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strictly for personal use only

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• This document is reserved for people enrolled into the

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AWS Certified Cloud Practitioner Course

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• Please do not share this document, it is intended for personal use and exam preparation only, thank you.

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• If you’ve obtained these slides for free on a website that is not the course’s

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website, please reach out to piracy@datacumulus.com. Thanks!

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• Best of luck for the exam and happy learning!

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© Stephane Maarek

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AWS Certified Cloud

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Welcome! We’re starting in 5 minutes 

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• We’re going to prepare for the Cloud Practitioner exam – CLF-C01

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• It’s a challenging certification, so this course will be long and interesting

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• Basic IT knowledge is helpful, but I will explain everything

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• We will cover over 40 AWS services (out of the 200+ in AWS)

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• AWS / IT Beginners welcome! (but take your time, it’s not a race)

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• Learn by doing – key learning technique!

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This course mixes both theory & hands on

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Sample question: Certified Cloud Practitioner

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**Which AWS service would simplify the migration of a database to AWS?**

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• A) AWS Storage Gateway

• B) AWS Database Migration Service • C) Amazon EC2

• D) Amazon AppStream 2.0

<= we will learn

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<= correct answer

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<= distractor (over 200 services in AWS)

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• https://d1.awsstatic.com/training-and-certification/docs-cloud

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practitioner/AWS-Certified-Cloud-Practitioner\_Sample-Questions.pdf

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About me

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• I’m Stephane!

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• 9x AWS Certified (so far!)

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• Worked with AWS many years: built websites, apps, streaming platforms

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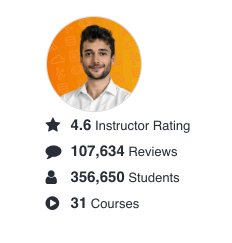
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• Veteran Instructor on AWS (Certifications, CloudFormation, Lambda, EC2…)

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• You can find me on

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• LinkedIn: https://www.linkedin.com/in/stephanemaarek

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• Medium: https://medium.com/@stephane.maarek

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• Twitter: https://twitter.com/stephanemaarek

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• GitHub: https://github.com/simplesteph

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Your AWS Certification journey

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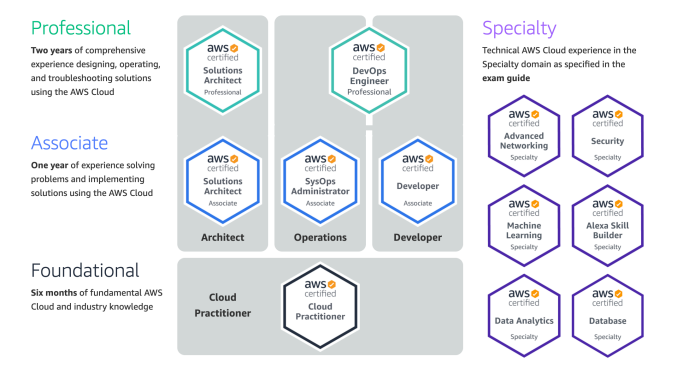
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Estimated Cost for this Course

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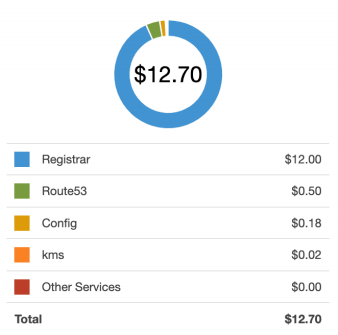
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• Most of the services we’ll use will be 

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within the AWS Free Tier = $0

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• If I use a service which will cost you

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money, I will mention it

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• You can read more about the

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AWS Free Tier at:

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https://aws.amazon.com/free/

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Udemy Tips

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What is Cloud Computing

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© Stephane Maarek

How websites work



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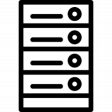
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Server

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**Clients have IP addressesServers have IP addresses**

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Just like when you’re sending post mail!

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What is a server composed of?

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• Compute: CPU 

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• Memory: RAM

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• Storage: Data

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• Database: Store data in a structured way

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• Network: Routers, switch, DNS server 

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IT Terminology

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• Network: cables, routers and servers connected with each other

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• Router: A networking device that forwards data packets between computer

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networks. They know where to send your packets on the internet!

