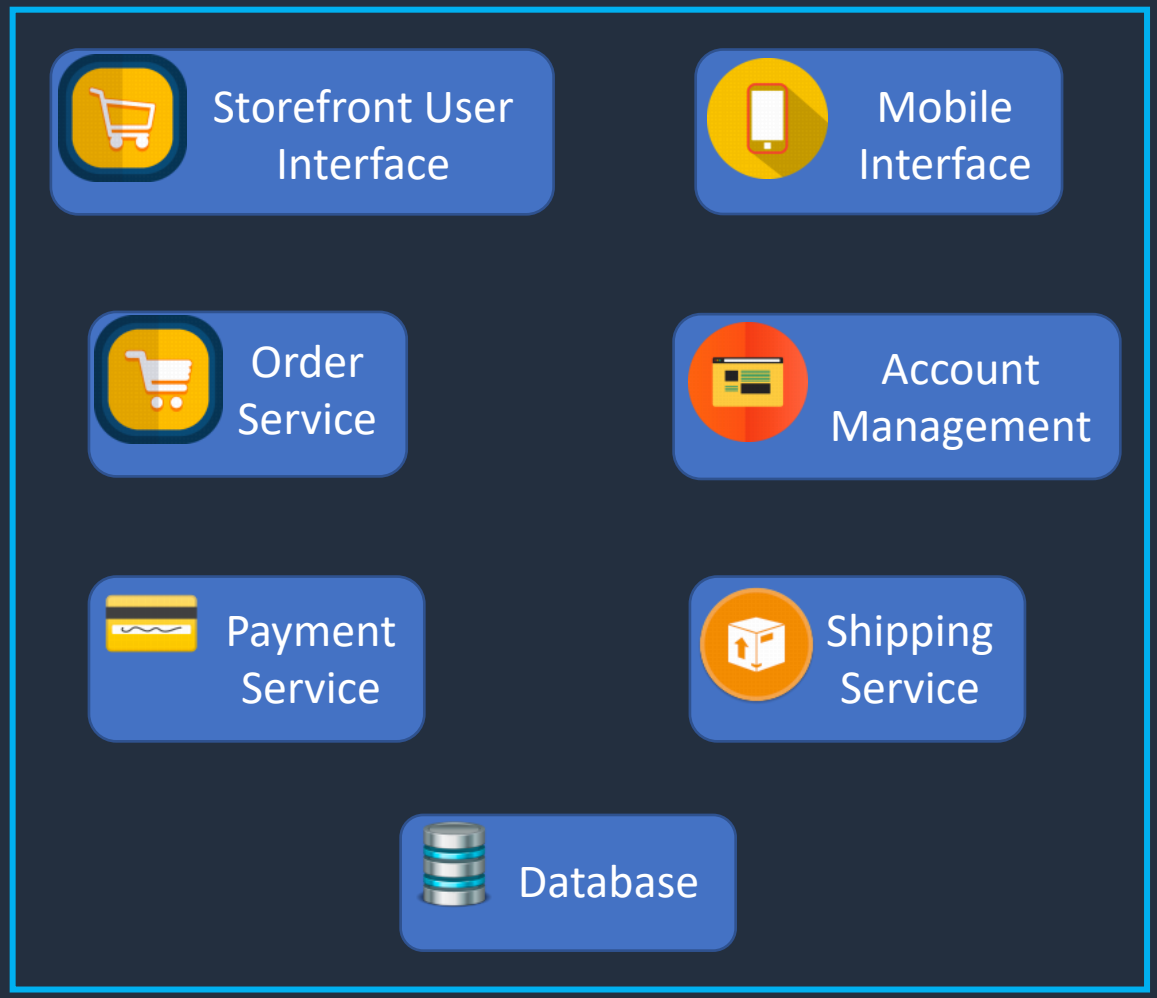
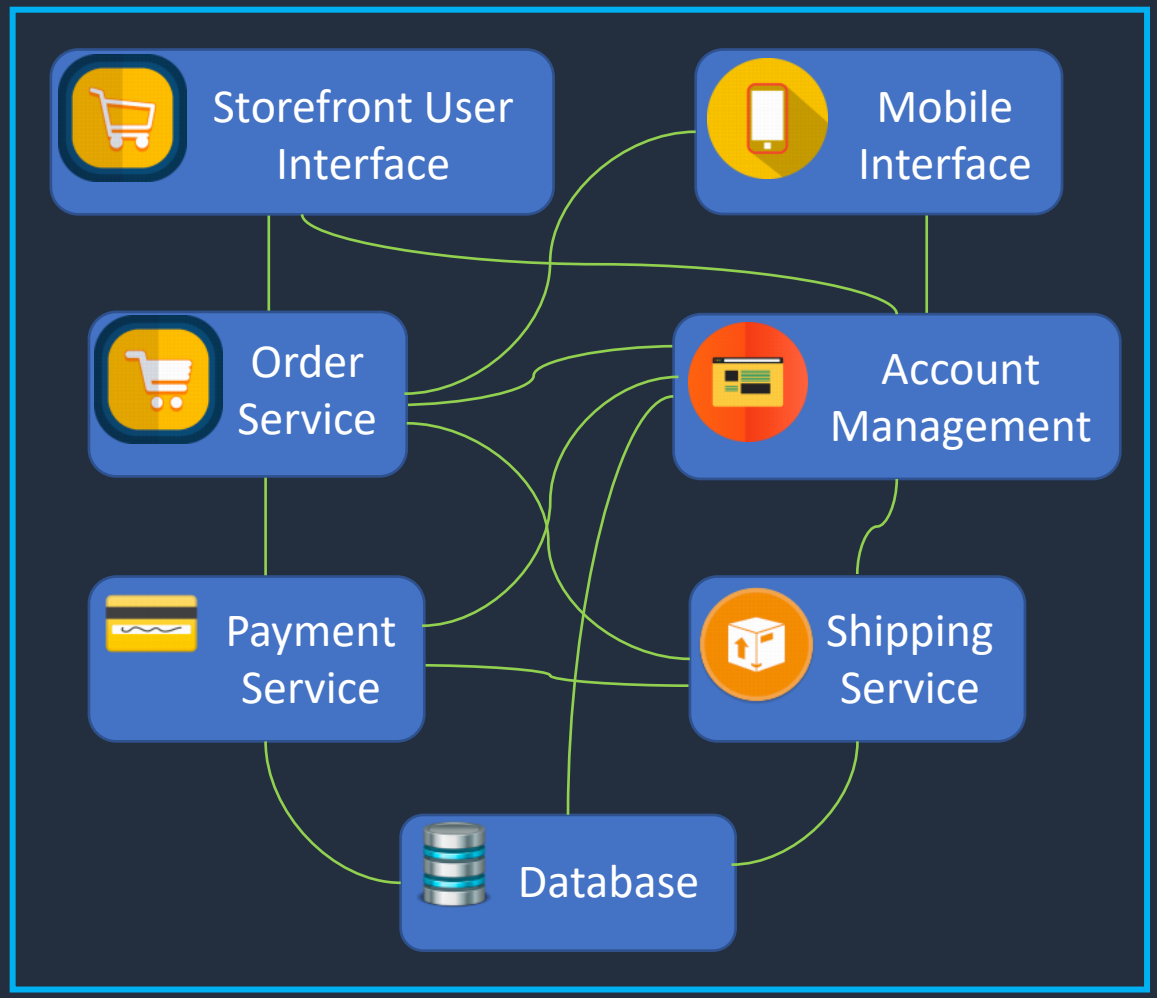
Monolithic Application



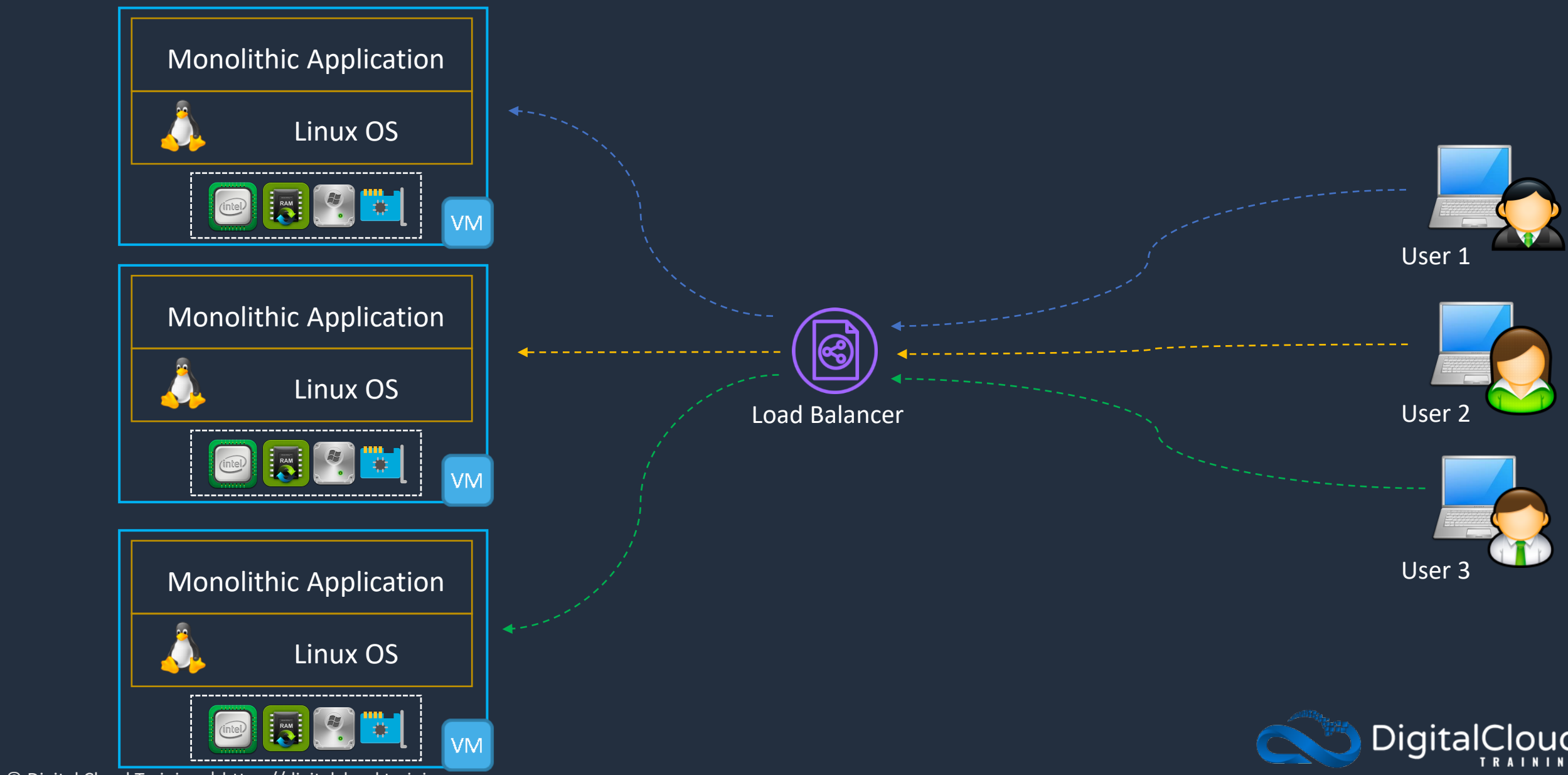
Monolithic Application

Updates to, or failures of, any single component can take down the whole application

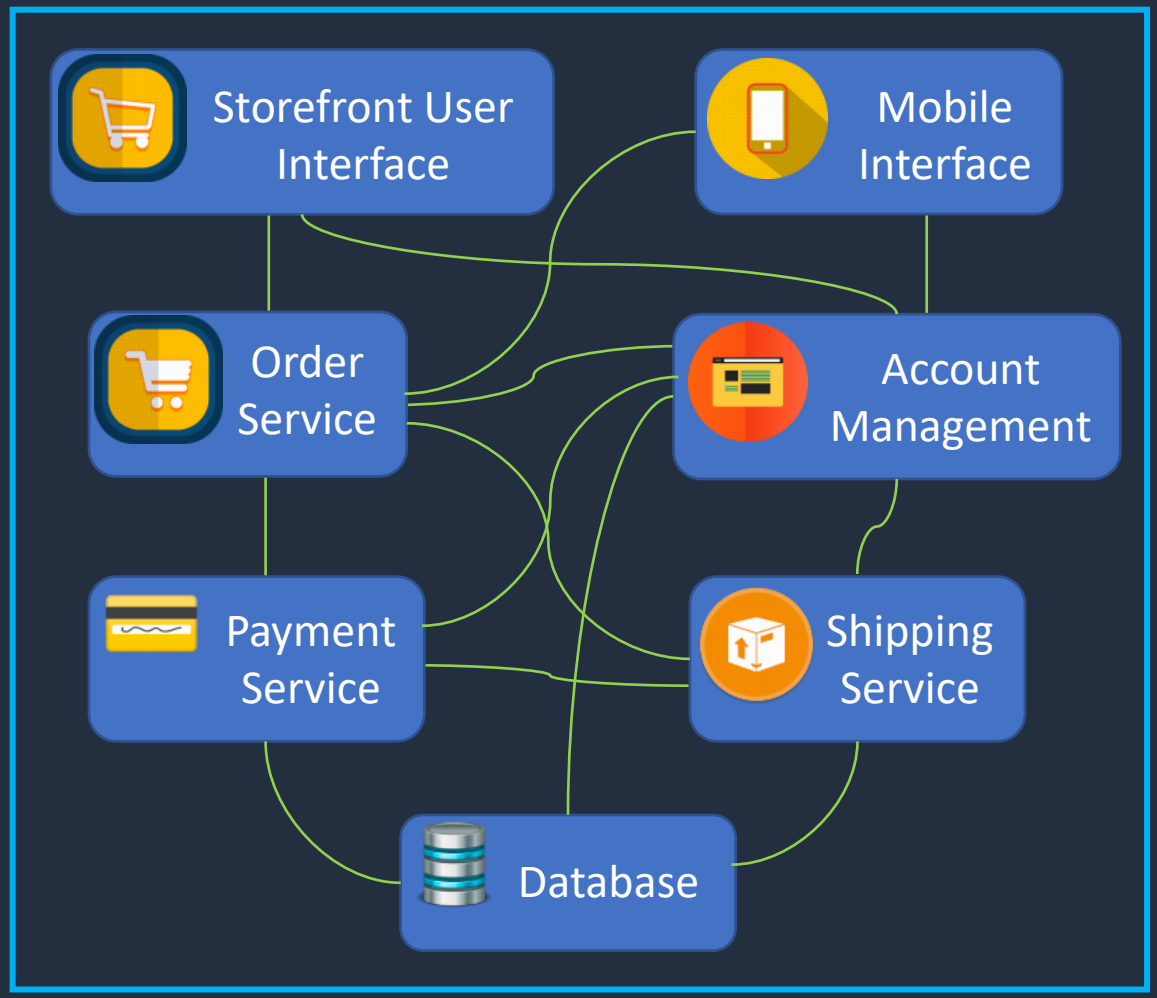


The user interface, business logic, and data access layer are combined on a single platform

Monolithic Application



Monolithic Application

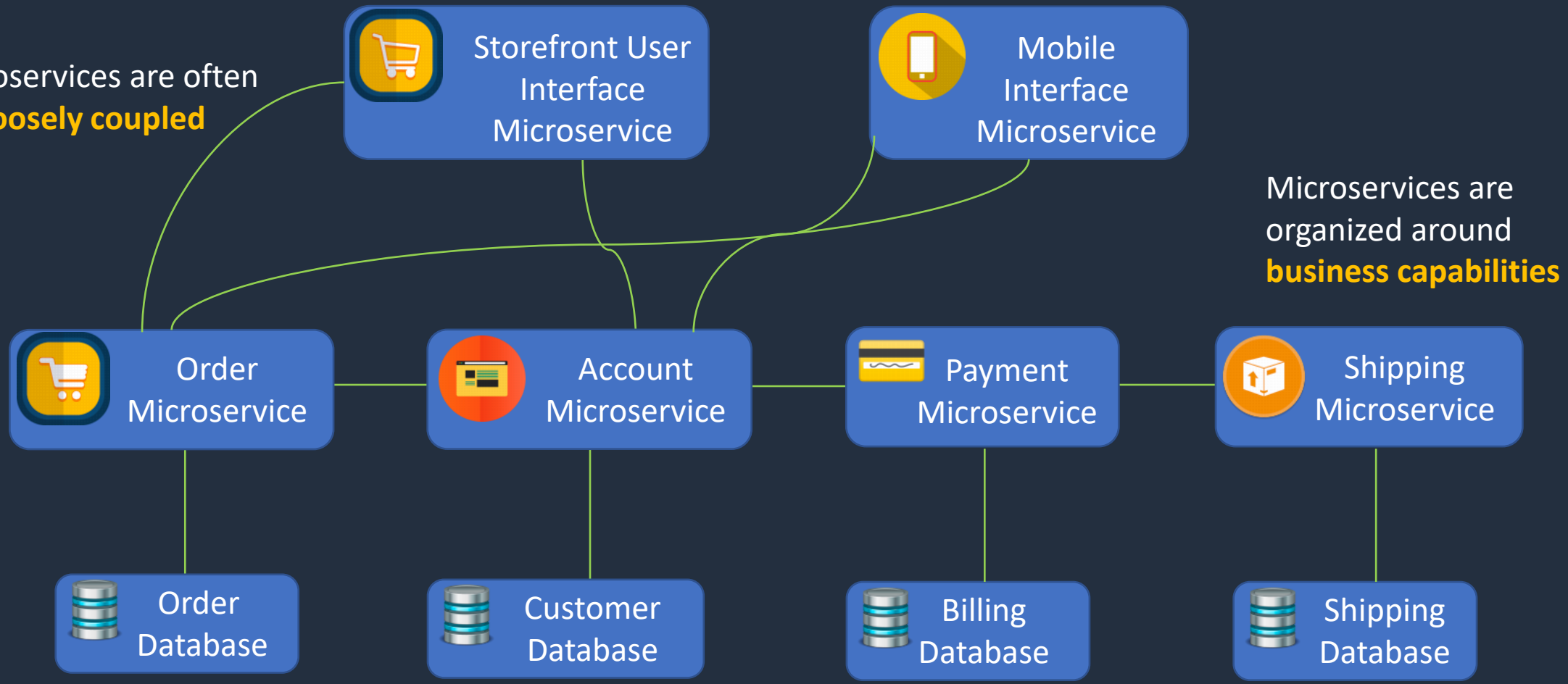


Microservices Architecture

A **microservice** is an independently deployable unit of code

Microservices are often **loosely coupled**

Microservices are organized around **business capabilities**



Microservices using Docker Containers

Storefront User Interface Microservice

Order Microservice

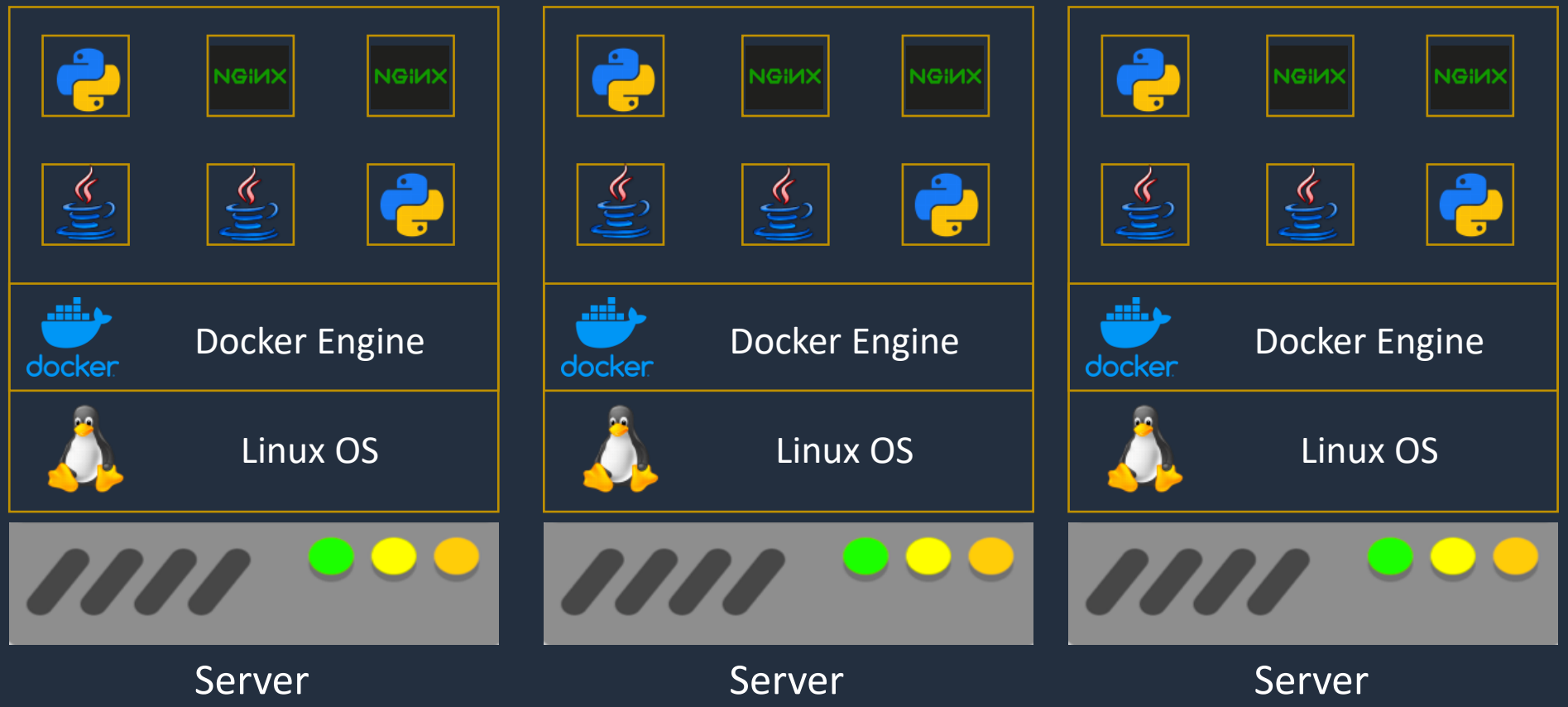
Shipping Microservice

Server

Microservices using Docker Containers

Microservices can also be spread across hosts

Many instances of each microservice can run on each host



Microservices: Attributes and Benefits

Microservices Attribute	Microservices Benefit
Use of Application Programming Interfaces (APIs)	Easier integrations between application components; assists with loose coupling
Independently deployable blocks of code	Can be scaled and maintained independently
Business-oriented architecture	Development organized around business capabilities; teams may be cross-functional and services may be reused
Flexible use of technologies	Each microservice can be written using different technologies (e.g. programming languages)
Speed and agility	Fast to deploy and update. Easy to include high availability and fault tolerance for each microservice

SECTION 5

AWS Access Control and Networking

Amazon Web Services Overview

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Amazon Web Services (AWS)

Subsidiary of Amazon

Charge for services based on usage

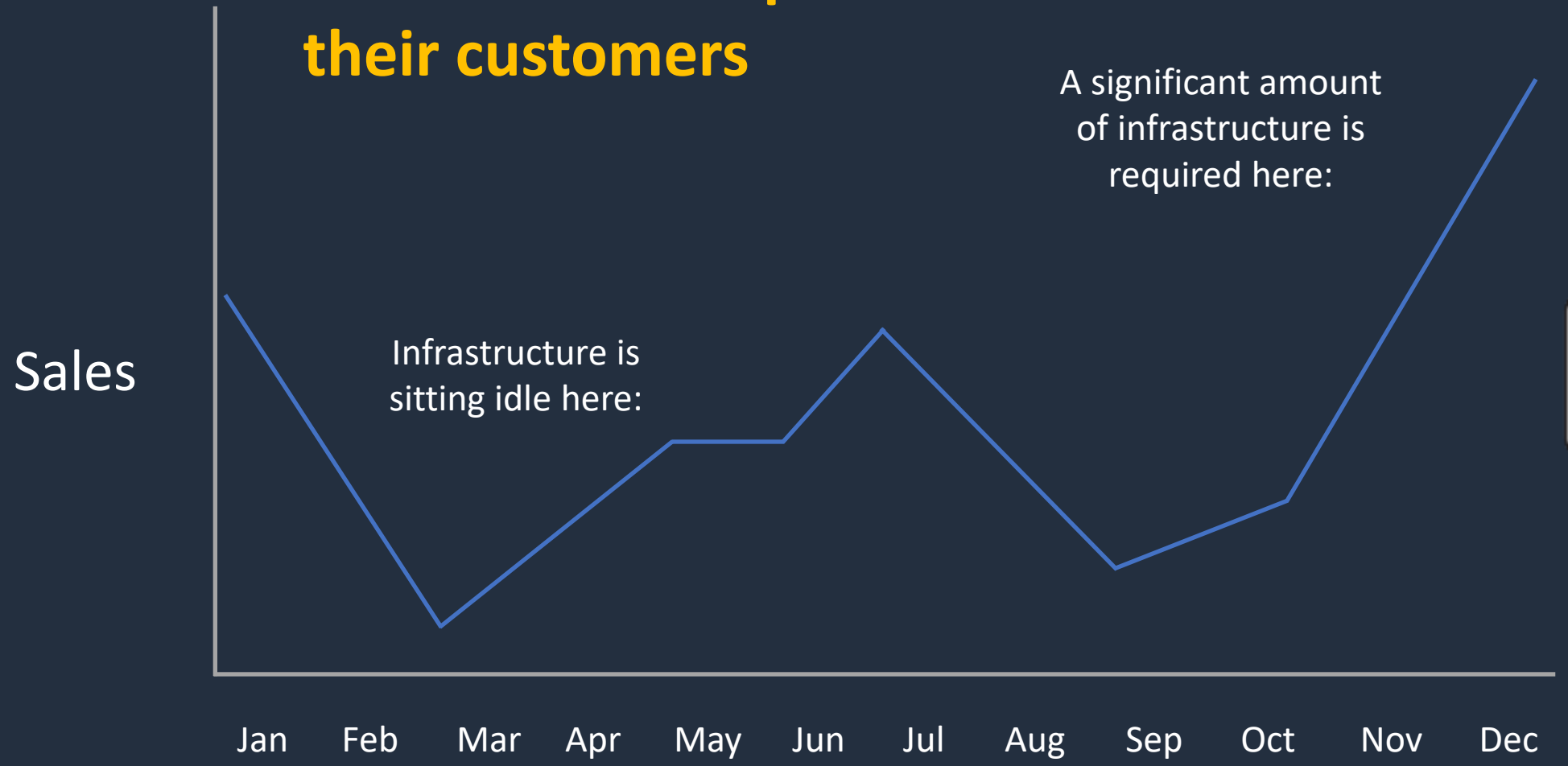
Hyperscale Public Cloud Provider

27 Regions around the world

Services are offered on-demand

Overview of AWS

AWS solves this problem for their customers



AWS Service Categories (a few examples)

Machine Learning

Compute

Media Services

Storage

aws

Networking

Database

Many more categories and over **200** services!

End User Computing

Analytics

Internet of Things

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Fundamentals of AWS Pricing

Compute

Amount of resources such as CPU and RAM and duration

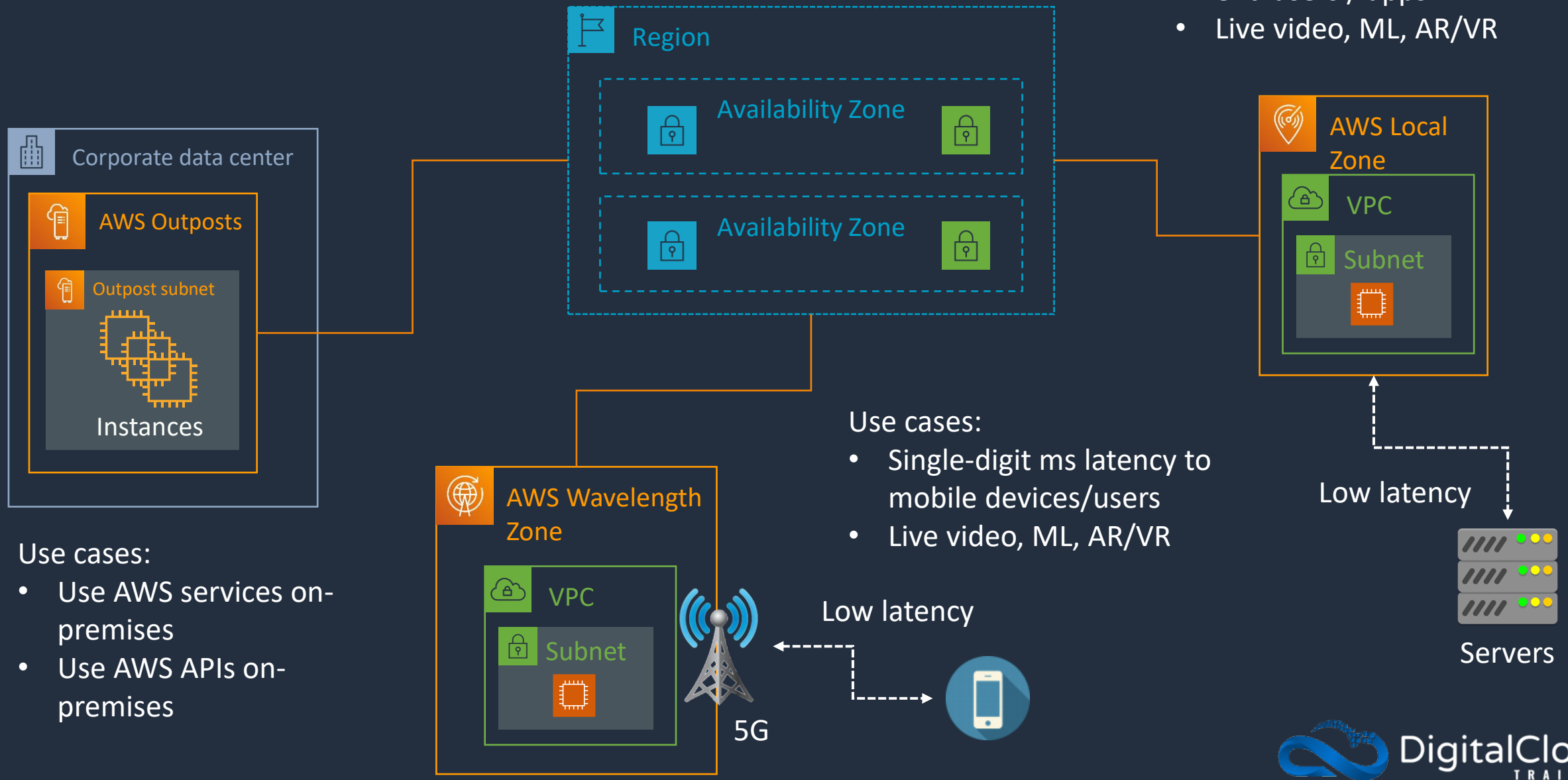
Storage

Quantity of data stored

Outbound Data Transfer

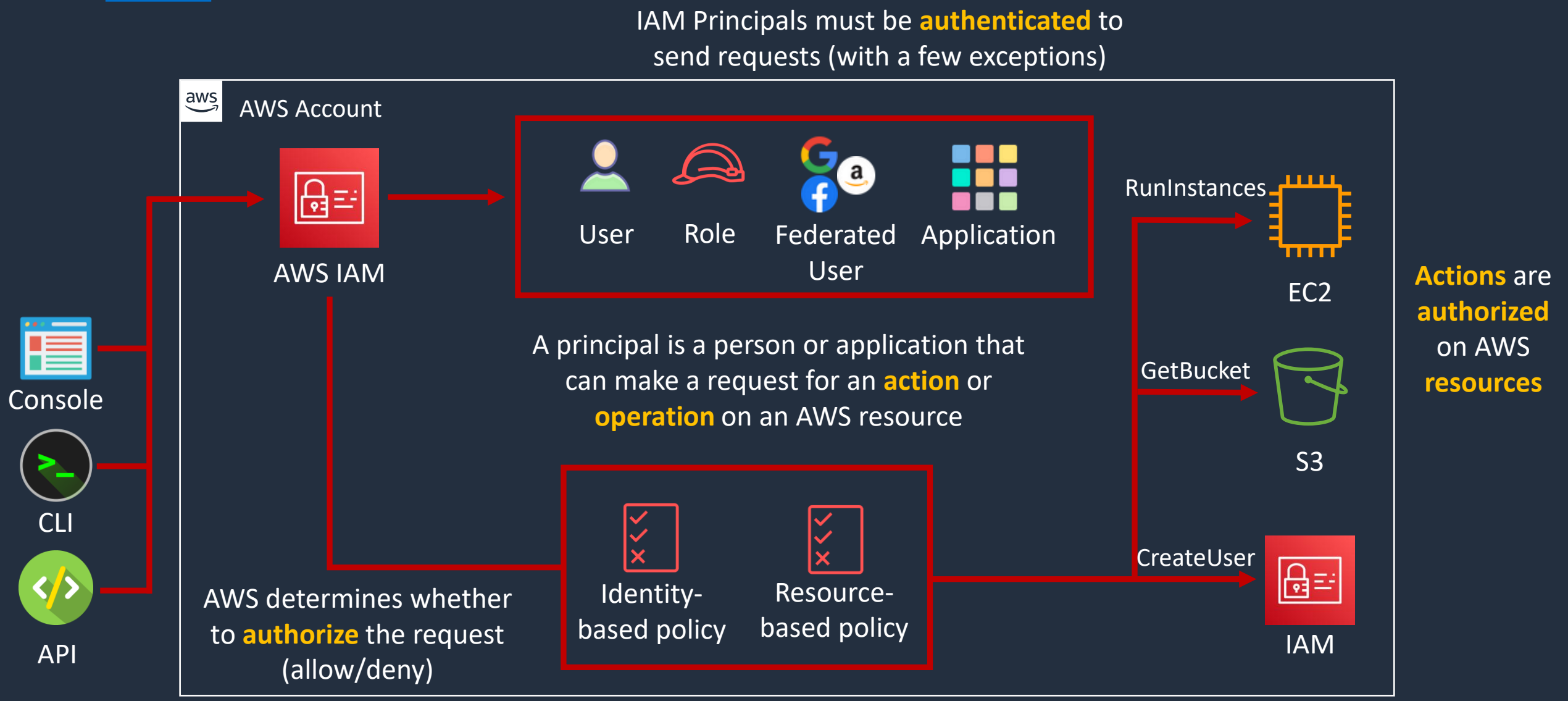
Quantity of data that is transferred out from all services

AWS Global Infrastructure

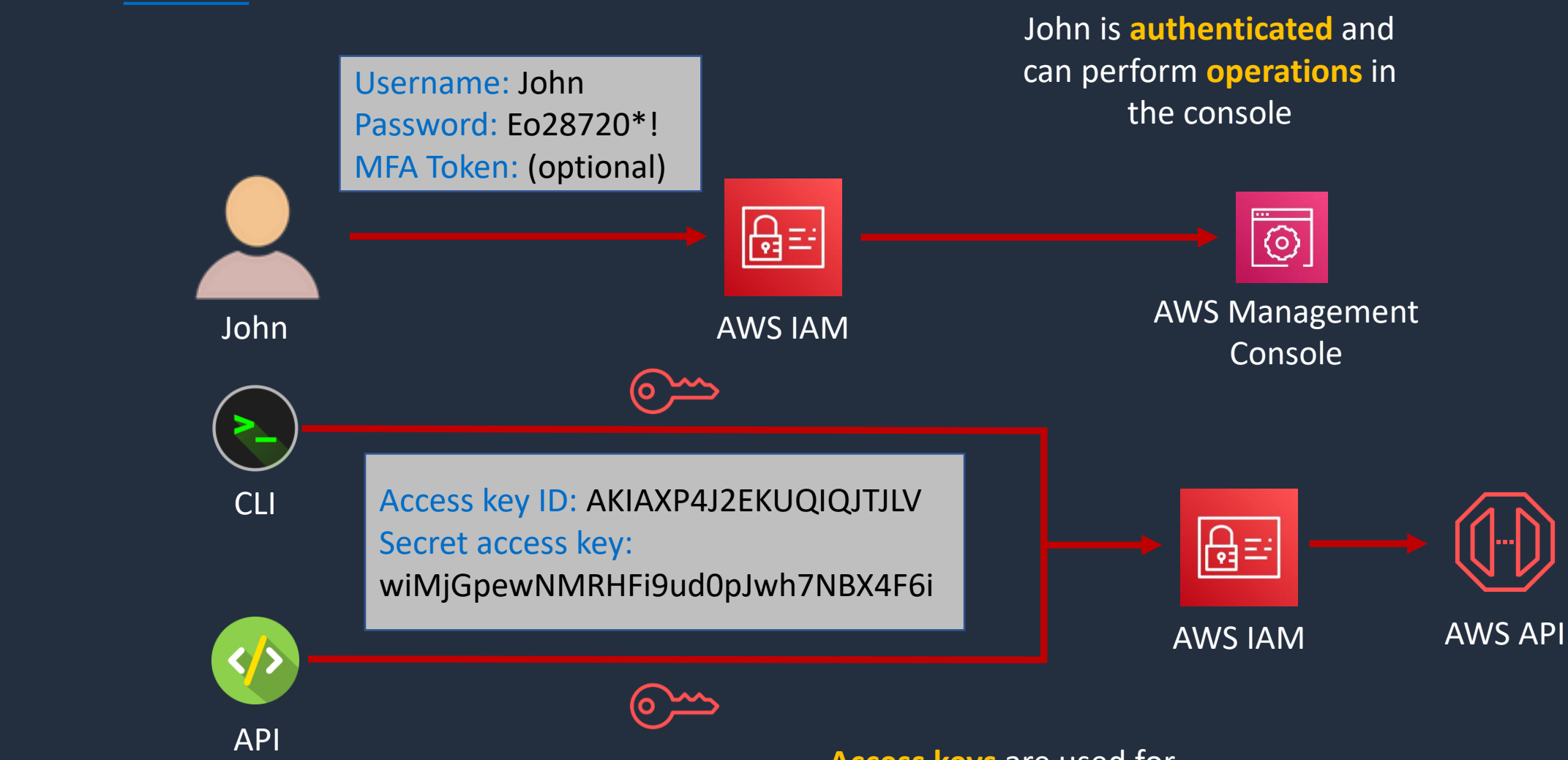


IAM Overview

AWS Identity and Access Management (IAM)



IAM Authentication Methods



Create an IAM User and Group

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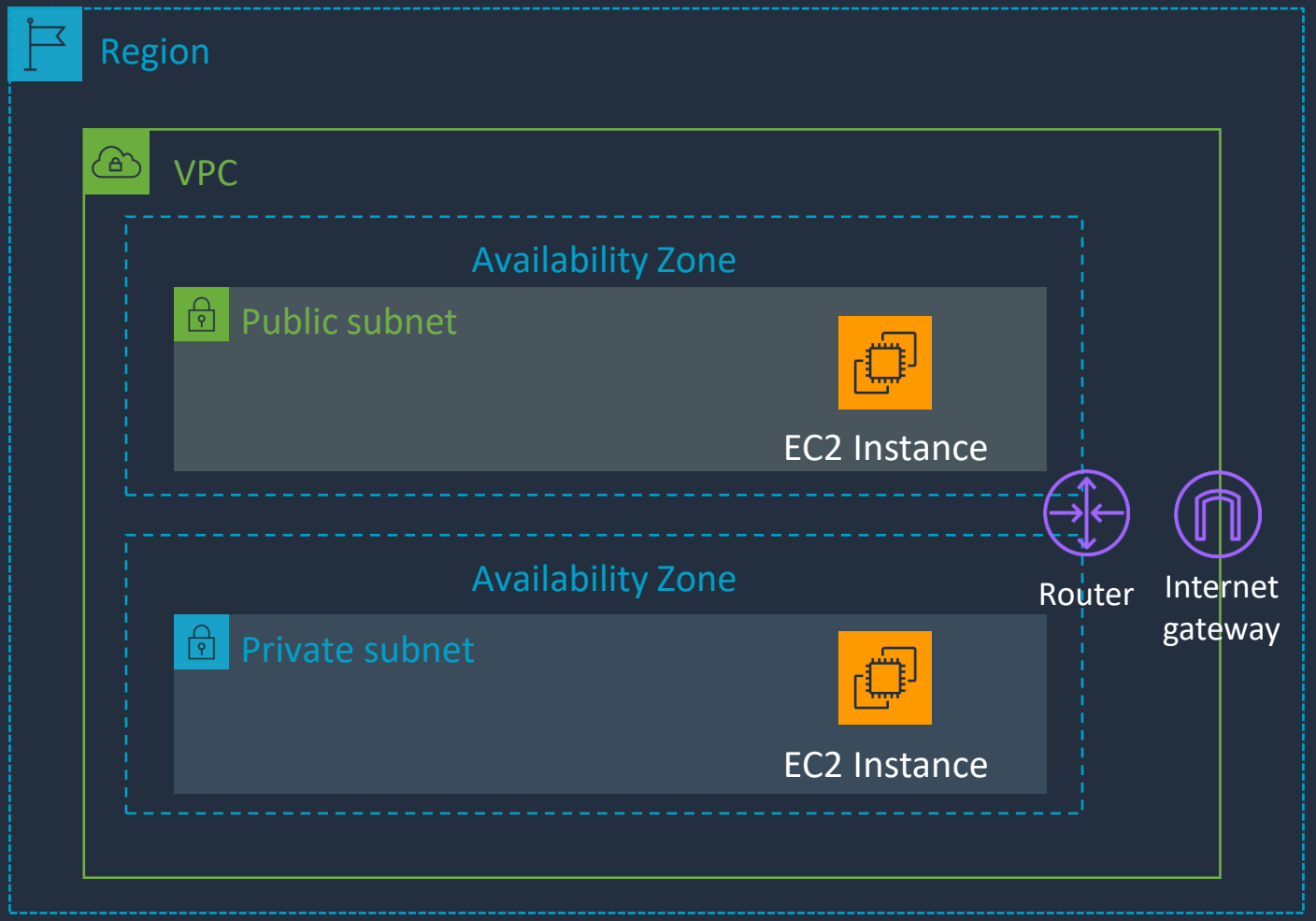
Amazon Virtual Private Cloud (VPC)

Amazon VPC

A **VPC** is a logically isolated portion of the AWS cloud within a region

Subnets are created within **AZs**



Main Route Table

Destination	Target
10.0.0.0/16	Local
0.0.0.0/0	igw-id

The **route table** is used to configure the VPC router

An **Internet Gateway** is used to connect to the Internet

You can launch **EC2 instances** into your VPC subnets

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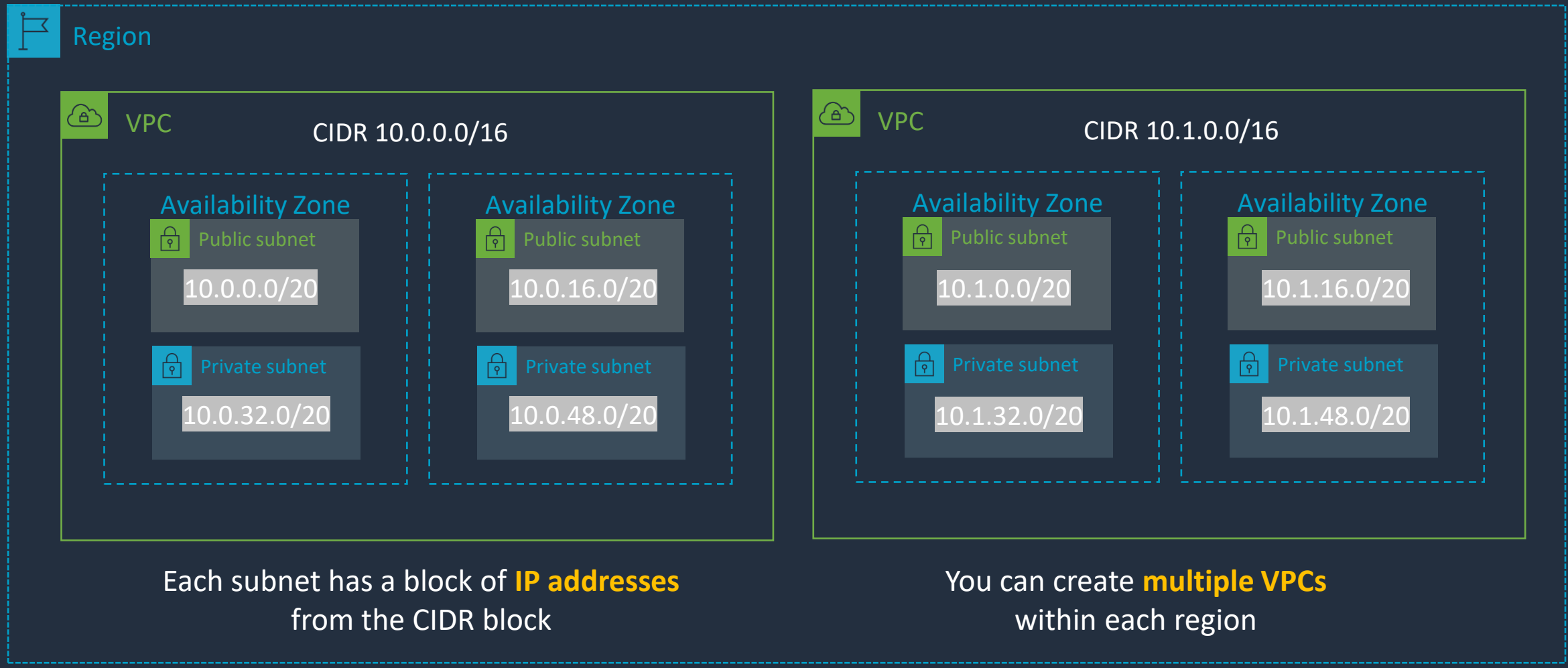
Amazon VPC

Each **VPC** has a different block of IP addresses

CIDR stands for Classless Interdomain Routing



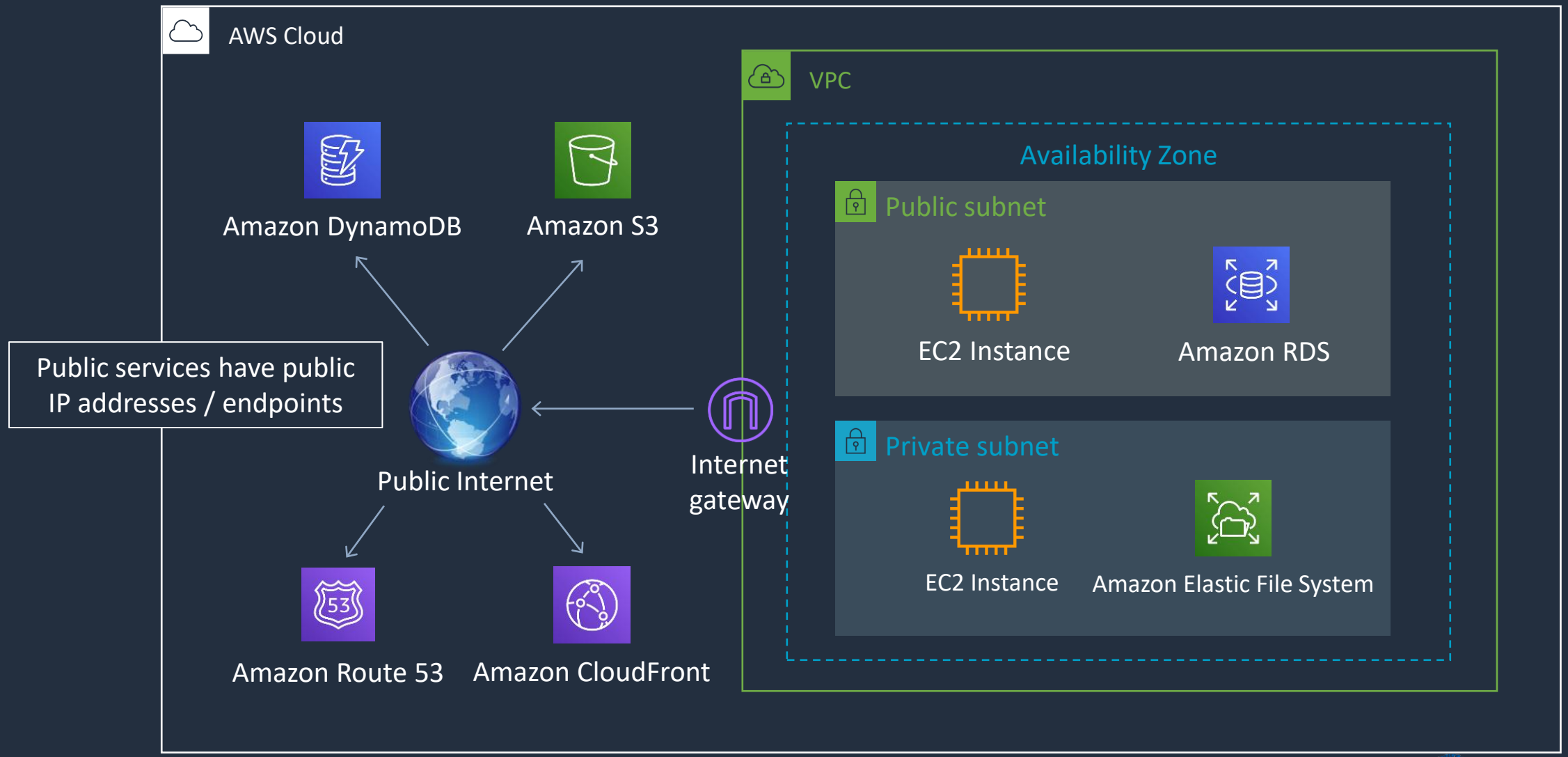
Each subnet has a block of **IP addresses** from the CIDR block