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• Switch: Takes a packet and send it to the correct server / client on your network

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**Router Switch**

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© Stephane Maarek

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Traditionally, how to build infrastructure

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Home or Garage Office

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Data center

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Problems with traditional IT approach

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• Pay for the rent for the data center

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• Pay for power supply, cooling, maintenance

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• Adding and replacing hardware takes time

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• Scaling is limited

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• Hire 24/7 team to monitor the infrastructure

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• How to deal with disasters? (earthquake, power shutdown, fire…)

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• Can we externalize all this?

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© Stephane Maarek

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What is Cloud Computing? 

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• Cloud computing is the on-demand delivery of compute power, database storage,

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applications, and other IT resources

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• Through a cloud services platform with pay-as-you-go pricing

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• You can provision exactly the right type and size of computing resources you need

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• You can access as many resources as you need, almost instantly

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• Simple way to access servers, storage, databases and a set of application services

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• Amazon Web Services owns and maintains the network-connected hardware

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required for these application services, while you provision and use what you need

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via a web application.

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Office The Cloud

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You’ve been using some Cloud services

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**Gmail**

• E-mail cloud service

• Pay for ONLY your emails stored (no infrastructure, etc.)

**Dropbox**

• Cloud Storage Service • Originally built on AWS

**Netflix**

• Built on AWS • Video on Demand

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The Deployment Models of the Cloud

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Private Cloud:

• Cloud services used by a single organization, not exposed to the public.

• Complete control

• Security for sensitive applications

• Meet specific business needs



Public Cloud:

• Cloud resources owned and operated by a third party cloud service

provider delivered over the Internet.

• Six Advantages of Cloud Computing



Hybrid Cloud:

• Keep some servers on premises and extend some capabilities to the Cloud

• Control over sensitive assets in your private infrastructure

• Flexibility and cost effectiveness of the

public cloud



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The Five Characteristics of Cloud Computing

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• On-demand self service:

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• Users can provision resources and use them without human interaction from the service

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provider

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• Broad network access:

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• Resources available over the network, and can be accessed by diverse client platforms

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• Multi-tenancy and resource pooling:

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• Multiple customers can share the same infrastructure and applications with security and privacy

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• Multiple customers are serviced from the same physical resources

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• Rapid elasticity and scalability:

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• Automatically and quickly acquire and dispose resources when needed

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• Quickly and easily scale based on demand

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• Measured service:

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• Usage is measured, users pay correctly for what they have used

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Six Advantages of Cloud Computing

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• Trade capital expense (CAPEX) for operational expense (OPEX)

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• Pay On-Demand: don’t own hardware

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• Reduced Total Cost of Ownership (TCO) & Operational Expense (OPEX)

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• Benefit from massive economies of scale

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• Prices are reduced as AWS is more efficient due to large scale

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• Stop guessing capacity

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• Scale based on actual measured usage

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• Increase speed and agility

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• Stop spending money running and maintaining data centers

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• Go global in minutes: leverage the AWS global infrastructure

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Problems solved by the Cloud

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• Flexibility: change resource types when needed

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• Cost-Effectiveness: pay as you go, for what you use

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• Scalability: accommodate larger loads by making hardware stronger or

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adding additional nodes

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• Elasticity: ability to scale out and scale-in when needed

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• High-availability and fault-tolerance: build across data centers

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• Agility: rapidly develop, test and launch software applications

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Types of Cloud Computing

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• Infrastructure as a Service (IaaS)

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• Provide building blocks for cloud IT

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• Provides networking, computers, data storage space

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• Highest level of flexibility

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• Easy parallel with traditional on-premises IT

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• Platform as a Service (PaaS)

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• Removes the need for your organization to manage the underlying infrastructure

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• Focus on the deployment and management of your applications

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• Software as a Service (SaaS)

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• Completed product that is run and managed by the service provider

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© Stephane Maarek

On-premises

Applications

Data

Runtime

Middleware

O/S

Virtualization

Servers

Storage

Networking

Infrastructure as a Service (IaaS)

Applications

Data

Runtime

Middleware

O/S

Virtualization

Servers

Storage

Networking

Platform as a Service

(PaaS)