You can create **multiple VPCs** within each region

DigitalCloud TRAINING

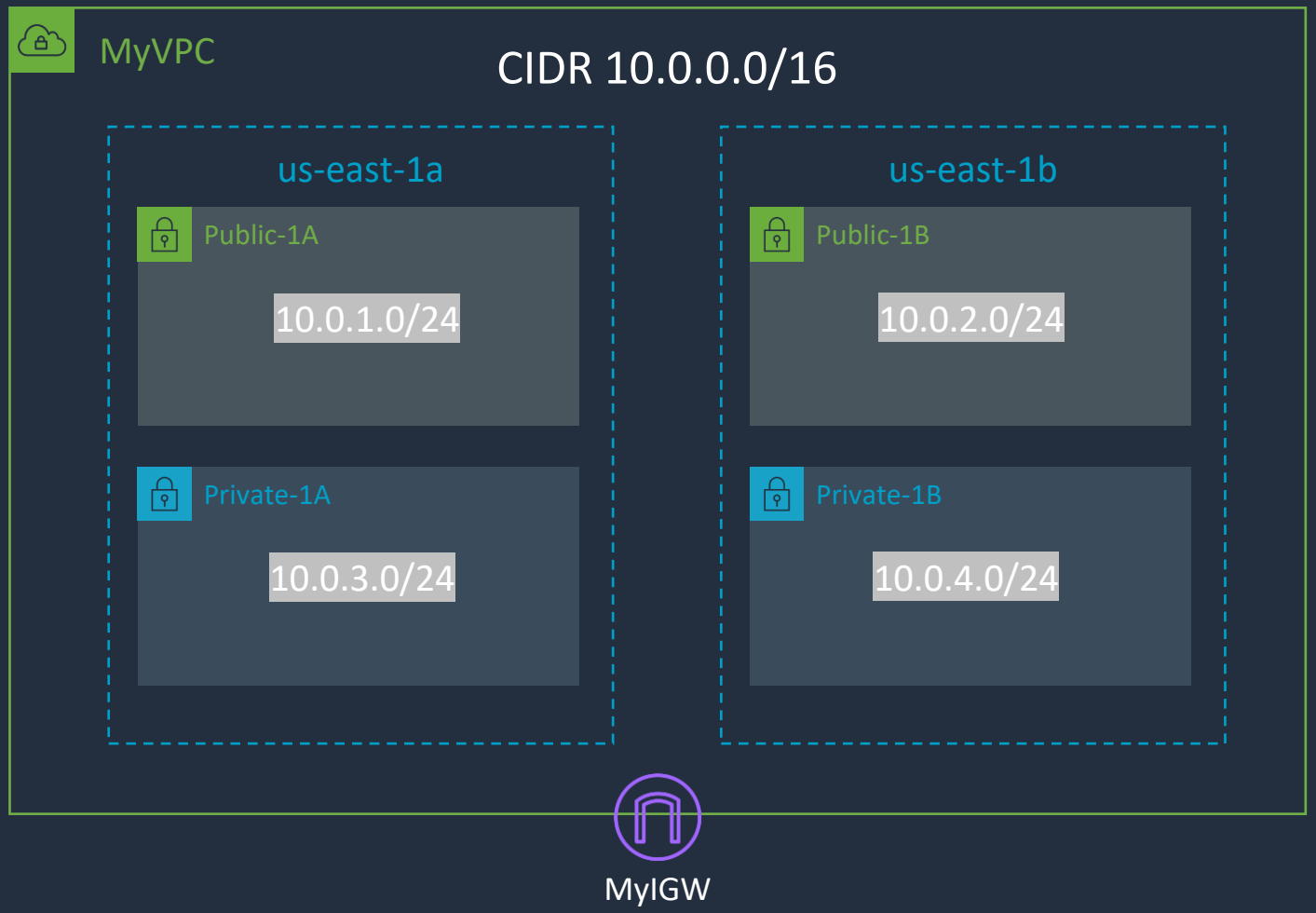
AWS Public and Private Services

Private services can have public IP addresses but exist within the VPC



Create a Custom VPC

Custom VPC



Main Route Table

Destination	Target
10.0.0.0/16	Local
0.0.0.0/0	igw-id

Private-RT Route Table

Destination	Target
10.0.0.0/16	Local

Security Groups and Network ACLs

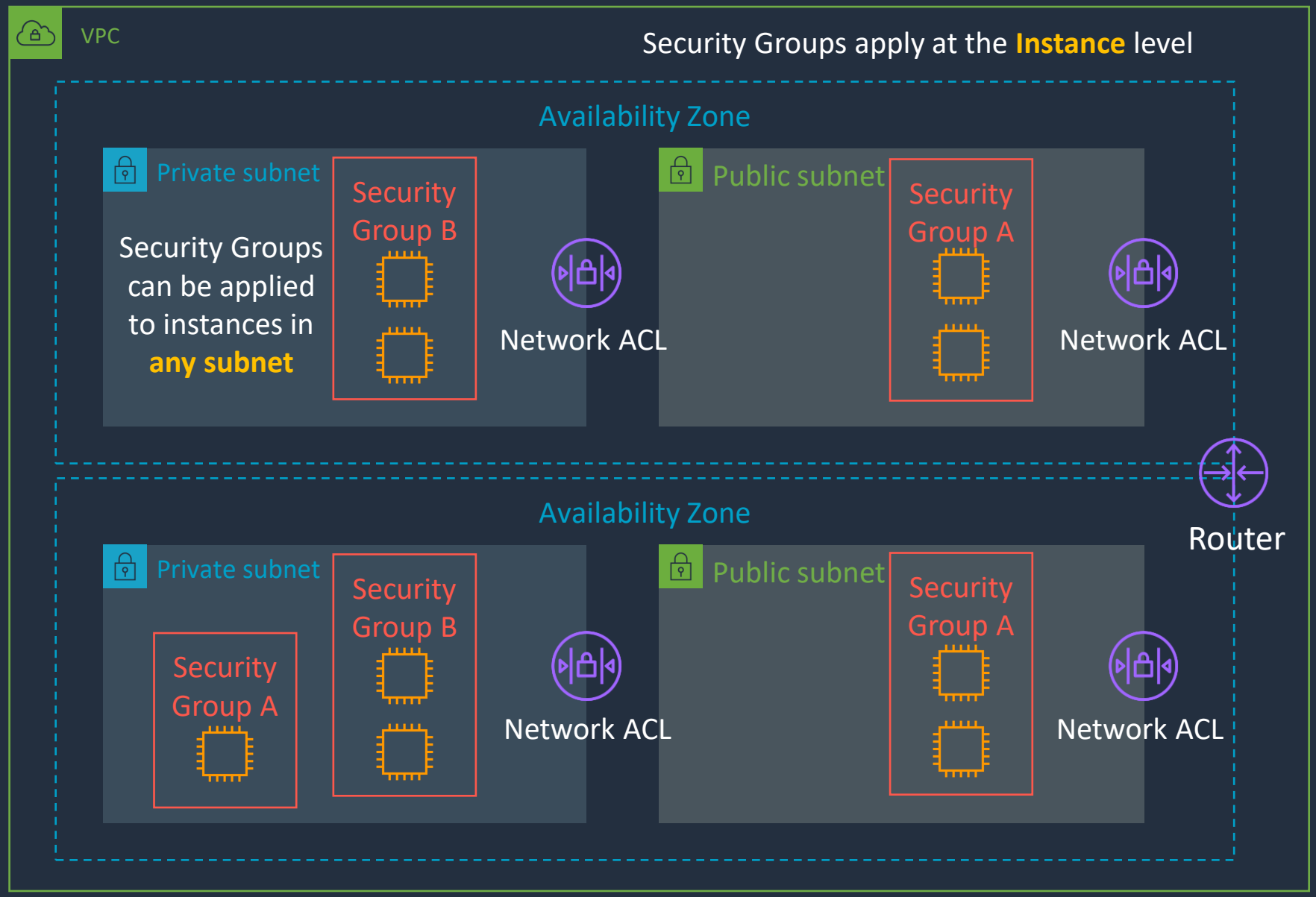
Stateful vs Stateless Firewalls

PROTOCOL	SOURCE IP	DESTINATION IP	SOURCE PORT	DESTINATION PORT
HTTP	10.1.1.1	10.2.1.10	65188	80
HTTP	10.2.1.10	10.1.1.1	80	65188

A stateful firewall allows the return traffic automatically

A stateless firewall checks for an allow rule for both connections

Security Groups and Network ACLs



NACLs apply at the **subnet** level

NACLs apply only to traffic **entering** / **exiting** the subnet

Security Groups & Network Access Control Lists (NACLs)

Security Group	Network ACL
Operates at the instance (interface) level	Operates at the subnet level
Supports allow rules only	Supports allow and deny rules
Stateful	Stateless
Evaluates all rules	Processes rules in order
Applies to an instance only if associated with a group	Automatically applies to all instances in the subnets its associated with

DigitalCloud TRAINING

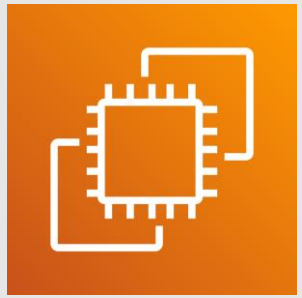
Create a Security Group

Configure the AWS CLI

SECTION 6

Amazon EC2, Auto Scaling, and Load Balancing

Amazon EC2 Overview

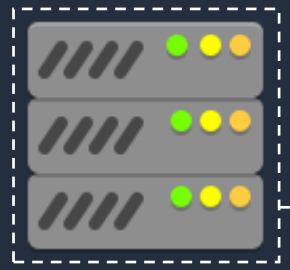


Amazon Elastic Compute Cloud (EC2)

EC2 instances run Windows, Linux, or MacOS

An **EC2 instance** is a virtual server

EC2 hosts are **managed by AWS**



EC2 Host Server

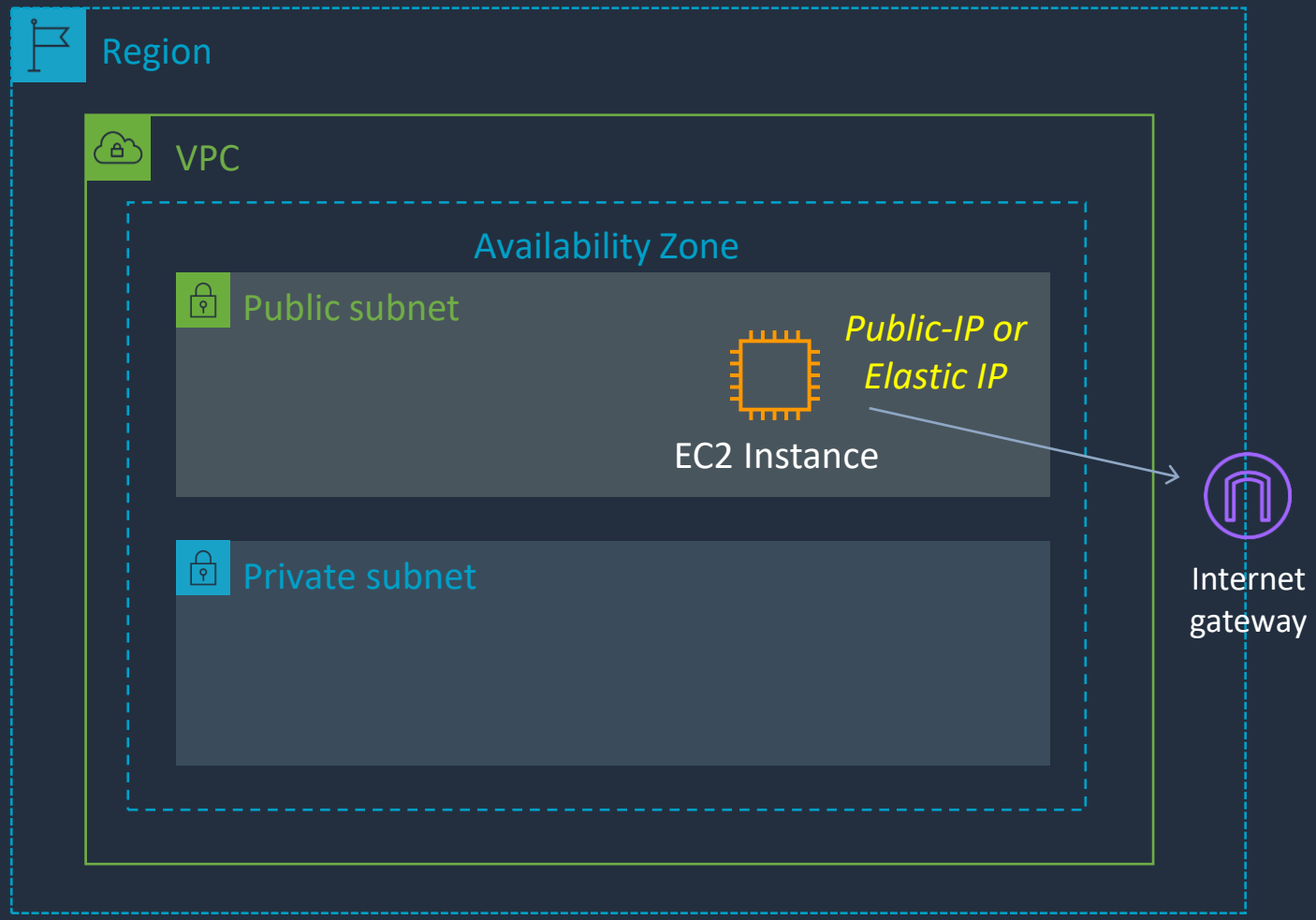
A selection of **instance types** come with varying combinations of CPU, memory, storage and networking

DigitalCloud TRAINING

Public, Private, and Elastic IP addresses

Type	Description
Public IP address	Lost when the instance is stopped Used in Public Subnets No charge Associated with a private IP address on the instance Cannot be moved between instances
Private IP address	Retained when the instance is stopped Used in Public and Private Subnets
Elastic IP address	Static Public IP address You are charged if not used Associated with a private IP address on the instance Can be moved between instances and Elastic Network Adapters

Public Subnets

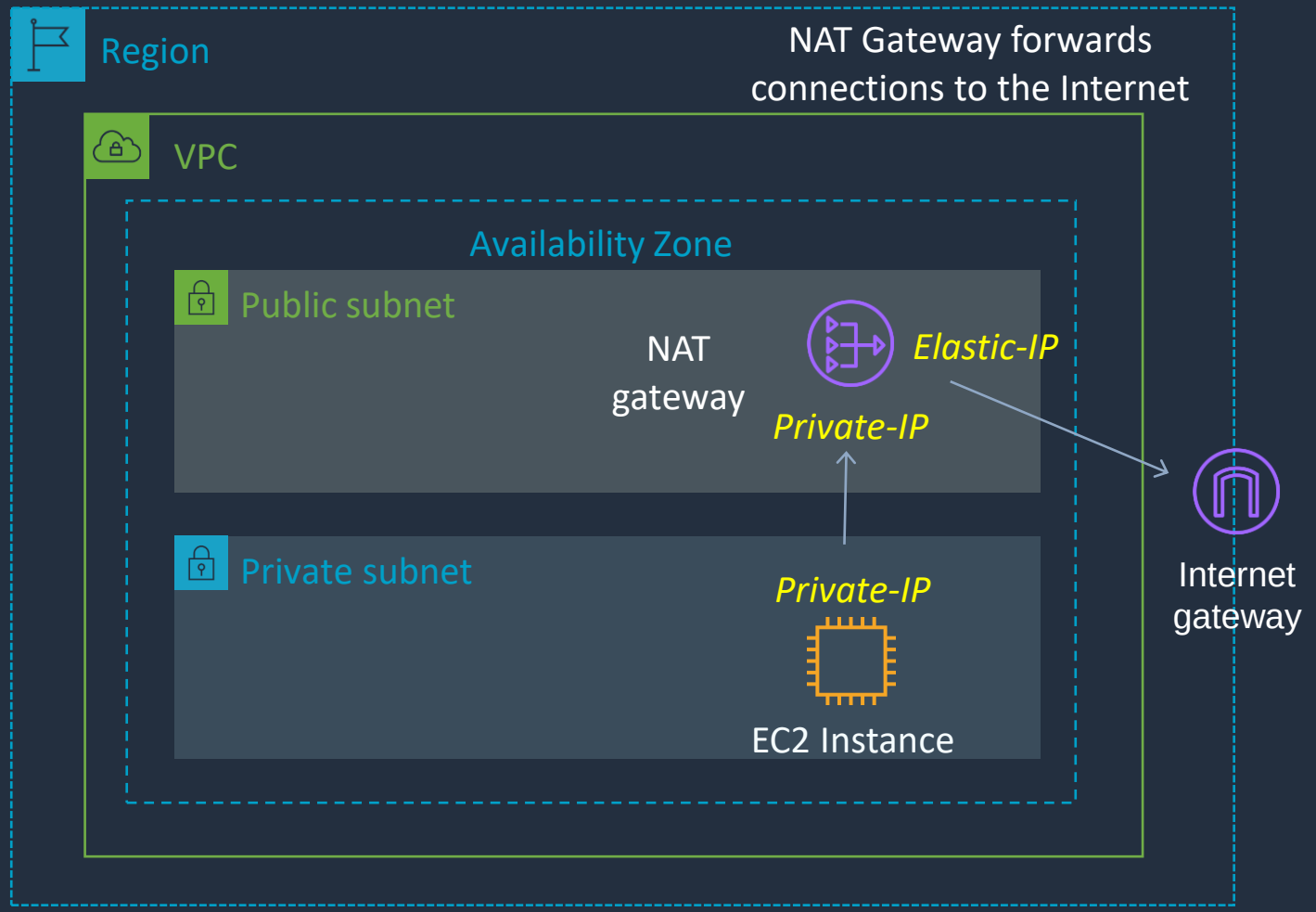


Public Subnet Route Table

Destination	Target
172.31.0.0/16	Local
0.0.0.0/0	igw-id

Private Subnets

NAT = Network Address Translation



Public Subnet Route Table

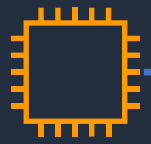
Destination	Target
172.31.0.0/16	Local
0.0.0.0/0	igw-id

Private Subnet Route Table

Destination	Target
172.31.0.0/16	Local
0.0.0.0/0	nat-gateway-id

Launching Amazon EC2 Instances

Launching an EC2 Instance



EC2 Instance

Select an **instance type**

An **AMI** defines the configuration of the instance

A **snapshot** is a point-in-time backup of an instance

Amazon Machine Image (AMI)

EBS Snapshot

Family	Type	vCPUs	Memory (GiB)
General purpose	t2.micro	1	1
Compute optimized	c5n.large	2	5.25
Memory optimized	r5ad.large	2	16
Storage optimized	d2.xlarge	4	30.5
GPU instances	g2.2xlarge	8	15

Linux

Microsoft Windows

You can customize your instance and create a **custom AMI**

Customized AMI

The **instance type** defines the hardware profile (and cost)

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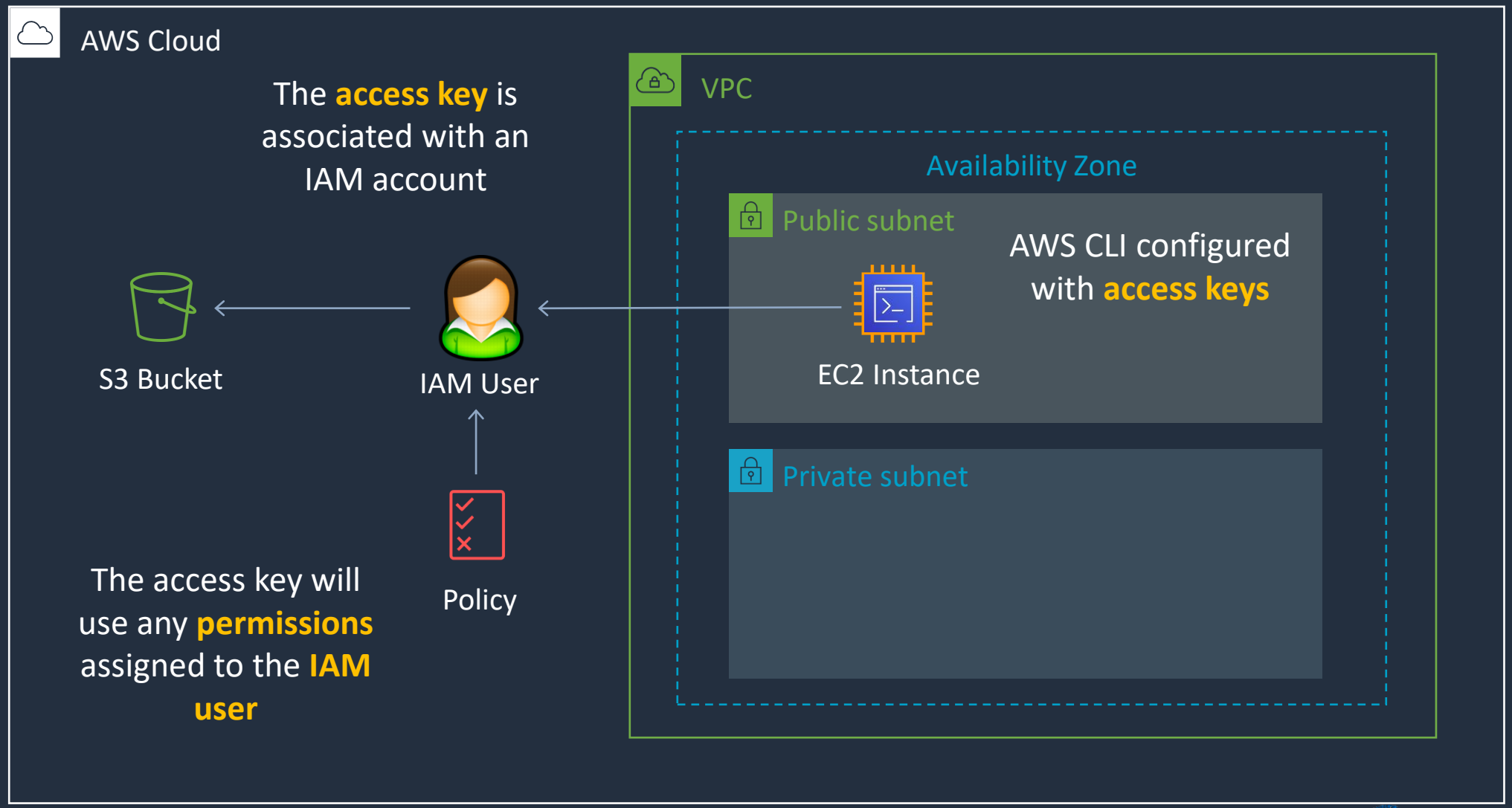
Connecting to Amazon EC2