Applications

Data

Runtime

Middleware

O/S

Virtualization

Servers

Storage

Networking

Software as a

Service

(SaaS)

Applications

Data

Runtime

Middleware

O/S

Virtualization

Servers

Storage

Networking

Managed by you Managed by others

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© Stephane Maarek

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Example of Cloud Computing Types

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• Infrastructure as a Service: 

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• Amazon EC2 (on AWS)

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• GCP, Azure, Rackspace, Digital Ocean, Linode

**©**

**S**

• Platform as a Service: 

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• Elastic Beanstalk (on AWS)

**a**

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• Heroku, Google App Engine (GCP), Windows Azure (Microsoft)

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• Software as a Service: 

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• Many AWS services (ex: Rekognition for Machine Learning)

**w**

**w**

• Google Apps (Gmail), Dropbox, Zoom

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© Stephane Maarek

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Pricing of the Cloud – Quick Overview

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• AWS has 3 pricing fundamentals, following the pay-as-you-go pricing

**I**

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model

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• Compute: 

**©**

**S**

**t**

• Pay for compute time

**e**

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**a**

• Storage: 

**n**

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• Pay for data stored in the Cloud

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• Data transfer OUT of the Cloud: 

**k**

**w**

**w**

• Data transfer IN is free

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• Solves the expensive issue of traditional IT

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© Stephane Maarek

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AWS Cloud History

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**T**

**R**

**I**

**B**

2002:

Internally launched

2004:

Launched publicly with SQS

2007:

Launched in Europe

**U**

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**S**

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2003:

Amazon infrastructure is one of their core strength. Idea to market

2006: 

Re-launched publicly with SQS, S3 & EC2



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© Stephane Maarek

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AWS Cloud Number Facts

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**R**

• In 2019, AWS had $35.02

**I**

**B**

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billion in annual revenue

**T**

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• AWS accounts for 47% of the

**©**

**S**

market in 2019 (Microsoft is

**t**

**e**

**p**

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2nd with 22%)

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**e**

• Pioneer and Leader of the

**M**

**a**

**a**

AWS Cloud Market for the

**r**

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9th consecutive year

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• Over 1,000,000 active users

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**Gartner Magic Quadrant**

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© Stephane Maarek

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AWS Cloud Use Cases

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• AWS enables you to build sophisticated, scalable applications

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• Applicable to a diverse set of industries

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**©**

• Use cases include

**S**

**t**

**e**

• Enterprise IT, Backup & Storage, Big Data analytics

**p**

**h**

**a**

• Website hosting, Mobile & Social Apps

**n**

**e**

**M**

• Gaming

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**d**

**a**

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© Stephane Maarek

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AWS Global Infrastructure

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**R**

• AWS Regions 

**I**

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**T**

• AWS Availability Zones

**I**

**O**

**N**

**©**

• AWS Data Centers

**S**

**t**

**e**

**p**

• AWS Edge Locations /

**h**

**a**

**n**

Points of Presence

**e**

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• https://infrastructure.aws/

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© Stephane Maarek

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AWS Regions 

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• AWS has Regions all around the world

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• Names can be us-east-1, eu-west-3…

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• A region is a cluster of data centers

**©**

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• Most AWS services are region-scoped

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https://aws.amazon.com/about-aws/global-infrastructure/

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© Stephane Maarek

AWS Availability Zones

• Each region has many availability zones (usually 3, min is 2, max is 6). Example: • ap-southeast-2a

• ap-southeast-2b

• ap-southeast-2c

• Each availability zone (AZ) is one or more discrete data centers with redundant power, networking, and connectivity

• They’re separate from each other, so that they’re isolated from disasters

• They’re connected with high bandwidth, ultra-low latency networking

AWS Region

Sydney: ap-southeast-2

ap-southeast-2a



ap-southeast-2b ap-southeast-2c

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© Stephane Maarek

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AWS Points of Presence (Edge Locations)

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• Amazon has 216 Points of Presence (205 Edge Locations & 11 Regional

**I**

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Caches) in 84 cities across 42 countries

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• Content is delivered to end users with lower latency 

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https://aws.amazon.com/cloudfront/features/