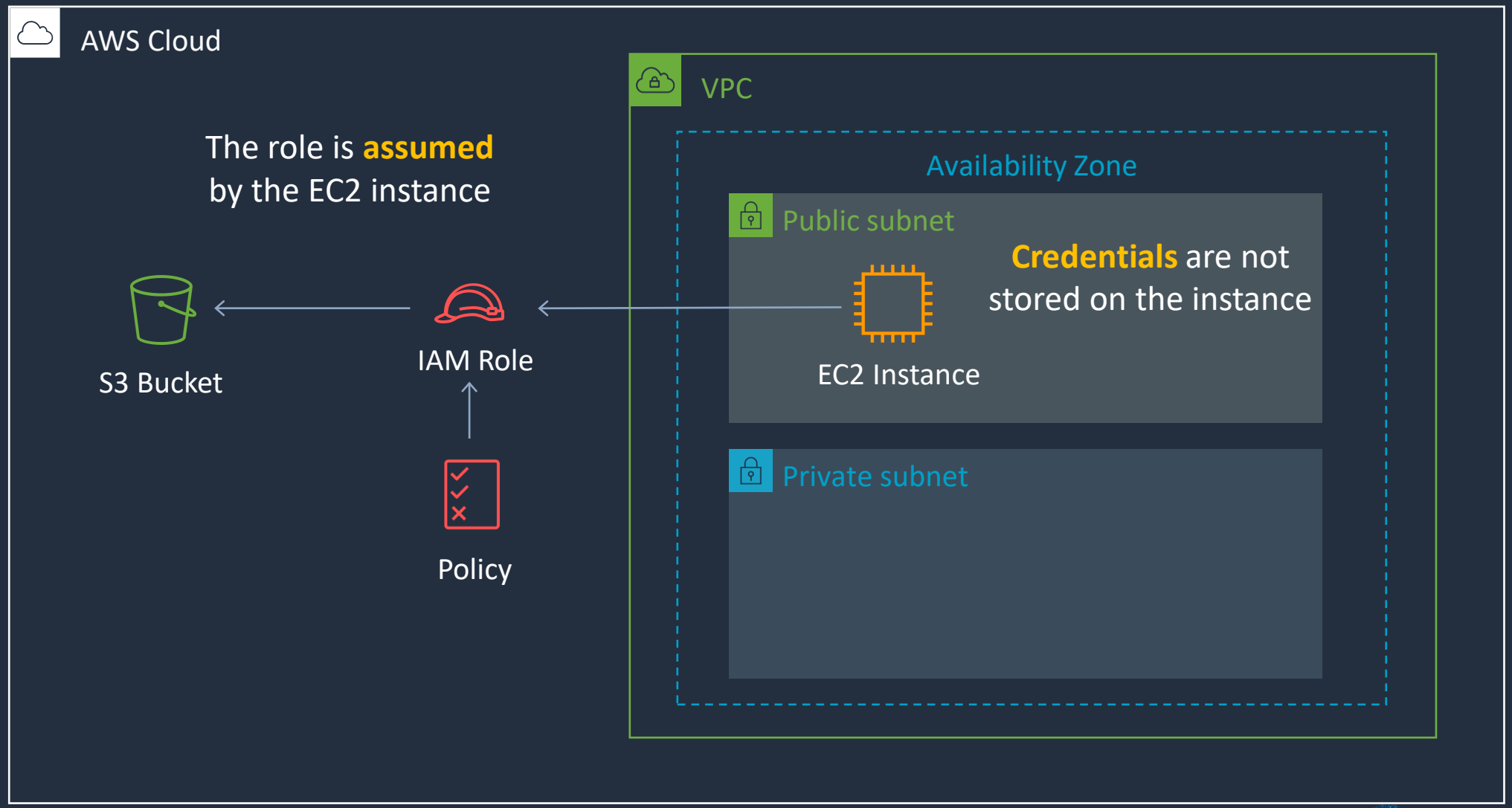
Access Keys and IAM Roles with EC2

DigitalCloud TRAINING

Using Access Keys with Amazon EC2



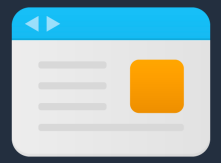
Using Roles with Amazon EC2



Practice with Access Keys and IAM Roles

Create a Website with User Data

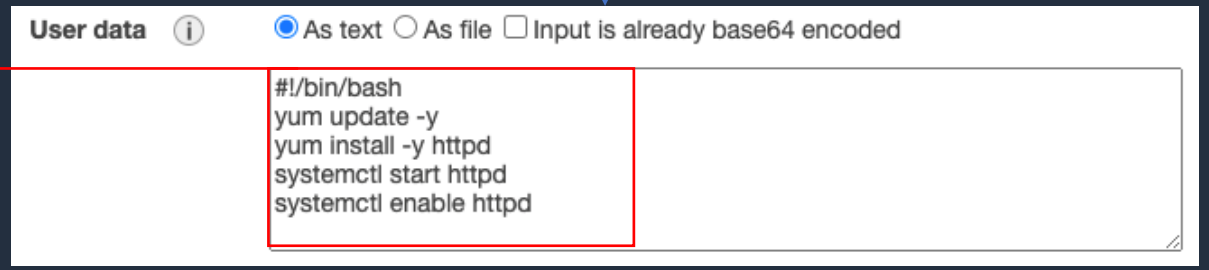
Amazon EC2 User Data



AWS Management Console

The code is run when the instance starts for the **first time**

Batch and **PowerShell** scripts can be run on Windows



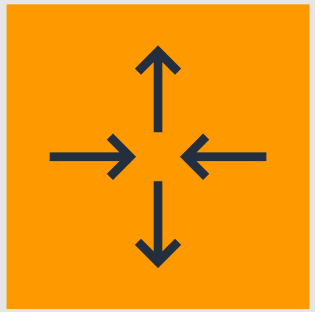
Limited to **16 KB**

EC2 Instance

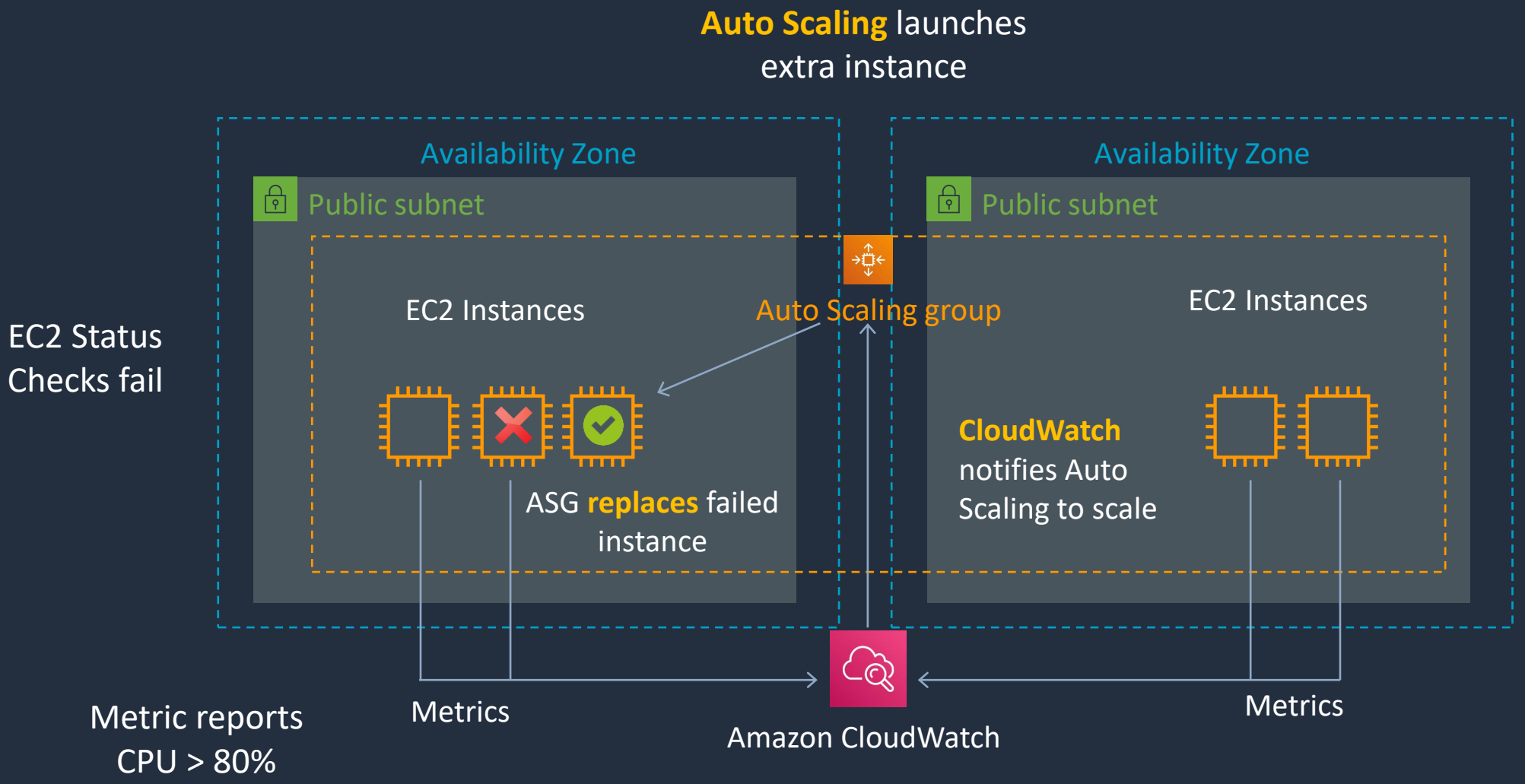
EC2 Instance with a **web service** is launched

DigitalCloud TRAINING

Amazon EC2 Auto Scaling



Amazon EC2 Auto Scaling

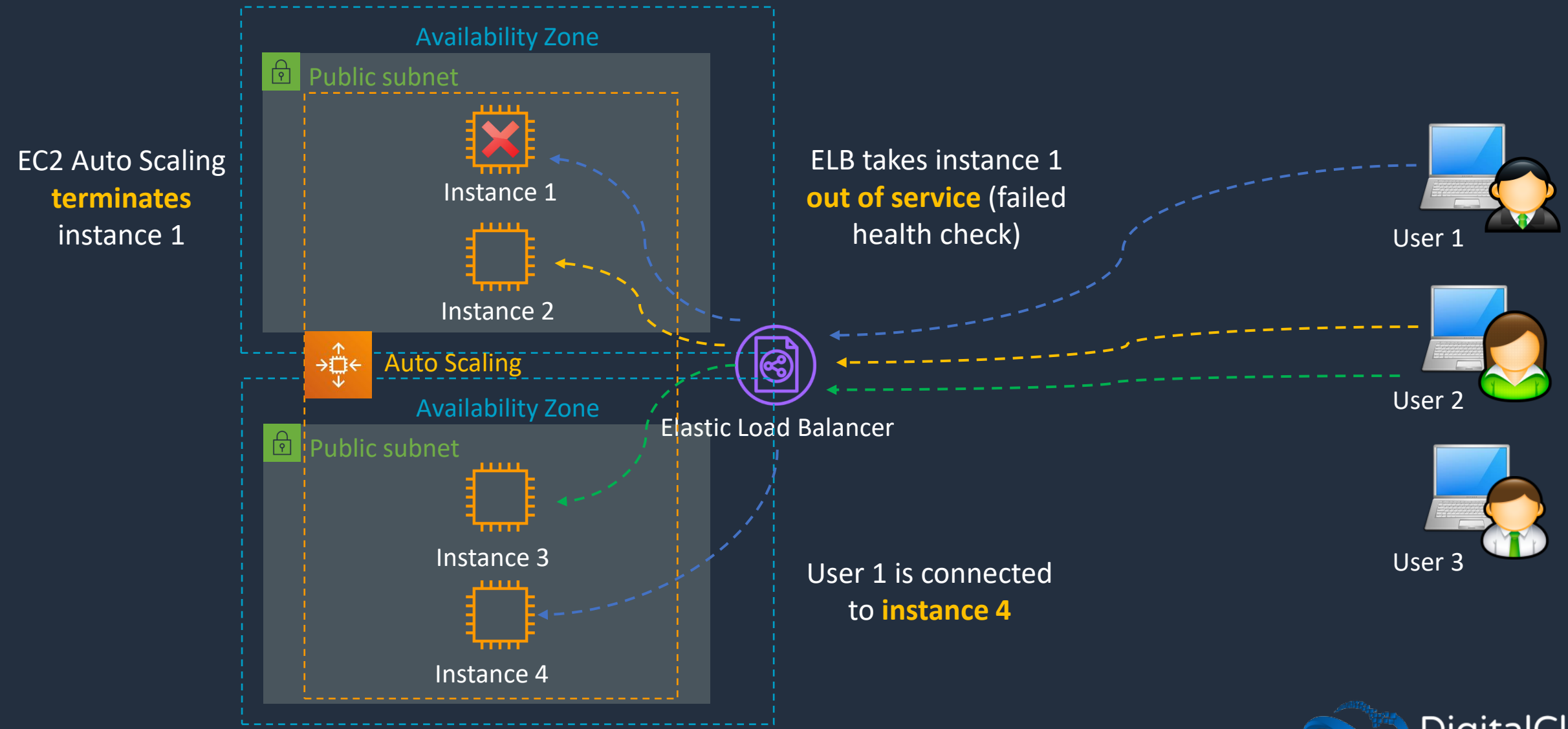


Create an Auto Scaling Group

Create a Scaling Policy

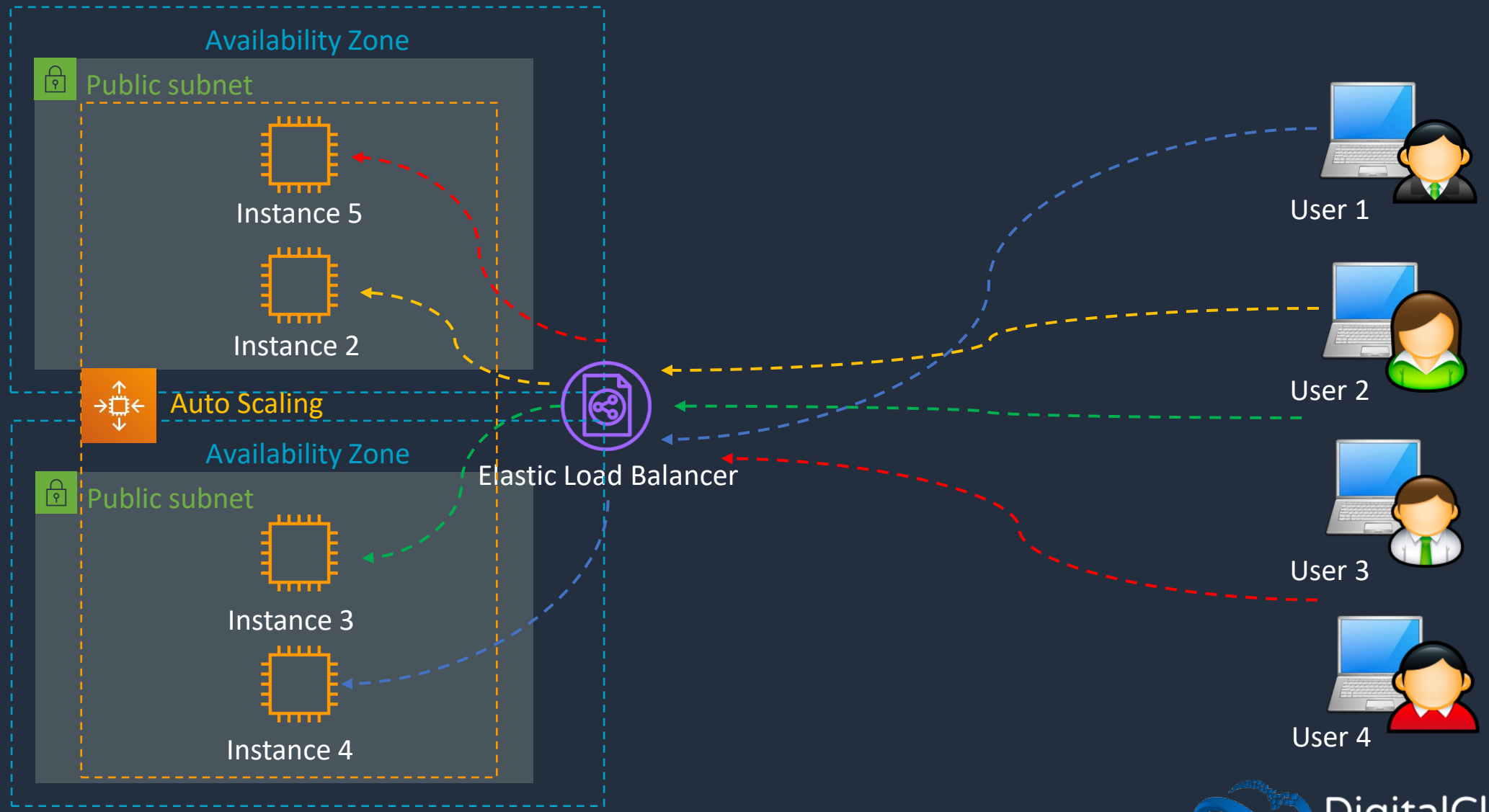
Amazon Elastic Load Balancing

Amazon Elastic Load Balancing

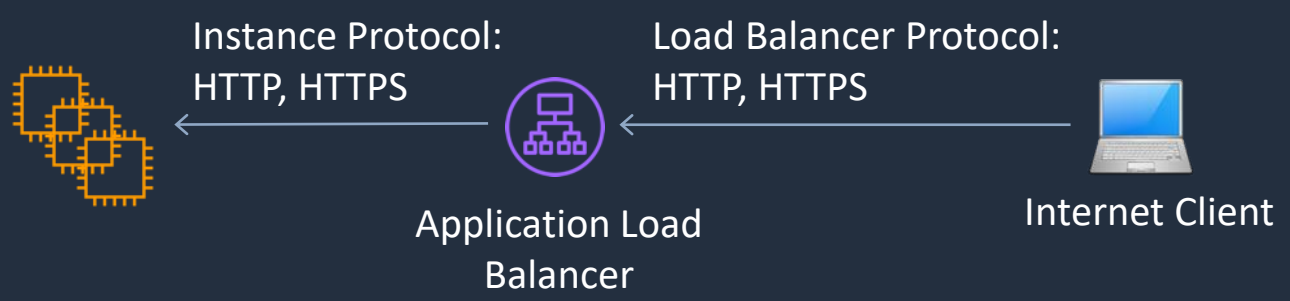


Amazon Elastic Load Balancing

EC2 Auto Scaling **launches** instance 5

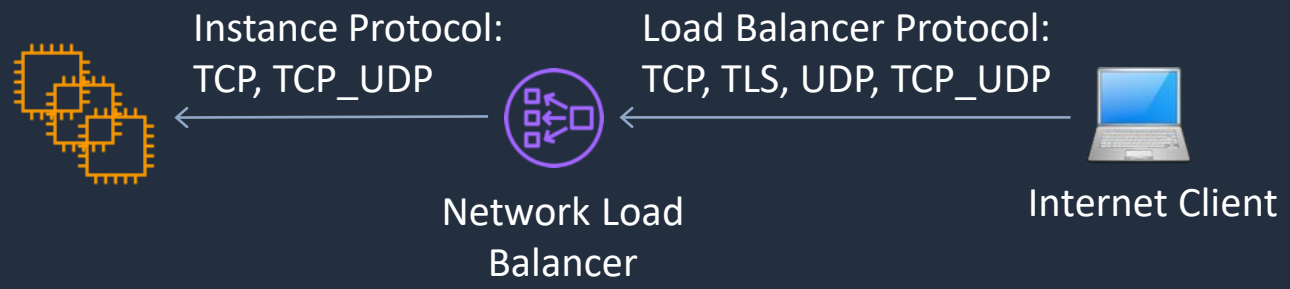


Types of Elastic Load Balancer (ELB)



Application Load Balancer

- Operates at the request level
- Routes based on the content of the request (layer 7)
- Supports path-based routing, host-based routing, query string parameter-based routing, and source IP address-based routing
- Supports instances, IP addresses, Lambda functions and containers as targets



Network Load Balancer

- Operates at the connection level
- Routes connections based on IP protocol data (layer 4)
- Offers ultra high performance, low latency and TLS offloading at scale
- Can have a static IP / Elastic IP
- Supports UDP and static IP addresses as targets

ELB Use Cases

Application Load Balancer

- Web applications with L7 routing (HTTP/HTTPS)
- Microservices architectures (e.g. Docker containers)
- Lambda targets

Network Load Balancer

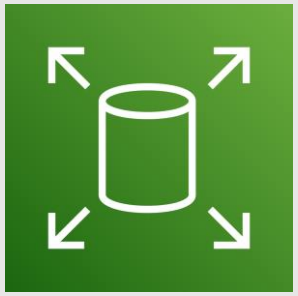
- TCP and UDP based applications
- Ultra-low latency
- Static IP addresses
- VPC endpoint services

Create an Application Load Balancer

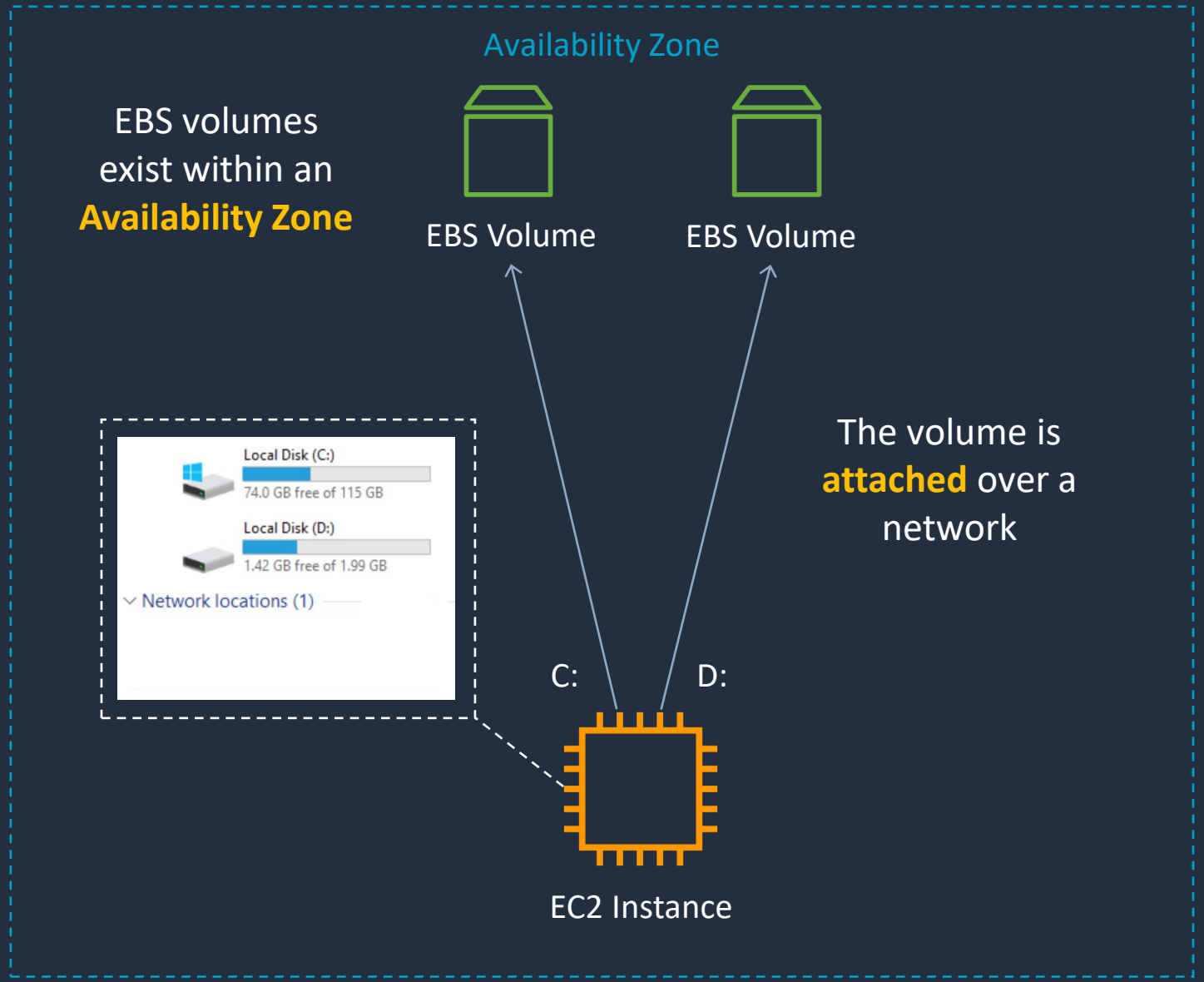
SECTION 7

AWS Storage Services

Amazon EBS and Instance Stores



Amazon Elastic Block Store (EBS)