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Tour of the AWS Console 

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• AWS has Global Services:

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• Identity and Access Management (IAM) 

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• Route 53 (DNS service)

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• CloudFront (Content Delivery Network)

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**e**

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• WAF (Web Application Firewall)

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• Most AWS services are Region-scoped:

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• Amazon EC2 (Infrastructure as a Service) 

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• Elastic Beanstalk (Platform as a Service)

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• Lambda (Function as a Service)

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• Rekognition (Software as a Service)

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• Region Table: https://aws.amazon.com/about-aws/global-infrastructure/regional-product-services

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Shared Responsibility Model diagram

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CUSTOMER = RESPONSIBILITY FOR

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THE SECURITY **IN** THE CLOUD

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AWS = RESPONSIBILITY FOR

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THE SECURITY **OF** THE CLOUD

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https://aws.amazon.com/compliance/shared-responsibility-model/

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AWS Acceptable Use Policy

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• https://aws.amazon.com/aup/

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• No Illegal, Harmful, or Offensive Use or Content

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• No Security Violations

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• No Network Abuse

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**a**

**a**

• No E-Mail or Other Message Abuse

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© Stephane Maarek

IAM Section

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© Stephane Maarek

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IAM: Users & Groups 

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• IAM = Identity and Access Management, Global service

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• Root account created by default, shouldn’t be used or shared

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• Users are people within your organization, and can be grouped

**©**

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• Groups only contain users, not other groups

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• Users don’t have to belong to a group, and user can belong to multiple groups

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**a**

**Group: Developers Group: Operations Group**

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**Audit Team** 

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**a**

**Alice Bob Charles David Edward**

**Fred**

**c**

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© Stephane Maarek

IAM: Permissions

• Users or Groups can be assigned JSON documents called policies

• These policies define the permissions of the users

• In AWS you apply the least privilege principle: don’t give more permissions than a user needs

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{ 

**I**

**S**

"Version": "2012-10-17",

**T**

**R**

"Statement": [

**I**

**B**

{

**U**

**T**

"Effect": "Allow",

**I**

**O**

"Action": "ec2:Describe\*",

**N**

"Resource": "\*"

**©**

},

**S**

{

**t**

**e**

"Effect": "Allow",

**p**

**h**

"Action": "elasticloadbalancing:Describe\*",

**a**

**n**

"Resource": "\*"

**e**

},

**M**

**a**

{

**a**

"Effect": "Allow",

**r**

**e**

**k**

"Action": [

**w**

"cloudwatch:ListMetrics",

**w**

"cloudwatch:GetMetricStatistics",

**w**

"cloudwatch:Describe\*"

**.**

**d**

**a**

],

**t**

**a**

"Resource": "\*"

**c**

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}

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© Stephane Maarek

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IAM Policies

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**R**

**D**

**I**

**S**

**Audit Team**

**T**

**R**

**I**

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**Developers Operations**

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**S**

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**a**

**Alice Bob Charles David Edward**

**Fred**

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**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

IAM – Password Policy

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**T**

**R**

• Strong passwords = higher security for your account

**I**

**B**

**U**

**T**

• In AWS, you can setup a password policy:

**I**

**O**

**N**

• Set a minimum password length

**©**

**S**

**t**

• Require specific character types:

**e**

**p**

**h**

• including uppercase letters

**a**

**n**

**e**

• lowercase letters

**M**

**a**

• numbers

**a**

**r**

**e**

• non-alphanumeric characters

**k**

**w**

• Allow all IAM users to change their own passwords

**w**

**w**

**.**

• Require users to change their password after some time (password expiration)

**d**

**a**

**t**

**a**

• Prevent password re-use

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

Multi Factor Authentication - MFA

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**R**

• Users have access to your account and can possibly change

**I**

**B**

**U**

configurations or delete resources in your AWS account

**T**

**I**

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**N**

• You want to protect your Root Accounts and IAM users

**©**

**S**

**t**

• MFA = password *you know* + security device *you own*

**e**

**p**

**h**

**a**

**n**

**e**

**M**

**Password** + => **Successful login**

**a**

**a**

**r**

**e**

**k**

**w**

**Alice**

**w**

**w**

**.**

• Main benefit of MFA:

**d**

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**a**

if a password is stolen or hacked, the account is not compromised

**c**

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**m**

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© Stephane Maarek

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MFA devices options in AWS

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**T**

**Virtual MFA device **

**Universal 2nd Factor (U2F) Security Key**

**R**

**I**

**B**

**U**

**T**

**I**

**O**

**N**

**©**

**S**

**t**

**e**

**p**

**h**

**a**

**n**

**e**

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**YubiKey** by Yubico (3rd party)

**w**

**Google Authenticator** (phone only)

**Authy**

(multi-device)

**w**

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**c**

Support for multiple tokens on a single device. Support for multiple root and IAM users

**u**

**m**

using a single security key

**u**

**l**

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© Stephane Maarek

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MFA devices options in AWS

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**F**

**O**

**R**

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**S**

**T**

**R**

**I**

**B**

**Hardware Key Fob MFA Device**

****

Provided by Gemalto (3rd party)

**Hardware Key Fob MFA Device for**

**U**

**T**

**AWS GovCloud (US)**

**I**

**O**

**N**

**©**

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**p**

**h**

**a**

**n**

**e**

**M**

**a**

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**k**

**w**

Provided by SurePassID (3rd party)

**w**

**w**

**.**

**d**

**a**

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© Stephane Maarek

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How can users access AWS ? 

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• To access AWS, you have three options:

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• AWS Management Console (protected by password + MFA)

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• AWS Command Line Interface (CLI): protected by access keys

**©**

**S**

• AWS Software Developer Kit (SDK) - for code: protected by access keys

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• Access Keys are generated through the AWS Console

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• Users manage their own access keys

**a**

**a**

**r**

**e**

• Access Keys are secret, just like a password. Don’t share them

**k**

**w**

**w**

• Access Key ID ~= username

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**.**

**d**

**a**

• Secret Access Key ~= password

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**a**

**c**

**u**

**m**

**u**

**l**

**u**

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**c**

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© Stephane Maarek

**N**

**O**

Example (Fake) Access Keys

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

**I**

**B**

**U**

**T**

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**r**

**e**

**k**

• Access key ID: AKIASK4E37PV4983d6C

**w**

**w**

**w**

• Secret Access Key: AZPN3zojWozWCndIjhB0Unh8239a1bzbzO5fqqkZq

**.**

**d**

**a**

**t**

**a**

• Remember: don’t share your access keys

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

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IAM Roles for Services

• Some AWS service will need to perform actions on your behalf

• To do so, we will assign

permissions to AWS services with IAM Roles

• Common roles:

• EC2 Instance Roles

• Lambda Function Roles

• Roles for CloudFormation

**IAM Role**

EC2 Instance (virtual server) 

Access AWS 

**N**

**O**

**T**

**F**

**O**

**R**

**D**

**I**

**ST**

**R**

**I**

**B**

**U**

**T**

**I**

**O**

**N**

**©**

**S**

**t**

**e**

**p**

**h**

**a**

**n**

**e**

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

**w**

**.**

**d**

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**a**

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© Stephane Maarek

**N**

**O**

IAM Security Tools

**T**

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**R**

**D**

**I**

**S**

**T**

**R**

• IAM Credentials Report (account-level)

**I**

**B**

**U**

**T**

• a report that lists all your account's users and the status of their various

**I**

**O**

**N**

credentials

**©**

**S**

**t**

**e**

**p**

**h**

**a**

**n**

**e**

• IAM Access Advisor (user-level)

**M**

**a**

**a**

• Access advisor shows the service permissions granted to a user and when those

**r**

**e**

**k**

services were last accessed.

**w**

**w**

**w**

• You can use this information to revise your policies.