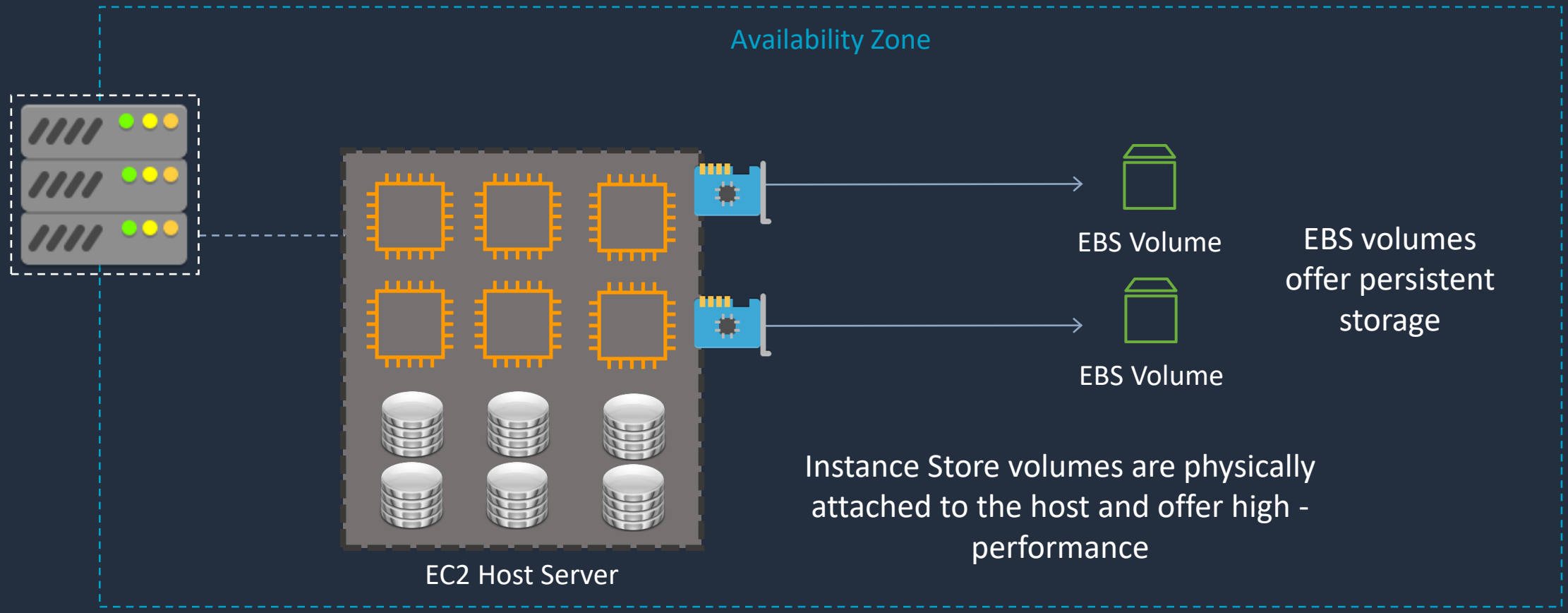


Amazon EBS Volume Types

	General Purpose SSD		Provisioned IOPS SSD		
Volume type	gp3	gp2	io2 Block Express ‡	io2	io1
Durability	99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)	99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)	99.999% durability (0.001% annual failure rate)		99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)
Use cases	• Low-latency interactive apps • Development and test environments		Workloads that require sub-millisecond latency, and sustained IOPS performance or more than 64,000 IOPS or 1,000 MiB/s of throughput	• Workloads that require sustained IOPS performance or more than 16,000 IOPS • I/O-intensive database workloads	
Volume size	1 GiB - 16 TiB		4 GiB - 64 TiB	4 GiB - 16 TiB	
Max IOPS per volume (16 KiB I/O)	16,000		256,000	64,000 †	
Max throughput per volume	1,000 MiB/s	250 MiB/s *	4,000 MiB/s	1,000 MiB/s †	
Amazon EBS Multi-attach	Not supported		Not supported	Supported	
Boot volume	Supported				

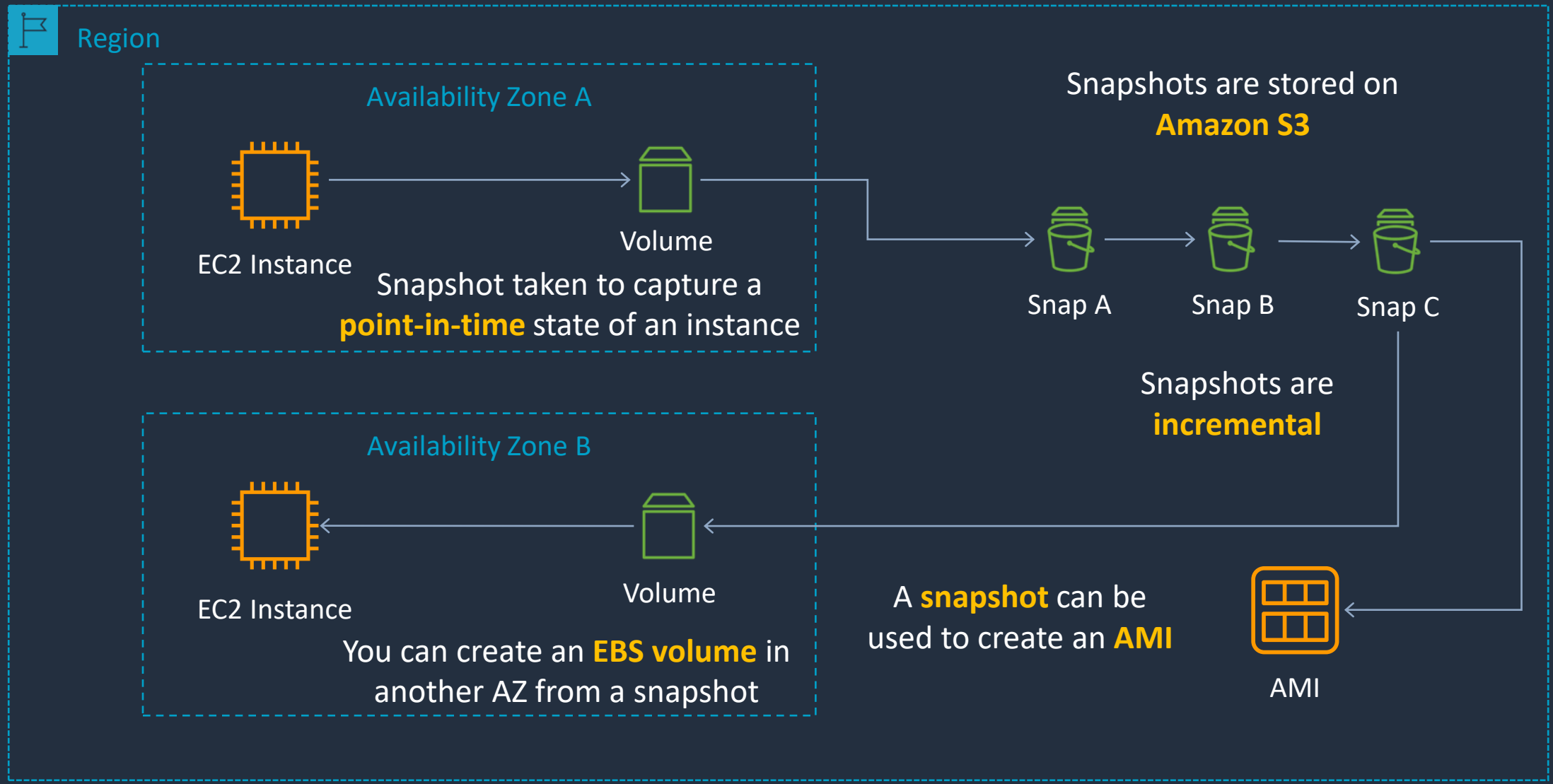
Amazon EBS vs Instance Store

EBS volumes are **attached** over the **network**



Instance Store volumes are **ephemeral** (non-persistent)

Amazon EBS Snapshots



Create and Attach an EBS Volume

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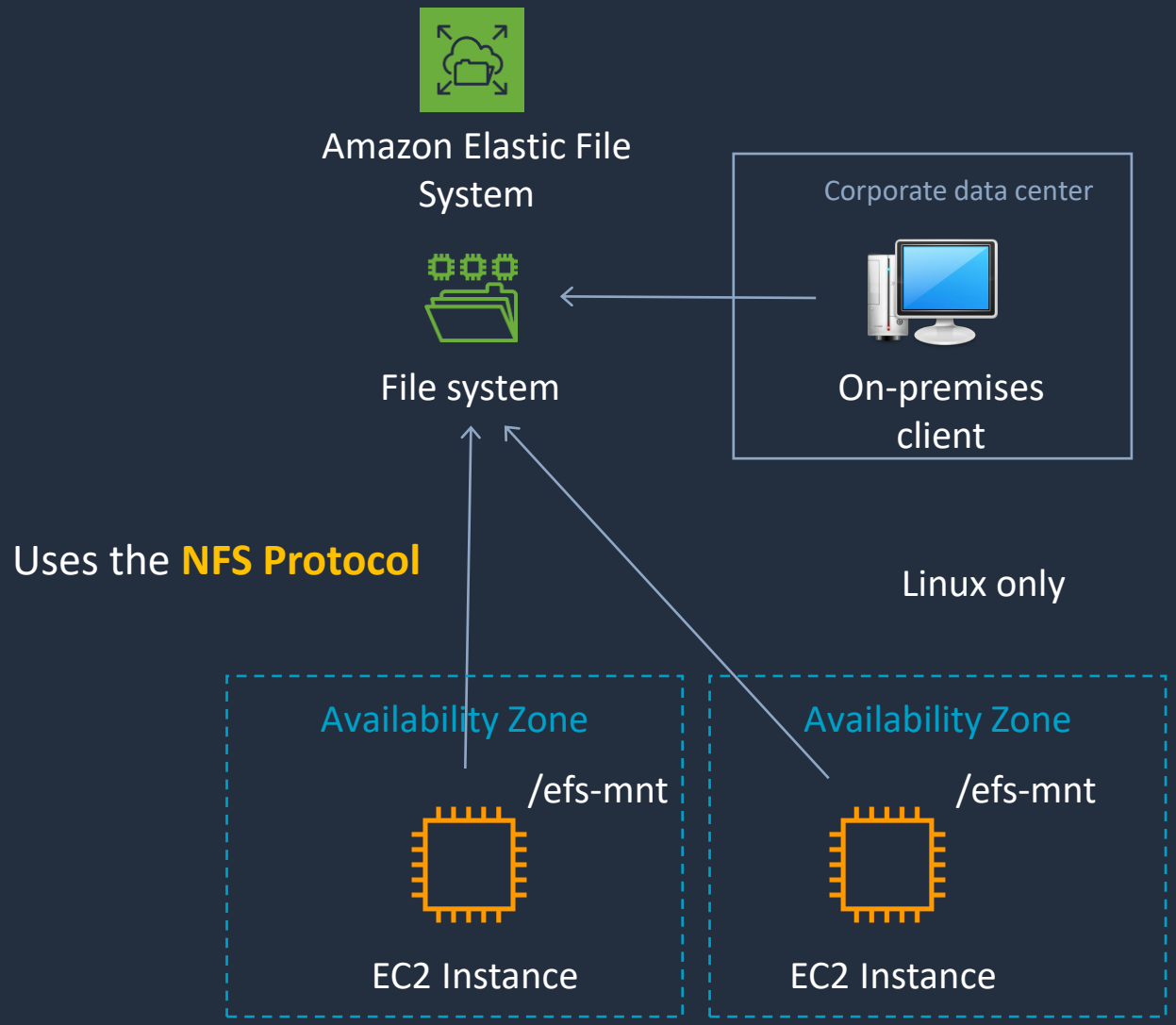
EBS Snapshots and AMIs

Amazon Elastic File System (EFS)

Amazon Elastic File System (EFS)



Create an Amazon EFS Filesystem

Mounting EFS File Systems

mkdir ~/efs-mount-point

 # Install NFS client

sudo yum -y install nfs-utils

 # Mount using the NFS client

sudo mount -t nfs4 -o nfsvers=4.1,rsize=1048576,wsize=1048576,hard,timeo=600,retrans=2,noresvport fs-0187058e25d360ce2.efs.us-east-1.amazonaws.com:/ ~/efs-mount-point

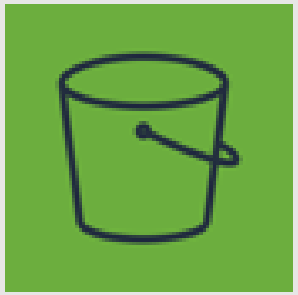
 # Install EFS utils

sudo yum install -y amazon-efs-utils

 # Mount using the EFS mount helper:

sudo mount -t efs -o tls fs-0187058e25d360ce2.efs.us-east-1.amazonaws.com:/ ~/efs-mount-point

Amazon Simple Storage Service (S3)



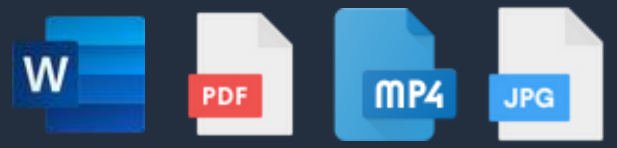
Amazon Simple Storage Service (S3)

S3 Bucket

A **bucket** is a container for objects

An **object** is a file you upload

You can store millions of **objects** in a **bucket**



Accessing objects in a bucket:

`https://bucket.s3.aws-region.amazonaws.com/key`

`https://s3.aws-region.amazonaws.com/bucket/key`

The **HTTP protocol** is used with a **REST API** (e.g. GET, PUT, POST, SELECT, DELETE)

DigitalCloud TRAINING

Amazon Simple Storage Service (S3)

Bucket

A **bucket** is a container for objects

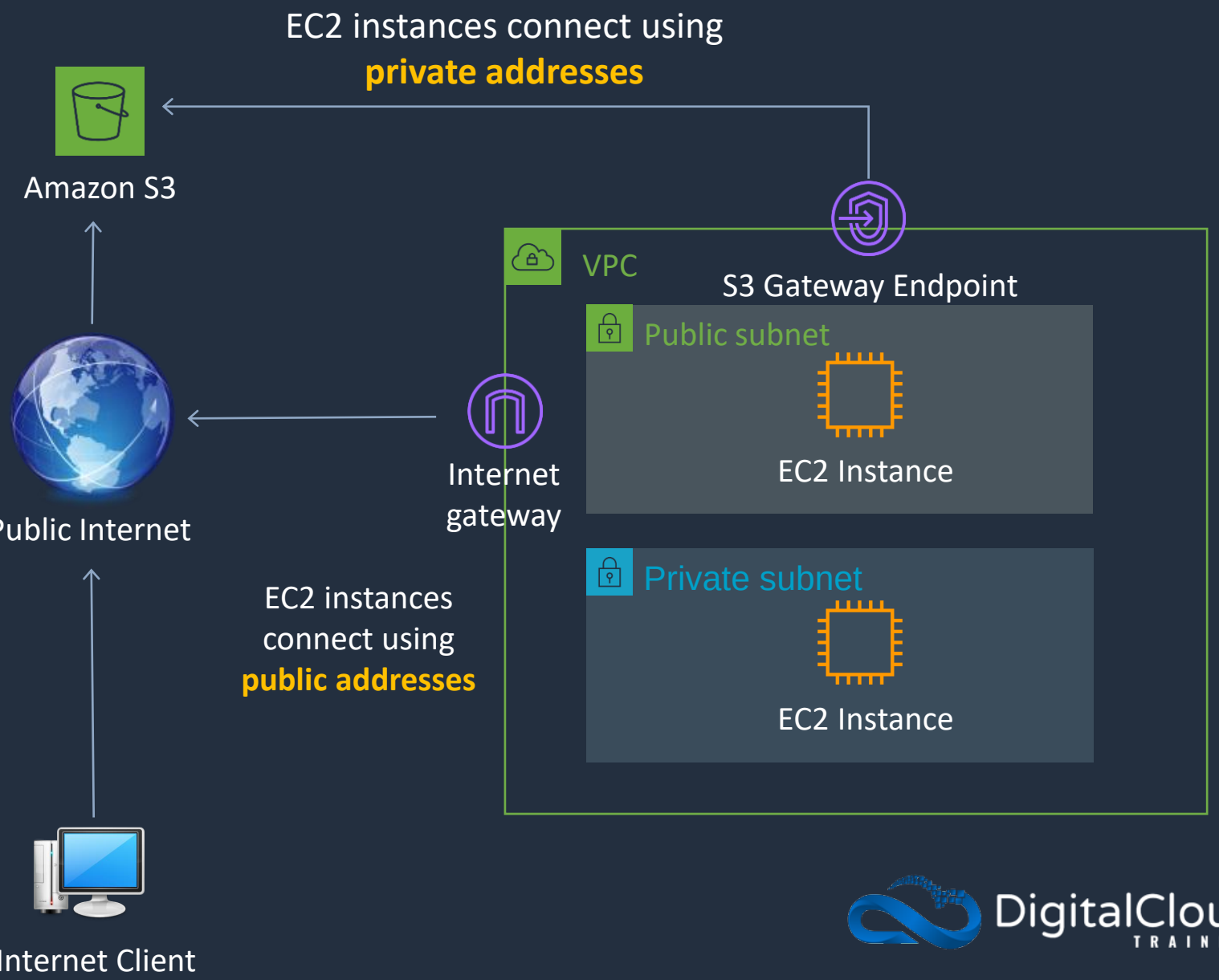
`http://bucket.s3.aws-region.amazonaws.com`

`http://s3.aws-region.amazonaws.com/bucket`

Object

An objects consists of:

- Key (name of objects)
- Version ID
- Value (actual data)
- Metadata
- Subresources
- Access control information



DigitalCloud TRAINING

File Storage vs Object Storage

File Share

- Data stored in directories
- A hierarchy of directories can be formed
- File systems are mounted to an operating system
- Function like local storage
- Network connection is maintained
- Example is Amazon EFS

Object Store

`http://bucket.s3.aws-region.amazonaws.com`

- Data stored in buckets
- Flat namespace (no hierarchy)
- Hierarchy can be mimicked with prefixes
- Accessed by **REST API** and cannot be mounted
- Network connection is completed after each request
- Example is Amazon S3

DigitalCloud TRAINING

Working with S3 Buckets and Objects

DigitalCloud TRAINING

Create an S3 Static Website

SECTION 8

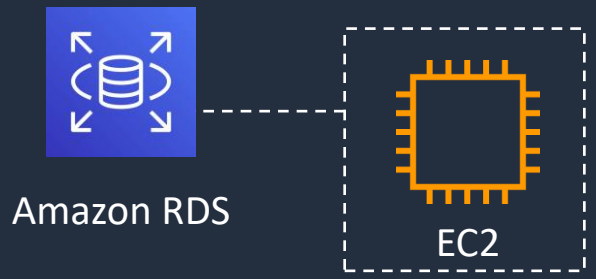
AWS Database Services

Amazon Relational Database Service (RDS)

Amazon RDS

RDS runs on EC2 instances, so you choose an **instance type**

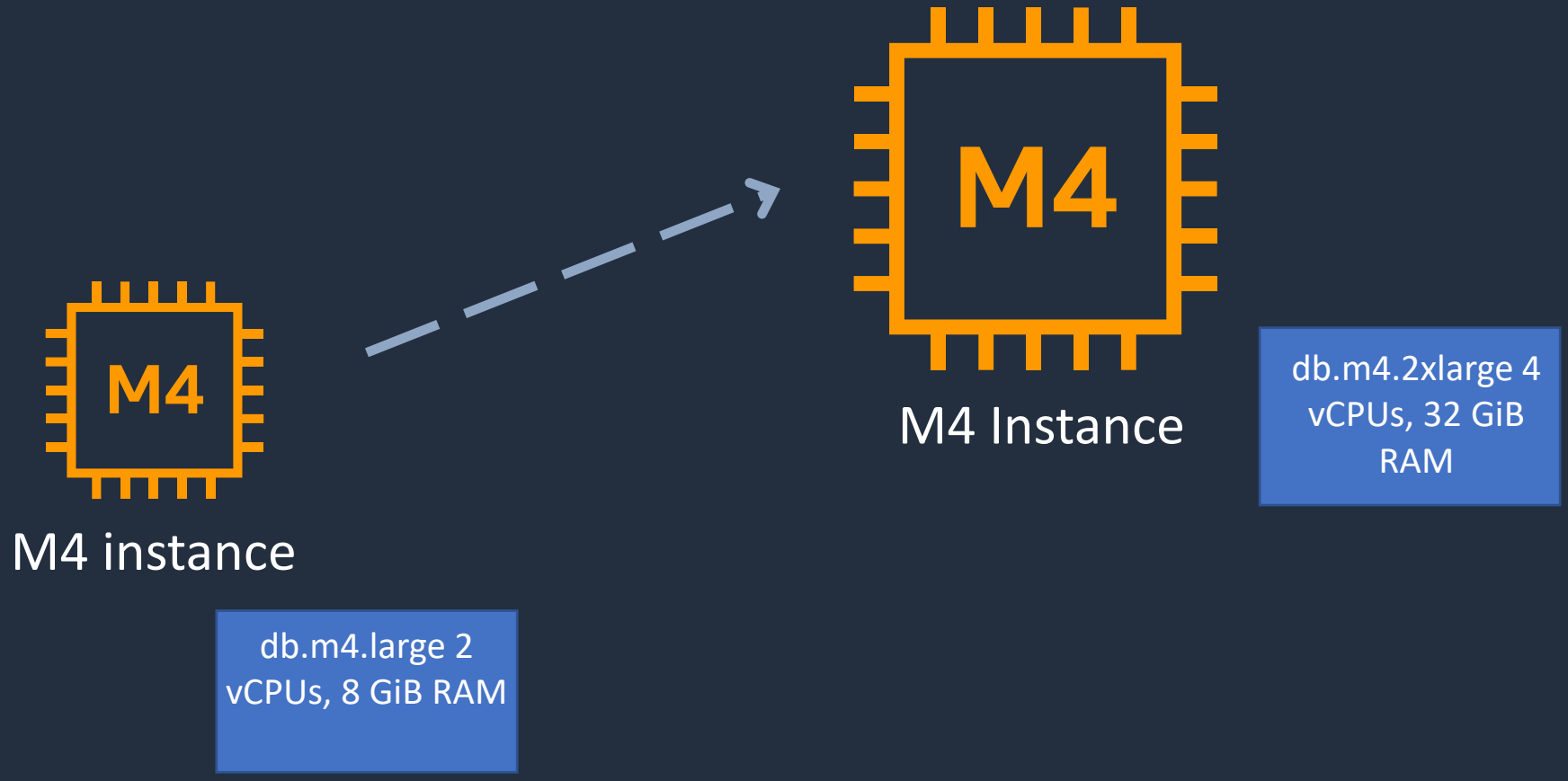
RDS is a managed, **relational database**



RDS supports the following database engines:

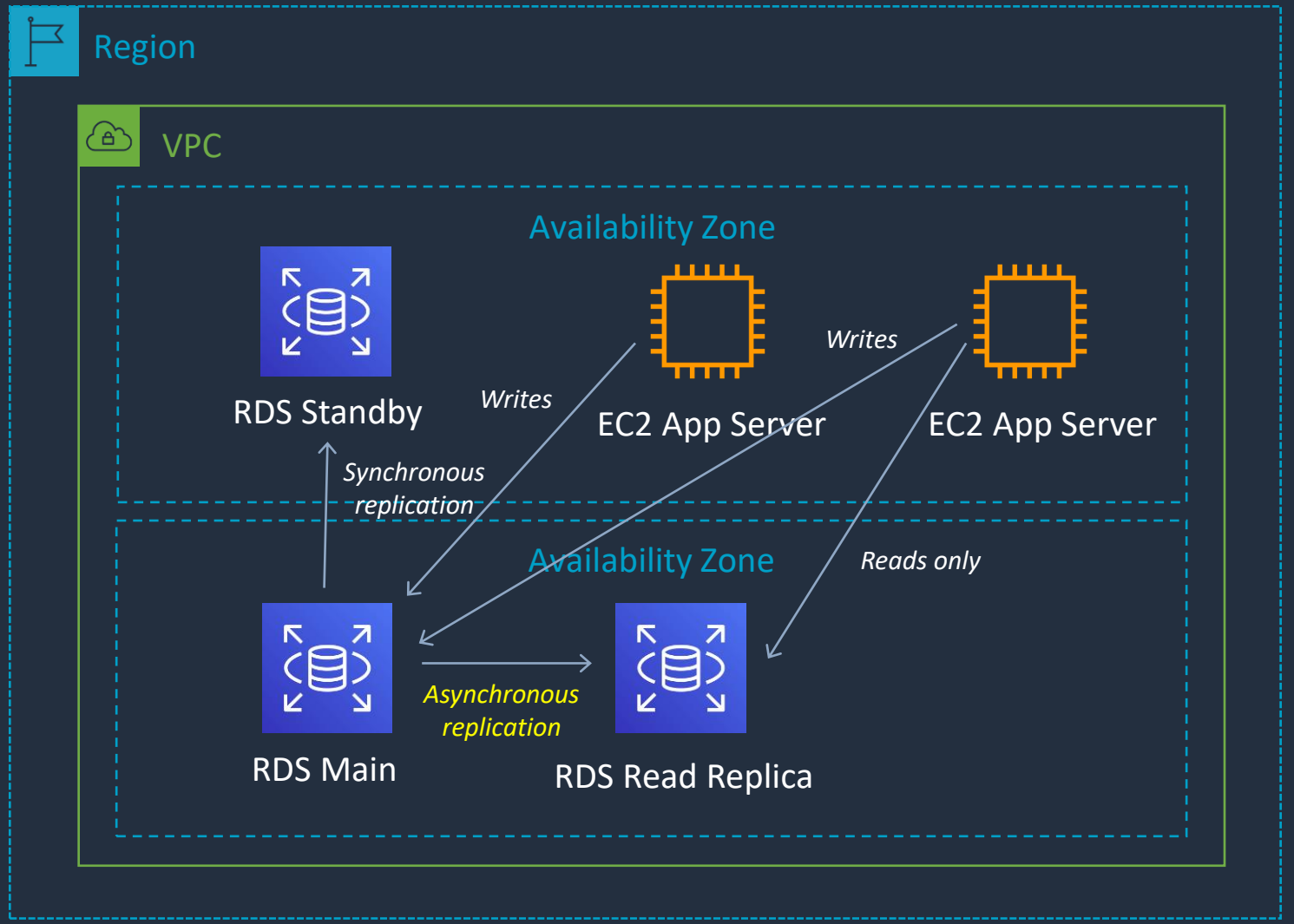
- Amazon Aurora
- MySQL
- MariaDB
- Oracle
- Microsoft SQL Server
- PostgreSQL

Amazon RDS – Scaling up (vertically)



Amazon RDS – Disaster Recovery (DR) and Scaling Out (horizontally)

Multi-AZ creates a passive standby. Primarily used for **disaster recovery**



Application servers can read from the read replica and write to the master

Read Replicas are used for scaling database queries (reads)

Create an Amazon RDS Database

Add an Amazon RDS Read Replica

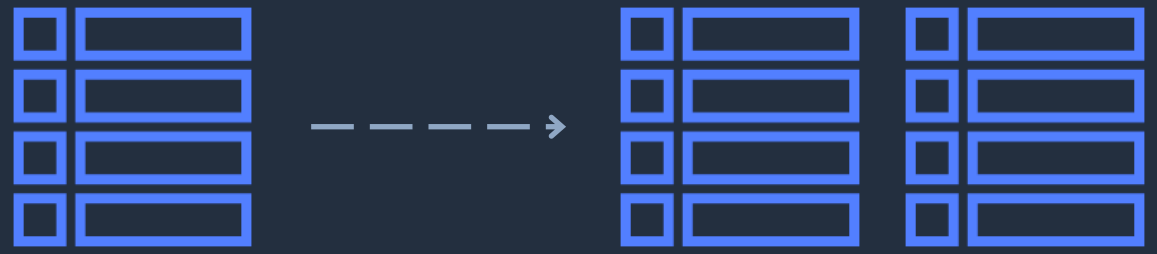
DigitalCloud TRAINING

Amazon DynamoDB

Amazon DynamoDB

Fully managed service. You create tables on an existing database

Offers seamless, horizontal, **scaling**



DynamoDB Table

Data is replicated across **multiple AZs** within a region

DynamoDB is a **NoSQL**, key-value type of database

Amazon DynamoDB

- DynamoDB is made up of:
  - Tables
  - Items
  - Attributes

userid	orderid	book	price	date
user001	1000092	ISBN100..	9.99	2020.04..
user002	1000102	ISBN100..	24.99	2020.03..
user003	1000168	ISBN2X0..	12.50	2020.04..