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**d**

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**a**

**c**

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**m**

© Stephane Maarek

**N**

**O**

IAM Guidelines & Best Practices 

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**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Don’t use the root account except for AWS account setup

**I**

**B**

**U**

**T**

• One physical user = One AWS user

**I**

**O**

**N**

**©**

• Assign users to groups and assign permissions to groups

**S**

**t**

**e**

**p**

• Create a strong password policy

**h**

**a**

**n**

**e**

• Use and enforce the use of Multi Factor Authentication (MFA)

**M**

**a**

**a**

• Create and use Roles for giving permissions to AWS services

**r**

**e**

**k**

**w**

• Use Access Keys for Programmatic Access (CLI / SDK)

**w**

**w**

**.**

**d**

• Audit permissions of your account with the IAM Credentials Report

**a**

**t**

**a**

**c**

**u**

• Never share IAM users & Access Keys

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

Shared Responsibility Model for IAM

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**O**

**R**

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**I**

**S**

**T**

**R**

**I**

**B**

**U**

You

**T**

**I**

**O**

**N**

**©**

• Infrastructure (global network security)

• Configuration and vulnerability analysis

• Compliance validation

• Users, Groups, Roles, Policies

**S**

**t**

**e**

management and monitoring

**p**

**h**

**a**

• Enable MFA on all accounts

**n**

**e**

**M**

• Rotate all your keys often

**a**

**a**

**r**

**e**

• Use IAM tools to apply

**k**

**w**

appropriate permissions

**w**

**w**

• Analyze access patterns &

**.**

**d**

**a**

review permissions

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

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© Stephane Maarek

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**O**

IAM Section – Summary 

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**R**

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**I**

**S**

**T**

**R**

• Users: mapped to a physical user, has a password for AWS Console

**I**

**B**

**U**

**T**

• Groups: contains users only

**I**

**O**

**N**

**©**

• Policies: JSON document that outlines permissions for users or groups

**S**

**t**

**e**

**p**

• Roles: for EC2 instances or AWS services

**h**

**a**

**n**

**e**

• Security: MFA + Password Policy

**M**

**a**

**a**

• Access Keys: access AWS using the CLI or SDK

**r**

**e**

**k**

**w**

• Audit: IAM Credential Reports & IAM Access Advisor

**w**

**w**

**.**

**d**

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**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

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**c**

**o**

**m**

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EC2 Section

**N**

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**O**

**R**

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**I**

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**R**

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**B**

**U**

**T**

**I**

**O**

**N**

**©**

**S**

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**e**

**p**

**h**

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**M**

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© Stephane Maarek

**N**

**O**

Amazon EC2 

**T**

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**R**

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**I**

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**R**

• EC2 is one of the most popular of AWS’ offering

**I**

**B**

**U**

**T**

• EC2 = Elastic Compute Cloud = Infrastructure as a Service

**I**

**O**

**N**

**©**

• It mainly consists in the capability of :

**S**

**t**

**e**

• Renting virtual machines (EC2)

**p**

**h**

**a**

• Storing data on virtual drives (EBS)

**n**

**e**

**M**

• Distributing load across machines (ELB)

**a**

**a**

**r**

• Scaling the services using an auto-scaling group (ASG)

**e**

**k**

**w**

**w**

**w**

**.**

**d**

• Knowing EC2 is fundamental to understand how the Cloud works

**a**

**t**

**a**

**c**

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**N**

**O**

EC2 sizing & configuration options

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Operating System (OS): Linux or Windows

**I**

**B**

**U**

**T**

• How much compute power & cores (CPU)

**I**

**O**

**N**

**©**

• How much random-access memory (RAM)

**S**

**t**

**e**

**p**

• How much storage space:

**h**

**a**

**n**

• Network-attached (EBS & EFS)

**e**

**M**

**a**

• hardware (EC2 Instance Store)

**a**

**r**

**e**

**k**

• Network card: speed of the card, Public IP address

**w**

**w**

**w**

• Firewall rules: security group

**.**

**d**

**a**

**t**

**a**

• Bootstrap script (configure at first launch): EC2 User Data

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

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EC2 instance types: example

Instance vCPU Mem (GiB) Storage Network Performance

t2.micro 1 1 EBS-Only Low to Moderate t2.xlarge 4 16 EBS-Only Moderate

EBS Bandwidth (Mbps)