Create an Amazon DynamoDB Table

DigitalCloud TRAINING

SECTION 9

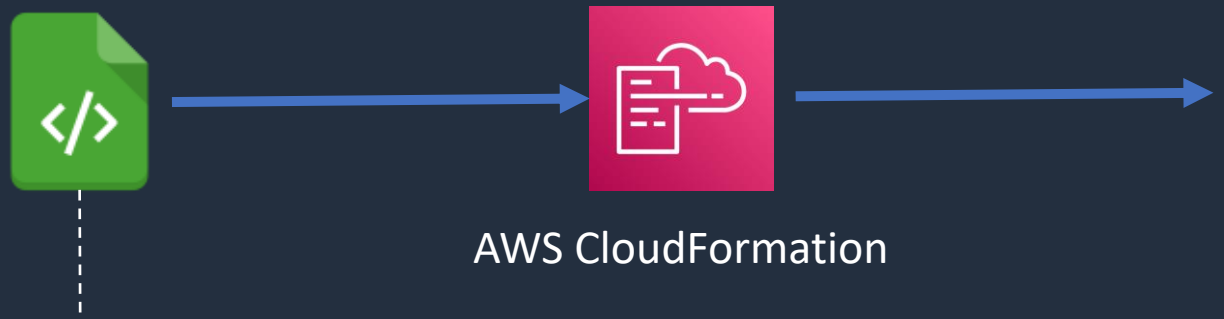
Automation and DevOps on AWS

Infrastructure as Code with AWS CloudFormation

AWS CloudFormation

Infrastructure patterns are defined in a **template** file using **code**

CloudFormation **builds** your infrastructure according to the **template**



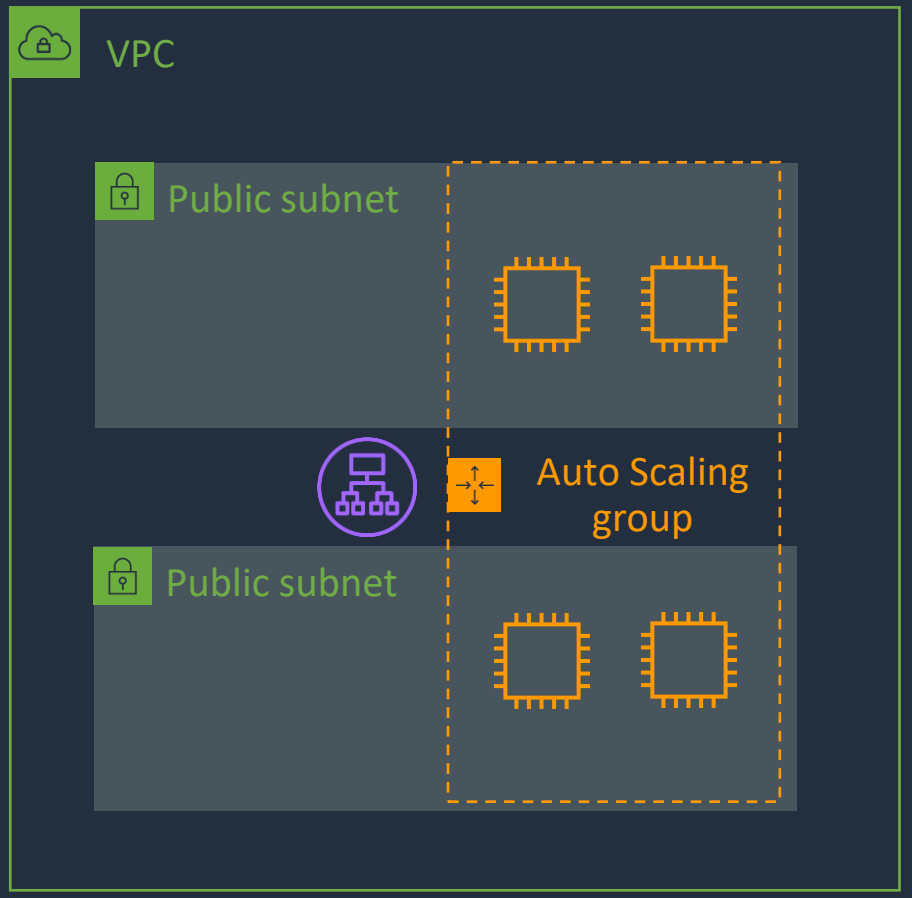
AWS CloudFormation

```
"AWSTemplateFormatVersion" : "2010-09-09",

"Description" : "AWS CloudFormation Sample Template WordPress_Multi_AZ: WordPress is web

"Parameters" : {
  "VpcId" : {
    "Type" : "AWS::EC2::VPC::Id",
    "Description" : "VpcId of your existing Virtual Private Cloud (VPC)",
    "ConstraintDescription" : "must be the VPC Id of an existing Virtual Private Cloud."
  },

  "Subnets" : {
    "Type" : "List<AWS::EC2::Subnet::Id>",
    "Description" : "The list of SubnetIds in your Virtual Private Cloud (VPC)",
    "ConstraintDescription" : "must be a list of at least two existing subnets associated
  },
```



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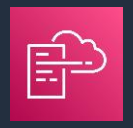

AWS CloudFormation

Component	Description
Templates	The JSON or YAML text file that contains the instructions for building out the AWS environment
Stacks	The entire environment described by the template and created, updated, and deleted as a single unit
StackSets	AWS CloudFormation StackSets extends the functionality of stacks by enabling you to create, update, or delete stacks across multiple accounts and regions with a single operation
Change Sets	A summary of proposed changes to your stack that will allow you to see how those changes might impact your existing resources before implementing them

Creating and Updating Stacks

Deploy a VPC Using CloudFormation

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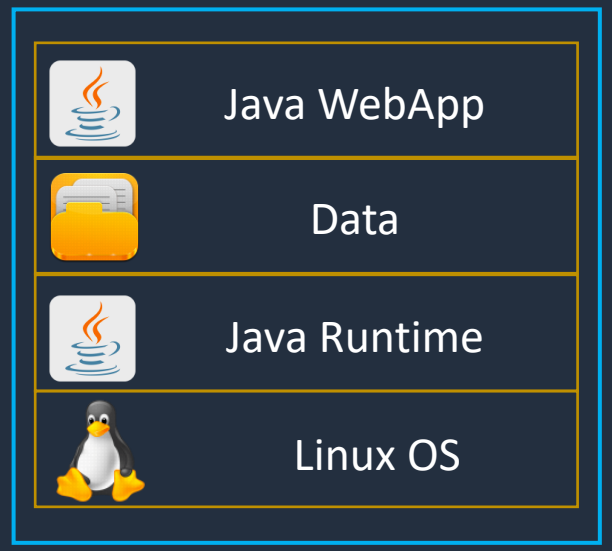
Platform as a Service with AWS Elastic Beanstalk

Cloud Service Models: Comparison

Example is **Amazon EC2**

IaaS



You manage from the **virtual server** upwards

PaaS

You simply upload your **code/data** to create your application

Example is **AWS Elastic Beanstalk**

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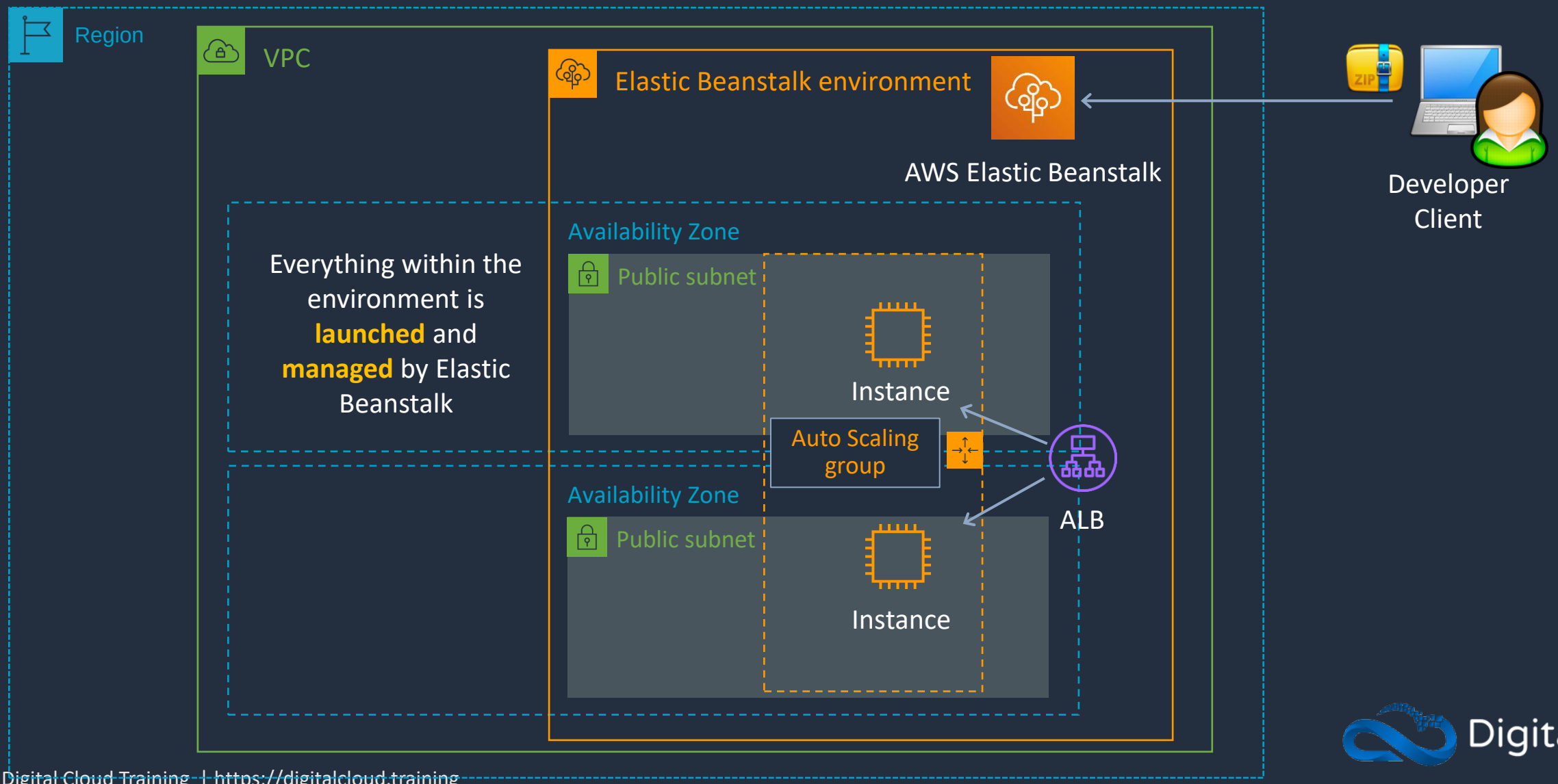
AWS Elastic Beanstalk



Create an Elastic Beanstalk Application

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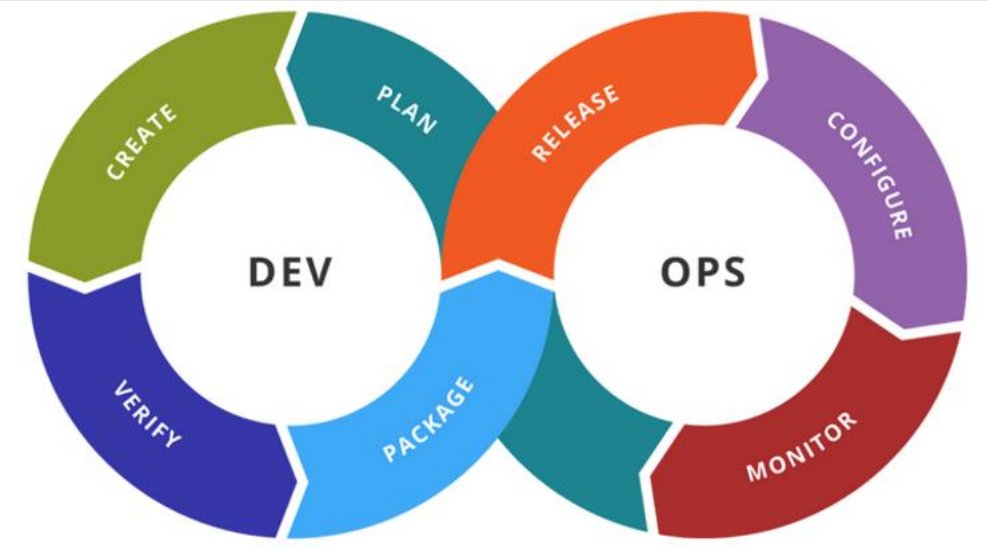
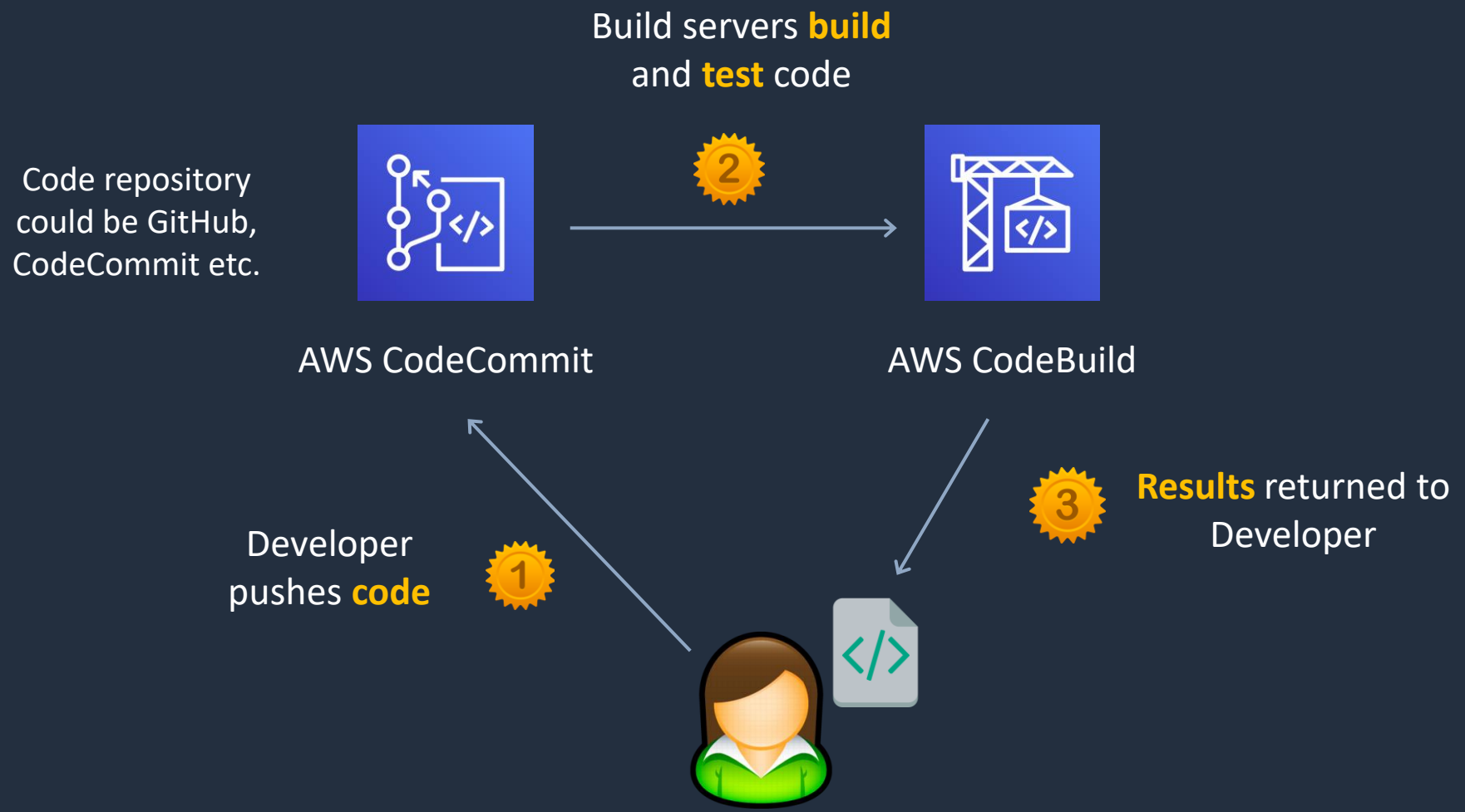
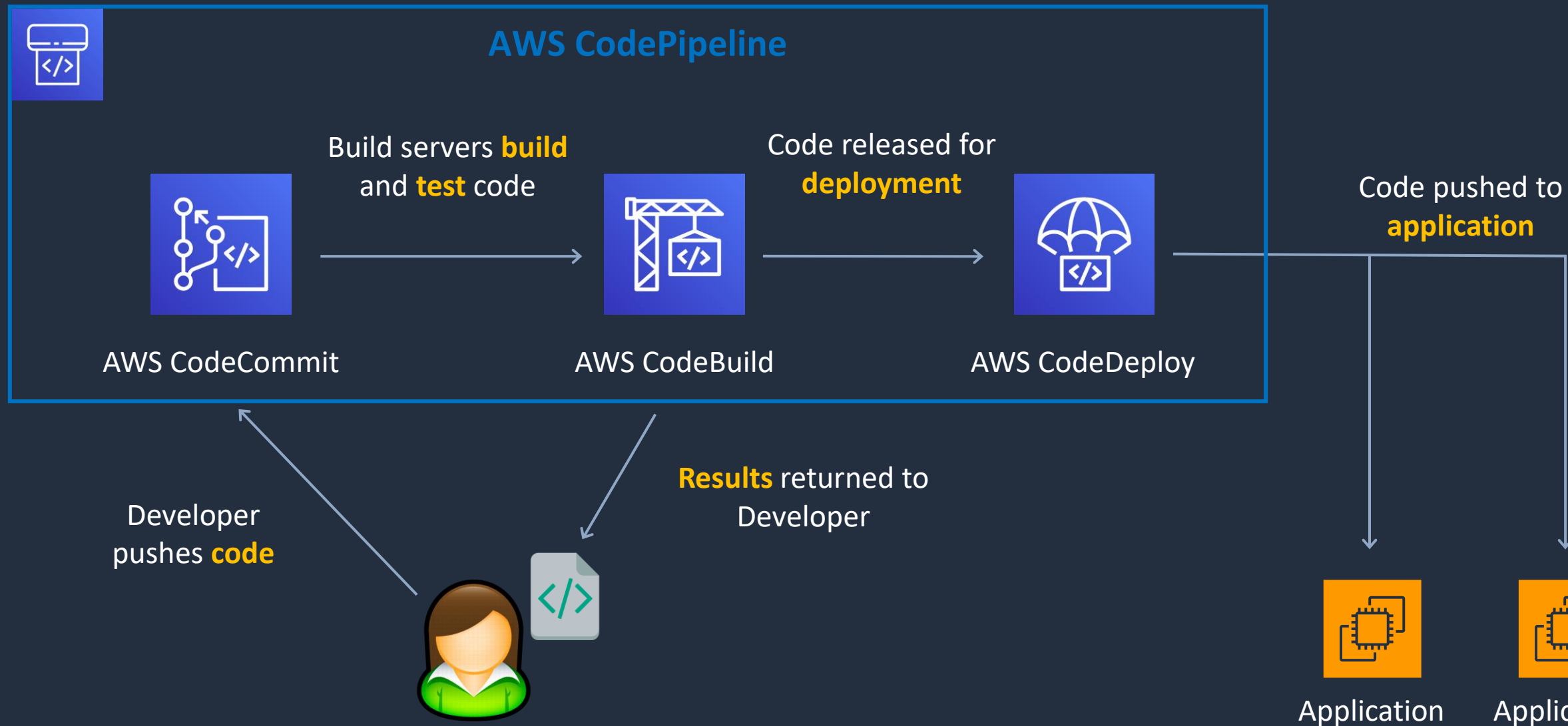
Continuous Integration and Continuous Delivery (CI/CD)



Continuous Integration



Continuous Integration & Continuous Delivery



Continuous Integration and Continuous Delivery

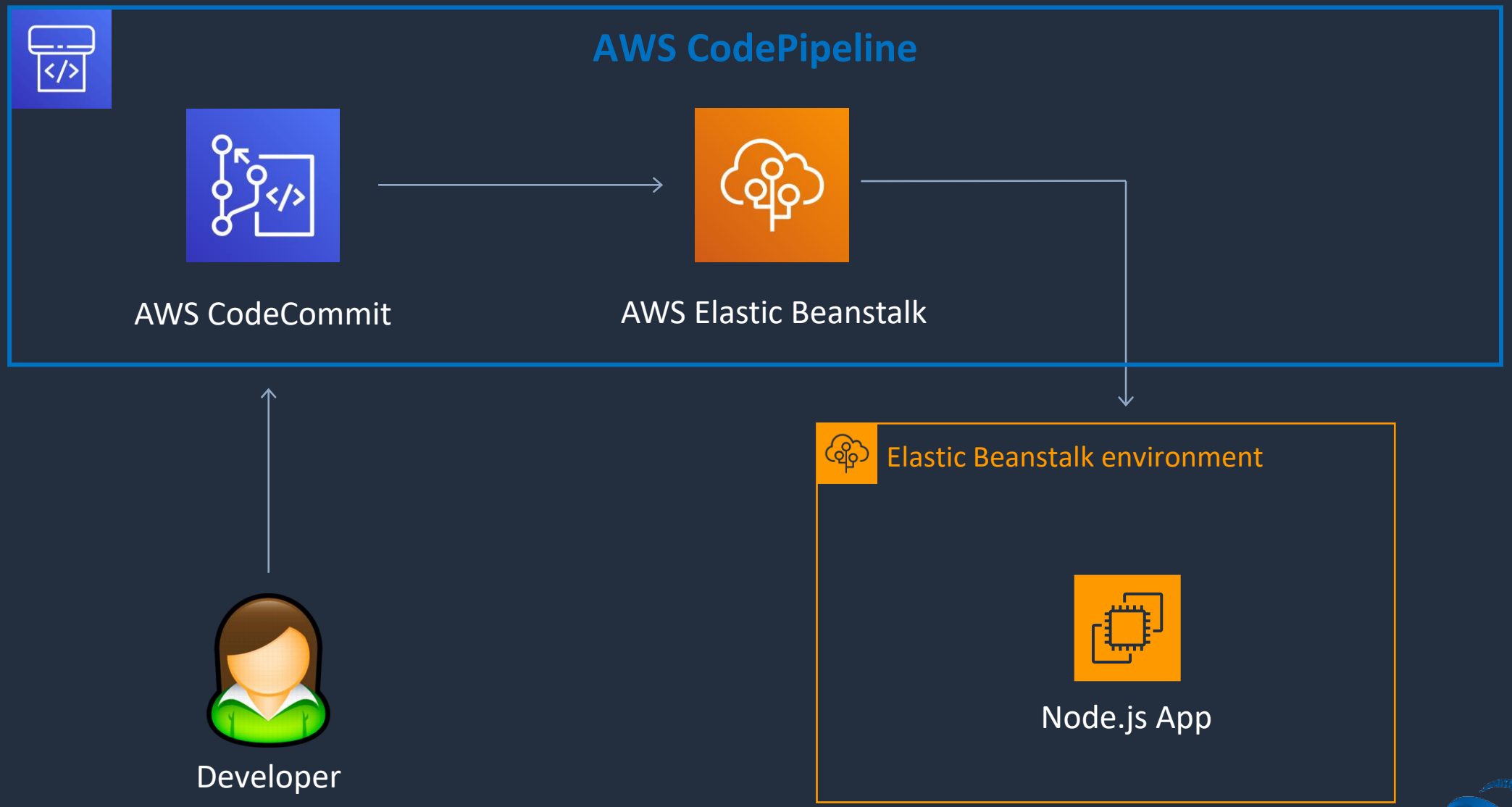
CODE	BUILD & TEST	DEPLOY
AWS CodeCommit	AWS CodeBuild	AWS CodeDeploy
GitHub	Jenkins	ANSIBLE

AWS CodePipeline

Create an AWS CodeCommit Repository

AWS CodePipeline with AWS Elastic Beanstalk

AWS CodePipeline with Elastic Beanstalk



SECTION 10

DNS, Caching, and Performance Optimization

Amazon Route 53 DNS

Amazon Route 53

Amazon Route 53

Domain Registration

.net
.com
.org

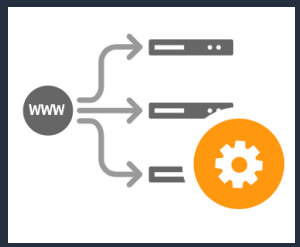
Hosted zone

example.com
dctlabs.com

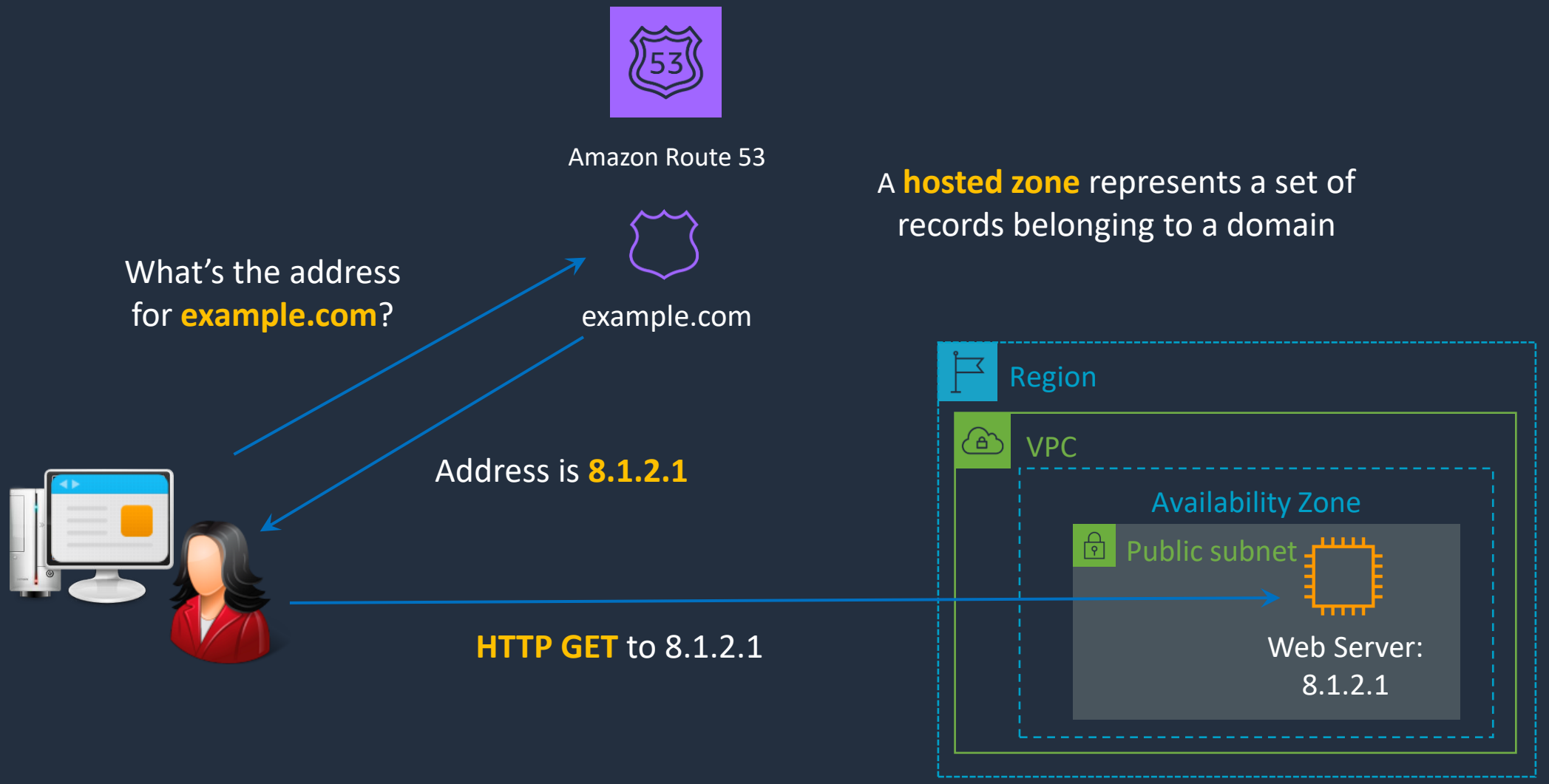
Health Checks

EC2 Instances

Traffic Flow



DNS Resolution with Route 53



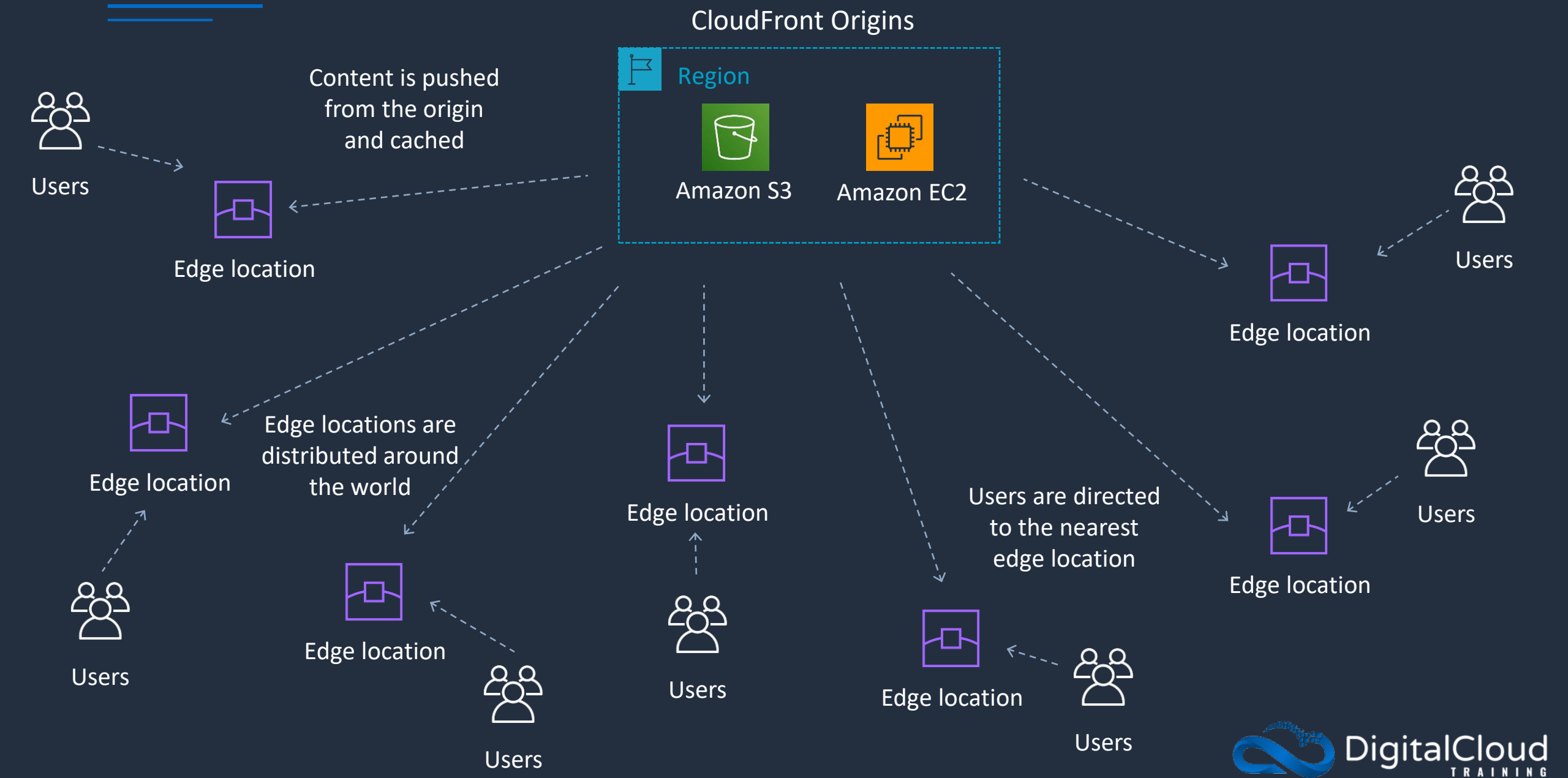
Route 53 DNS Record Types

Routing Policy	What it does
Simple	Simple DNS response providing the IP address associated with a name
Failover	If primary is down (based on health checks), routes to secondary destination
Geolocation	Uses geographic location you're in (e.g. Europe) to route you to the closest region
Geoproximity	Routes you to the closest region within a geographic area
Latency	Directs you based on the lowest latency route to resources
Multivalue answer	Returns several IP addresses and functions as a basic load balancer
Weighted	Uses the relative weights assigned to resources to determine which to route to

Register a Domain using Route 53

Amazon CloudFront

Amazon CloudFront

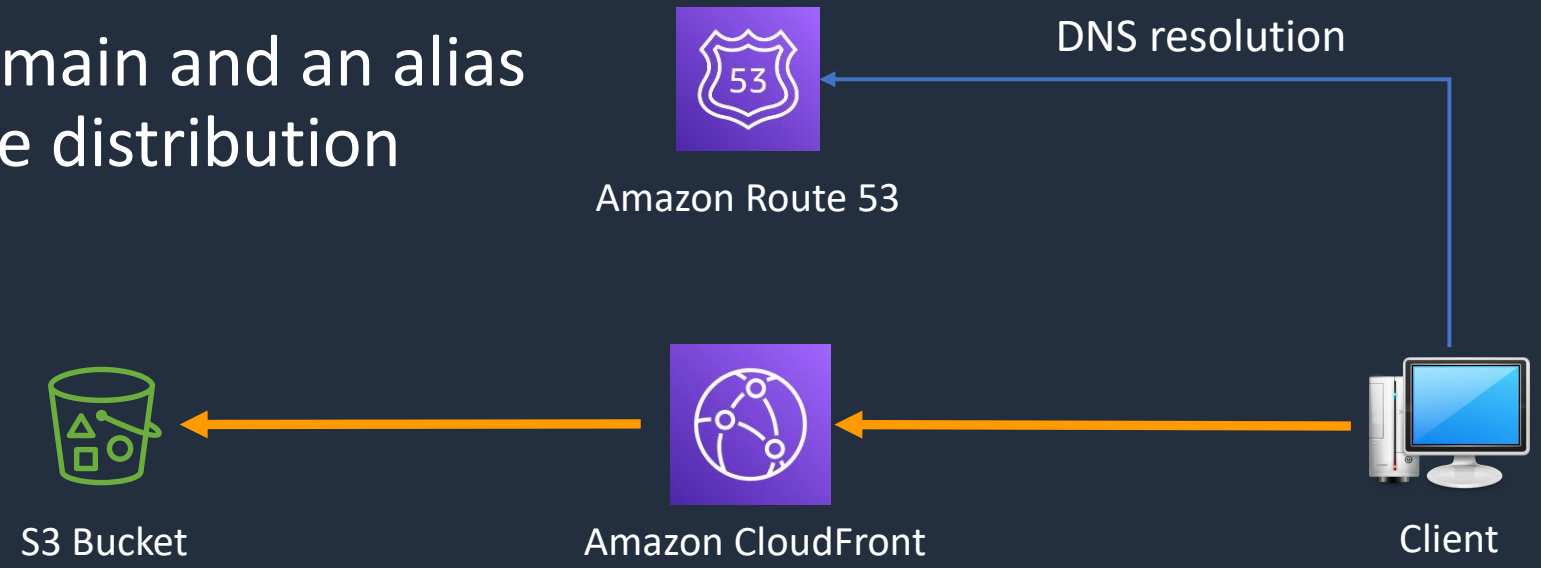


Create an Amazon CloudFront Distribution

Amazon CloudFront Distribution

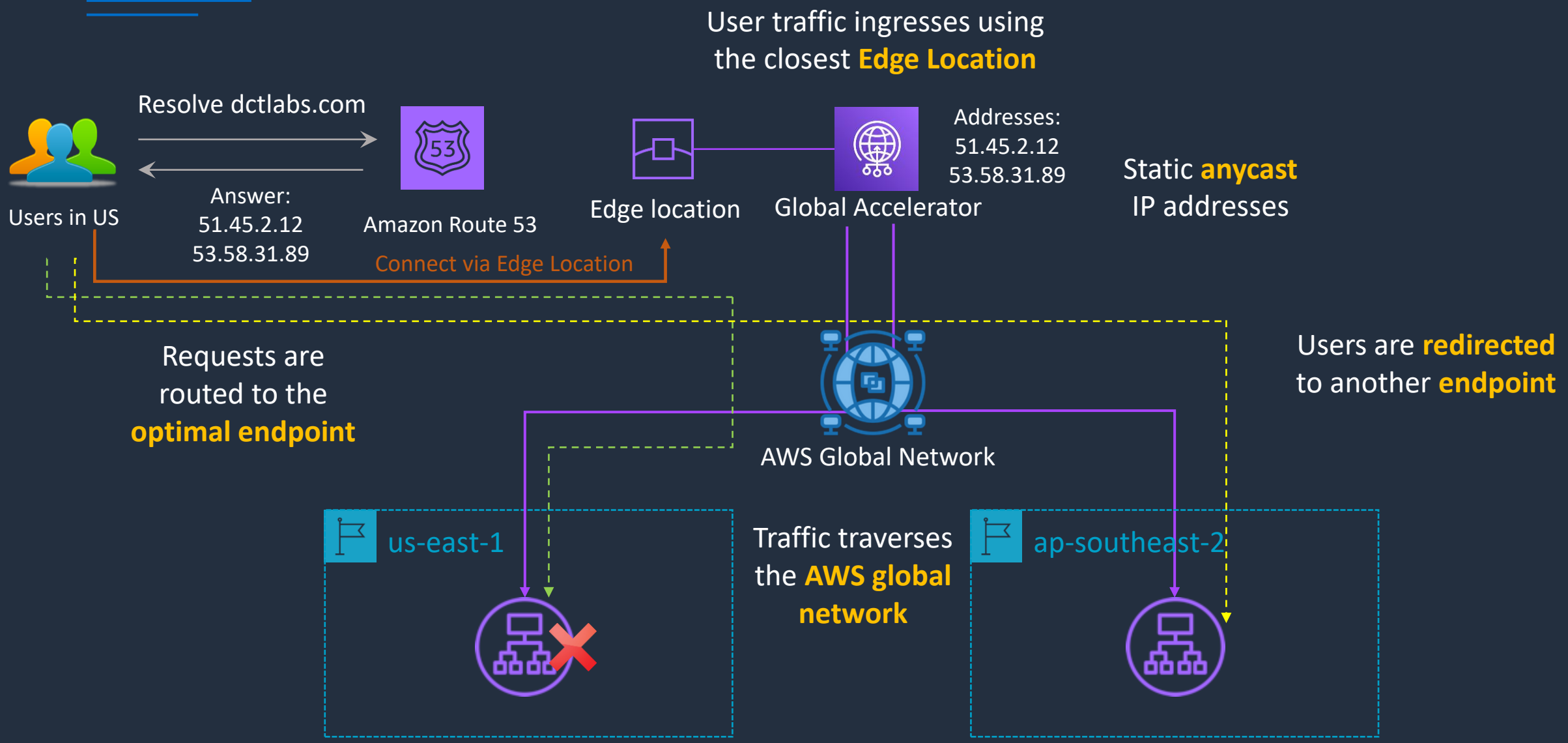
We will create:

- Amazon S3 bucket
- AWS Certificate Manager SSL/TLS certificate
- Amazon CloudFront distribution
- Amazon Route 53 domain and an alias record pointing to the distribution



AWS Global Accelerator

AWS Global Accelerator



SECTION 11

Containers and Serverless Computing

Docker Containers on Amazon ECS

Amazon ECS

ECS **Services** are used to maintain a **desired count** of tasks

Amazon Elastic Container Service

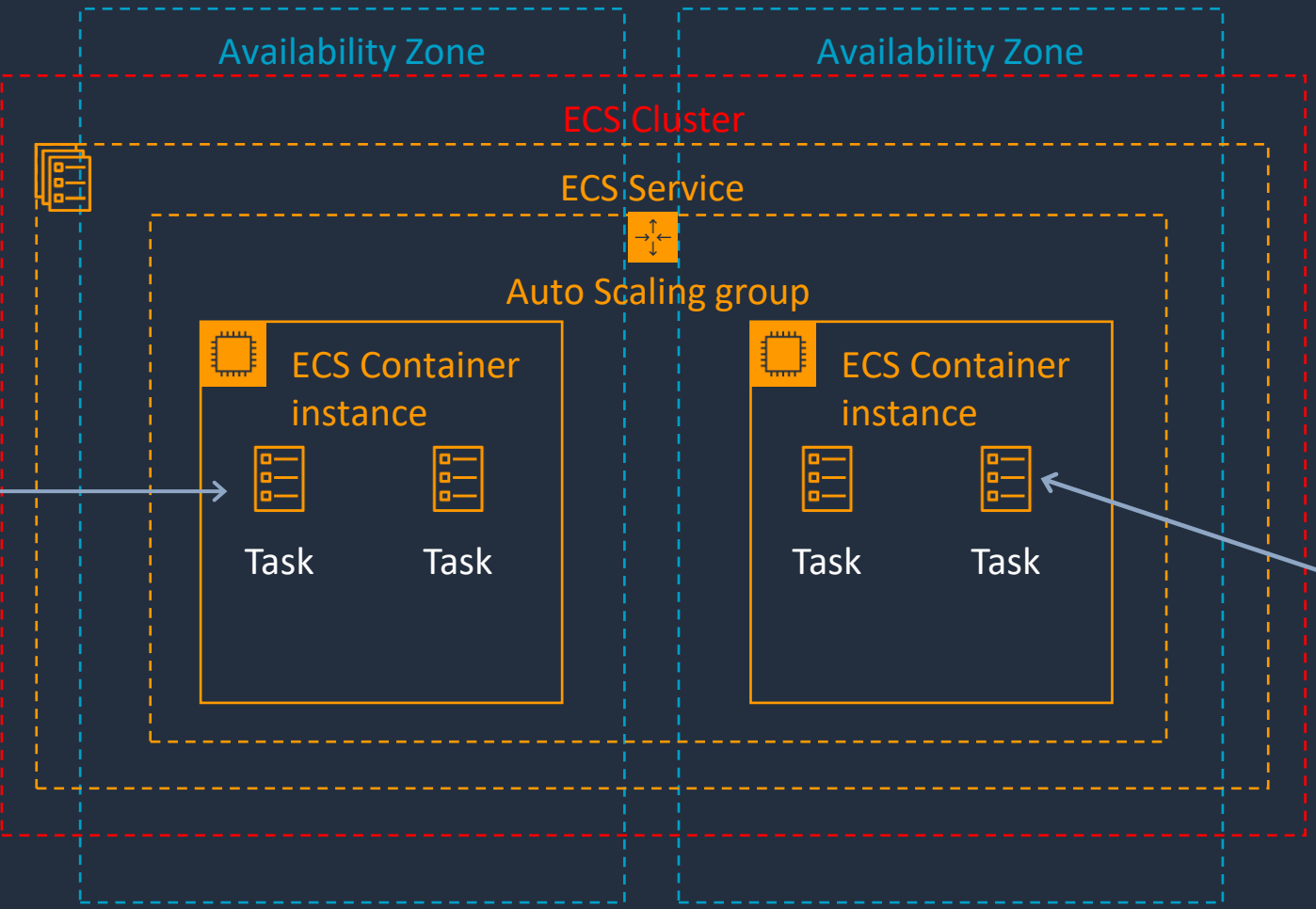
An Amazon **ECS Cluster** is a logical grouping of **tasks** or **services**

An ECS **Task** is created from a **Task Definition**

Task Definition

```
{
"containerDefinitions": [
                {
                  "name": "wordpress",
                  "links": [
                    "mysql"
                ],
                "image": "wordpress",
                "essential": true,
                "portMappings": [
                  {
                    "containerPort": 80,
                    "hostPort": 80
                     }
                  ],
                  "memory": 500,
                  "cpu": 10
                }
```

An ECS **Task** is a running **Docker container**



Docker **images** can be stored in **Amazon ECR**

Amazon Elastic Container Registry

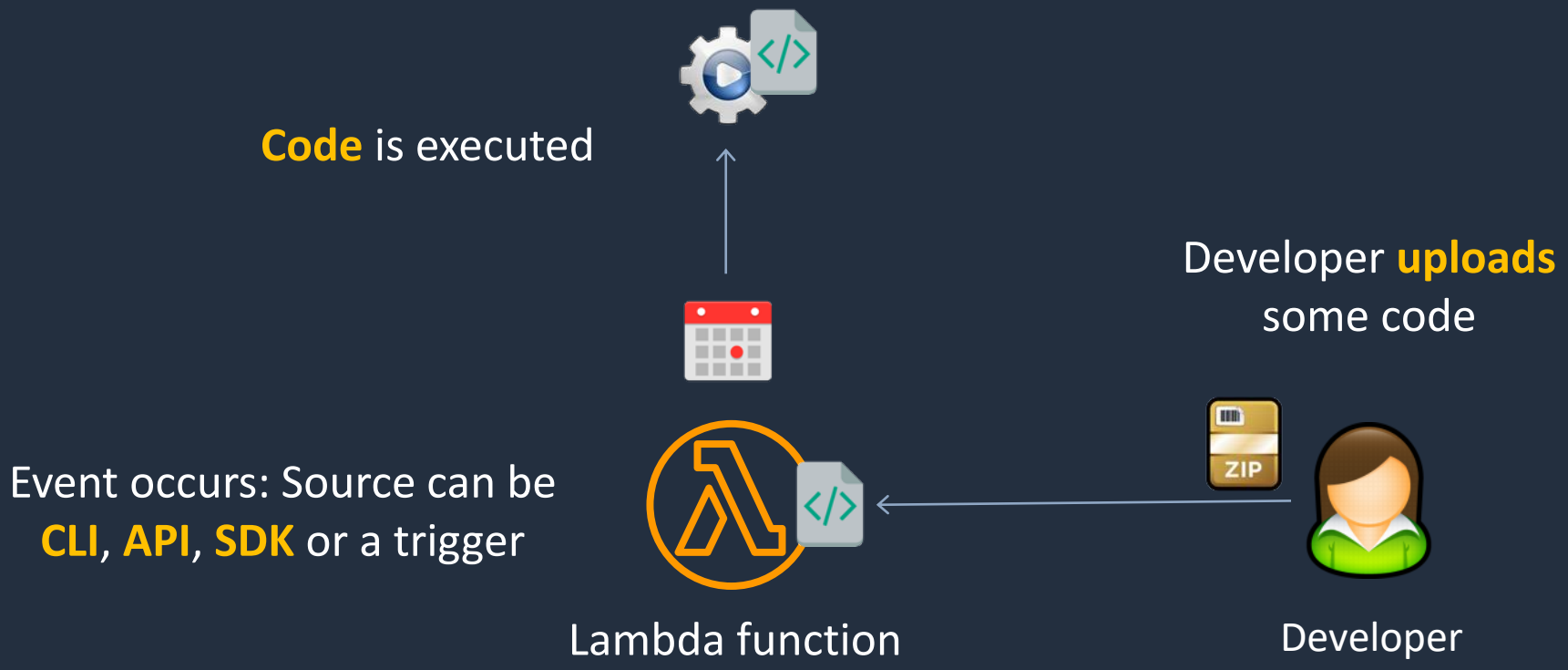
Amazon ECS Components

Elastic Container Service (ECS)	Description
Cluster	Logical grouping of tasks or services
Container instance	EC2 instance running the 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

Create an AWS Fargate Cluster

Serverless with AWS Lambda

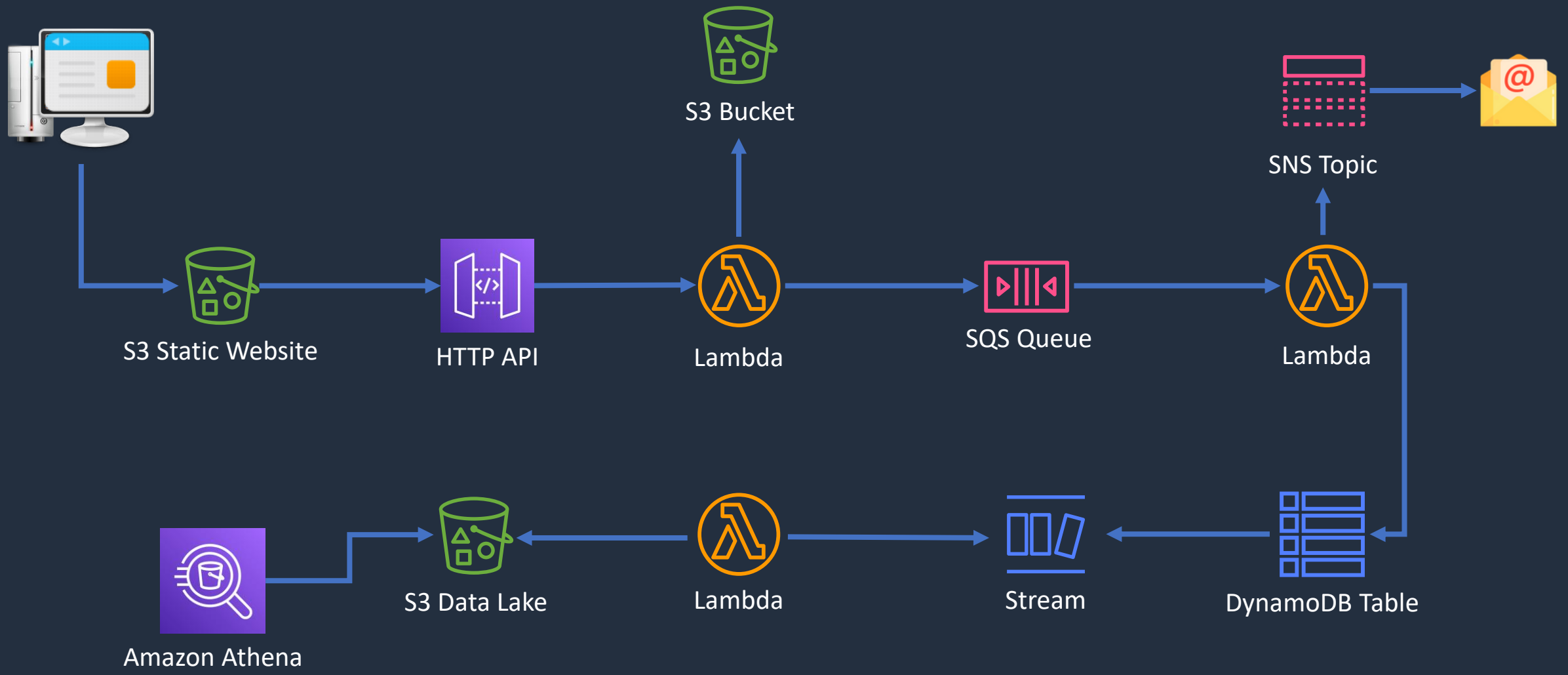
AWS Lambda



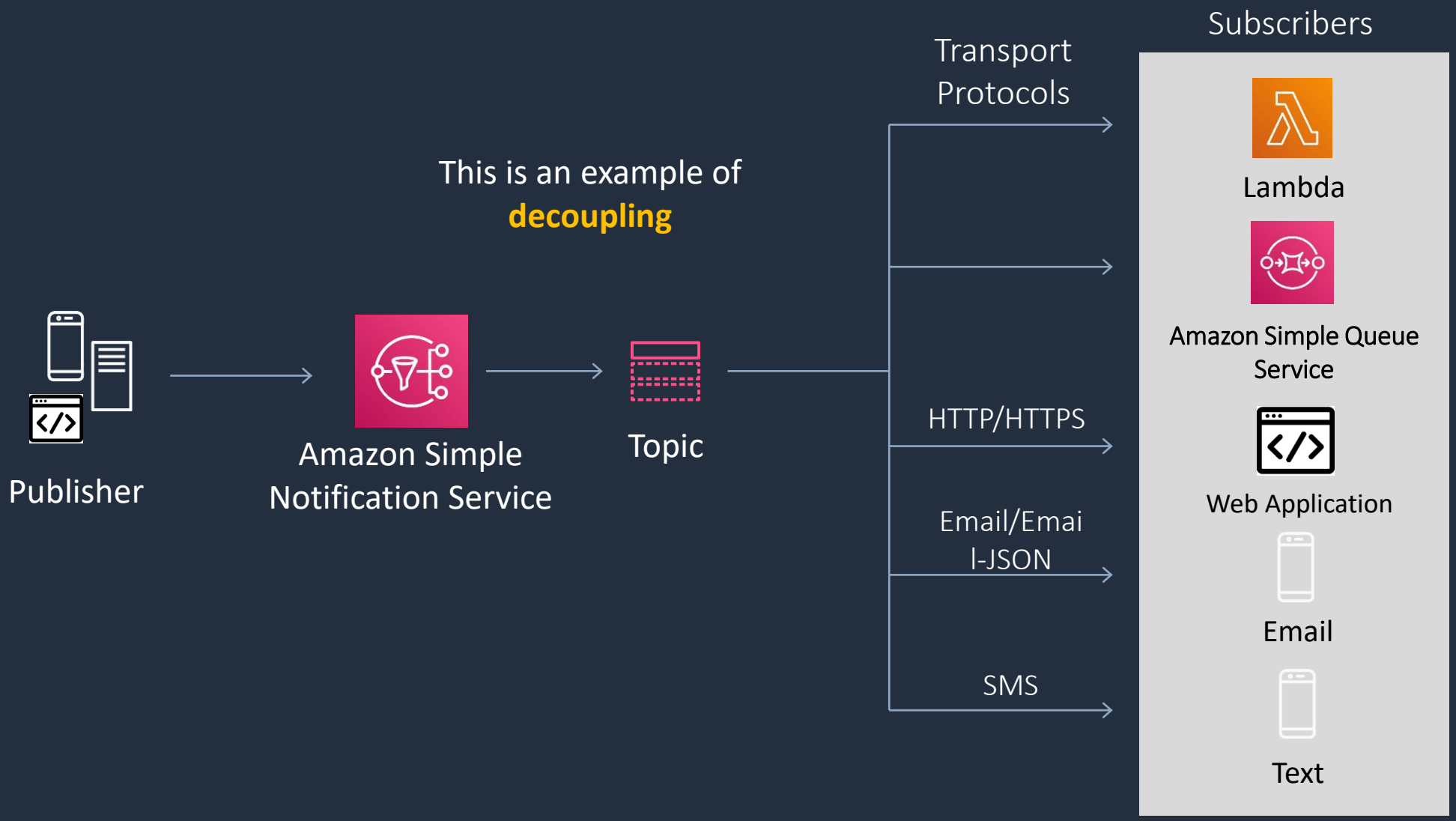
Create an AWS Lambda Function

Application Integration Services

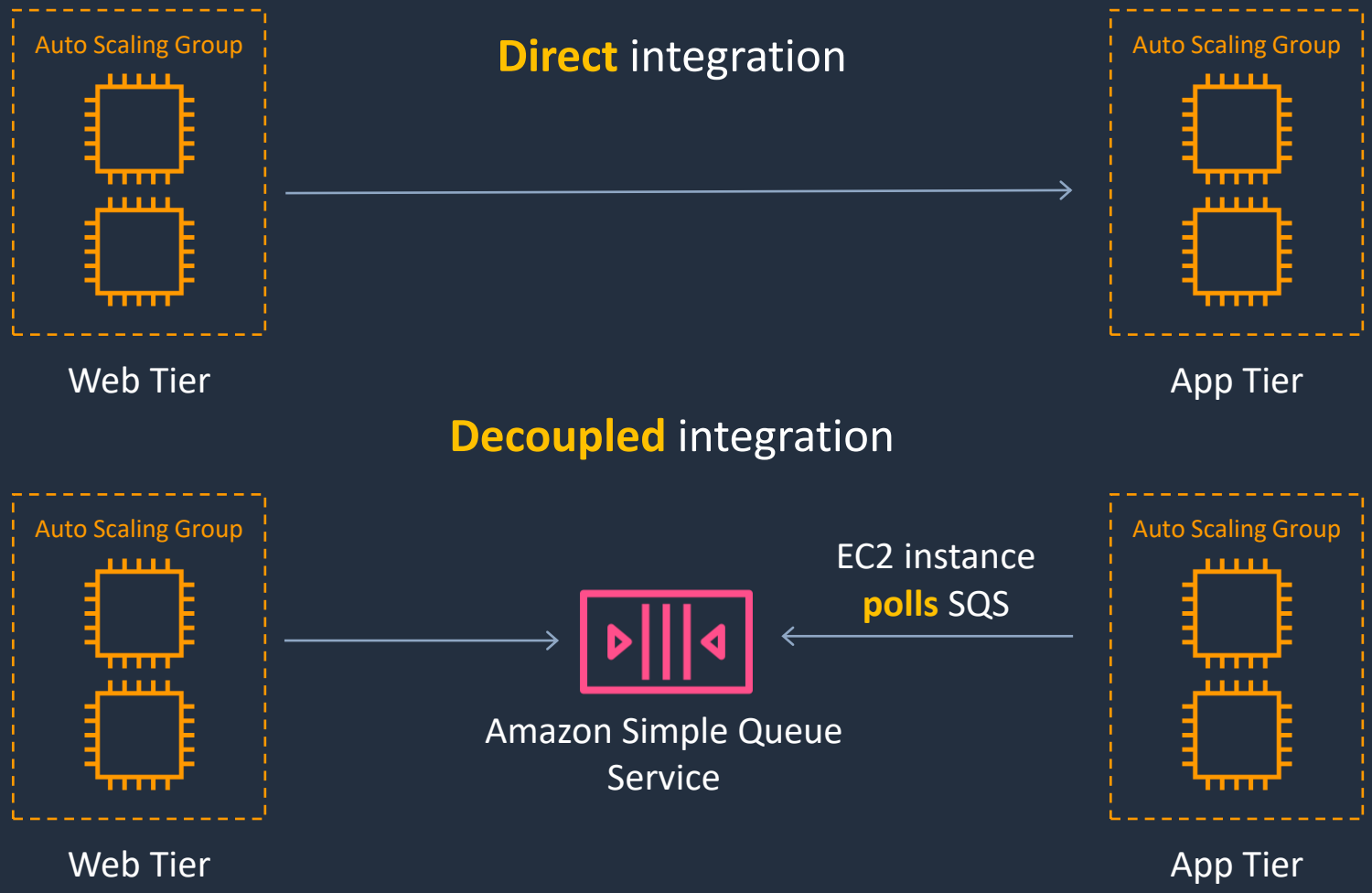
Serverless Services and Event-Driven Architecture



Amazon Simple Notification Service (SNS)



Amazon Simple Queue Service (SQS)



Create a Serverless Application

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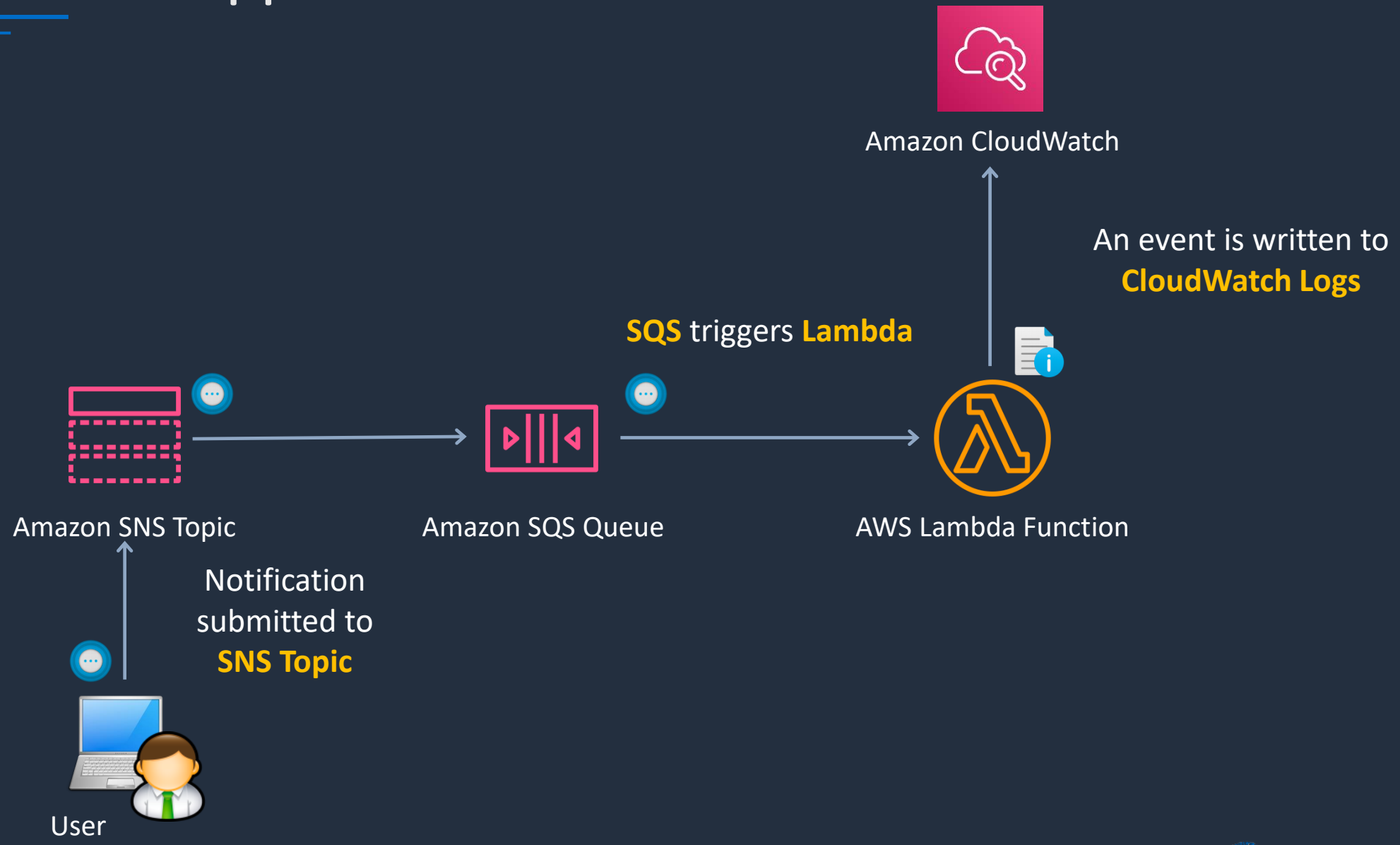
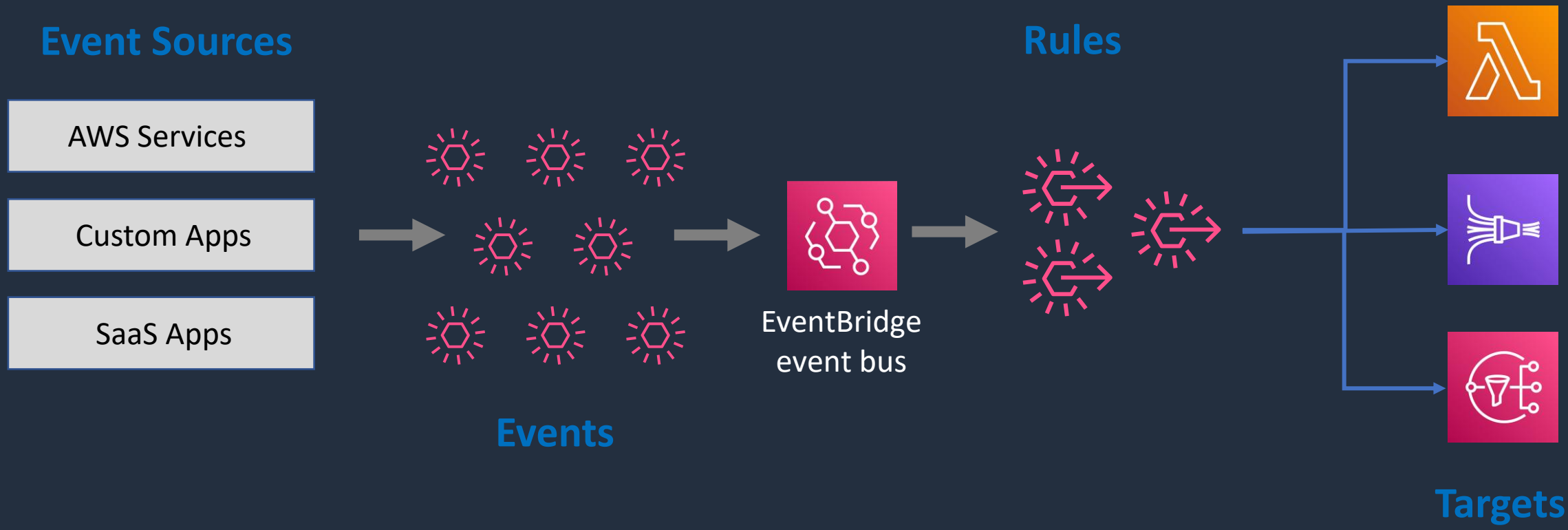
Serverless Application



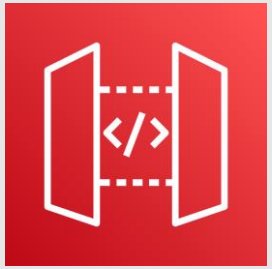
Amazon EventBridge

Amazon EventBridge

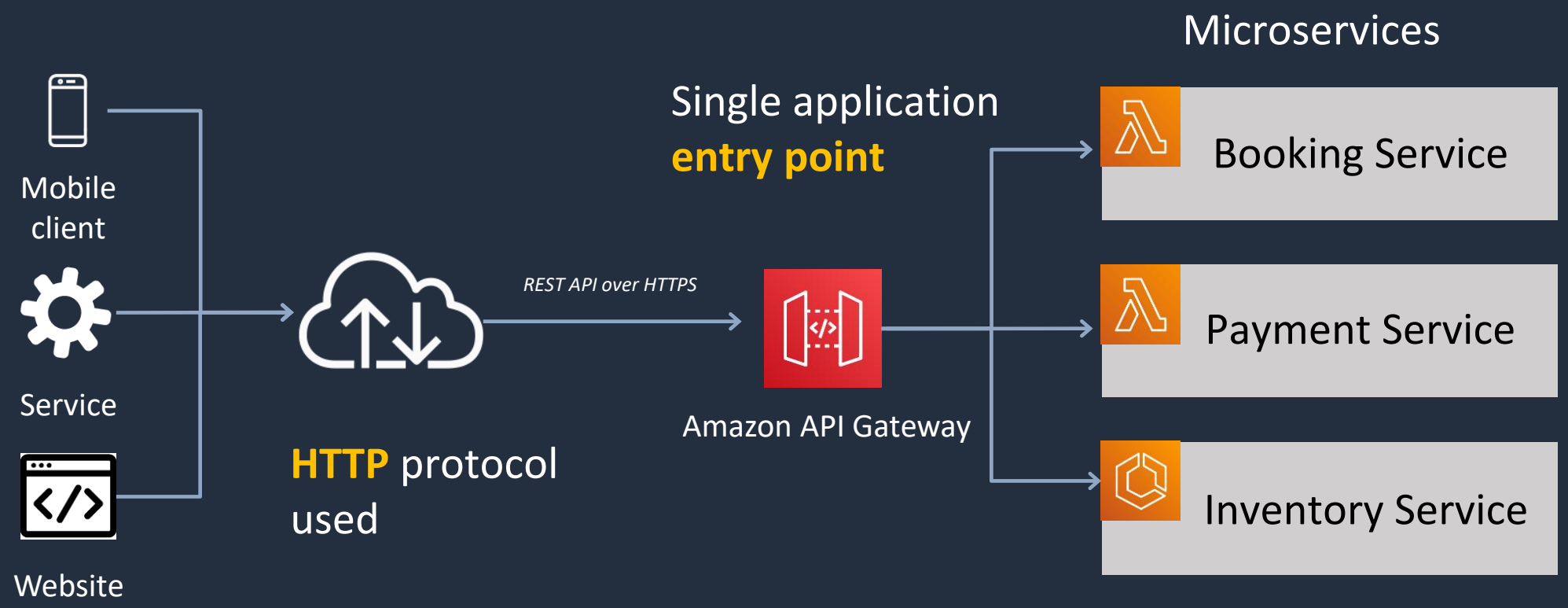
EventBridge used to be known as **CloudWatch Events**



Amazon API Gateway



REST API with Amazon API Gateway



Structure of a REST API

arn:aws:execute-api:ap-southeast-2:515148227241:fk49ji8iff/*/**GET**/

Map the **request parameters** of **method request** to the **format** required by the backend

Web App

Published API

ANY
DELETE
GET
HEAD
OPTIONS
PATCH
POST
PUT

Method Request

HTTP
HTTP_PROXY
LAMBDA
LAMBDA_PROXY
MOCK

Integration Request

Endpoint

Lambda function, HTTP endpoint, EC2 instance, AWS service etc.

CONVERT
PASSTHROUGH

Integration Response

HTTP STATUS CODES
RESPONSE BODIES

Method Response

Map the **status codes**, **headers**, and **payload** received from backend into format for client

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Create a REST API with Lambda Proxy Integration

SECTION 13

Get Certified on AWS

Get Certified on AWS

Get Certified on AWS

Why work in cloud computing?

1. Job demand
2. Globally relevant skills
3. Rewarding career paths
4. Great salaries

Why get AWS certified?

1. Demonstrate skills to employers
2. Differentiate yourself
3. Gain knowledge
4. Develop practical skills

AWS Certification

New to the industry

Some experience

Highly experienced

Specialized in an IT role

FOUNDATIONAL

Six months of fundamental AWS Cloud and industry knowledge

PROFESSIONAL

Two years of experience designing, operating, and troubleshooting solutions using the AWS Cloud

ASSOCIATE

One year of experience solving problems and implementing solutions using the AWS Cloud

SPECIALTY

Technical AWS Cloud experience in the Specialty domain as specified in the exam guide

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Take Action Now!

Prepare for your next AWS certification with video courses & practice exams

Build hands-on cloud skills in a secure sandbox environment

Get ready for your next cloud job with real-world projects in a virtual classroom