**N**

**O**

**T**

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**R**

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**B**

**U**

**T**

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**N**

**©**

**S**

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**e**

**p**

**h**

**a**

**n**

**e**

c5d.4xlarge 16 32 1 x 400 NVMe SSD Up to 10 Gbps 4,750

**M**

**a**

r5.16xlarge 64 512 EBS Only 20 Gbps 13,600

**a**

**r**

**e**

**k**

m5.8xlarge 32 128 EBS Only 10 Gbps 6,800

**w**

**w**

**w**

**.**

**d**

**a**

**t2.micro is part of the AWS free tier (up to 750 hours per month)**

**t**

**a**

**c**

**u**

**m**

**u**

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**u**

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Hands-On:

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Launching an EC2 Instance running Linux

**R**

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**S**

**T**

**R**

**I**

**B**

**U**

**T**

• We’ll be launching our first virtual server using the AWS Console

**I**

**O**

**N**

**©**

• We’ll get a first high-level approach to the various parameters

**S**

**t**

**e**

**p**

• We’ll see that our web server is launched using EC2 user data

**h**

**a**

**n**

**e**

• We’ll learn how to start / stop / terminate our instance.

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

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**u**

**s**

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**c**

**o**

**m**

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**N**

**O**

Introduction to Security Groups

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Security Groups are the fundamental of network security in AWS

**I**

**B**

**U**

**T**

• They control how traffic is allowed into or out of our EC2 Instances.

**I**

**O**

**N**

**©**

**S**

**t**

Inbound traffic

**e**

**p**

y

**h**

**WWW**

Outbound traffic

t

p

EC2 Instance

i

**a**

r

u

**n**

u

o

**e**

r

c

**M**

e

G

S

**a**

**a**

**r**

**e**

**k**

**w**

• Security groups only contain rules

**w**

**w**

**.**

**d**

• Security groups rules can reference by IP or by security group

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

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Security Groups

**N**

**O**

**T**

**F**

**O**

Deeper Dive

**R**

**D**

**I**

**S**

**T**

**R**

• Security groups are acting as a “firewall” on EC2 instances

**I**

**B**

**U**

**T**

• They regulate:

**I**

**O**

**N**

• Access to Ports

**©**

**S**

**t**

• Authorised IP ranges – IPv4 and IPv6

**e**

**p**

**h**

• Control of inbound network (from other to the instance)

**a**

**n**

**e**

• Control of outbound network (from the instance to other)

**M**

**a**

**a**

**r**

**e**

**k**



**w**

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

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Security Groups

Diagram

Security Group 1 Port 22

Inbound

Your Computer - IP XX.XX.XX.XX (authorised port 22)

Other computer

**N**

**O**

**T**

**FO**

**R**

**D**

**IS**

**TR**

**IB**

**U**

**T**

**IO**

**N**

**©**

**S**

EC2 Instance IP XX.XX.XX.XX

Filter IP / Port with Rules

Security Group 1

Outbound

Filter IP / Port with Rules

Port 22

Any Port

(not authorised port 22)

WWW

Any IP – Any Port

**t**

**e**

**p**

**h**

**a**

**n**

**e**

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

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**c**

**o**

**m**

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**N**

**O**

Classic Ports to know

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• 22 = SSH (Secure Shell) - log into a Linux instance

**I**

**B**

**U**

**T**

• 21 = FTP (File Transport Protocol) – upload files into a file share

**I**

**O**

**N**

**©**

• 22 = SFTP (Secure File Transport Protocol) – upload files using SSH

**S**

**t**

**e**

**p**

• 80 = HTTP – access unsecured websites

**h**

**a**

**n**

**e**

• 443 = HTTPS – access secured websites

**M**

**a**

**a**

• 3389 = RDP (Remote Desktop Protocol) – log into a Windows instance

**r**

**e**

**k**

**w**

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

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**N**

**O**

SSH Summary Table

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

SSH Putty EC2 Instance

**R**

**I**

**B**

Connect

**U**

**T**

**I**

**O**

**N**



**©**

Mac

**S**

**t**

**e**

**p**

**h**

**a**

**n**

Linux

**e**

**M**

**a**

**a**

**r**

**e**

**k**

**w**

Windows < 10

**w**

**w**

**.**

**d**

**a**

**t**

**a**

Windows >= 10

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

Which Lectures to watch

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Mac / Linux:

**I**

**B**

**U**

**T**

• SSH on Mac/Linux lecture

**I**

**O**

**N**

**©**

**S**

• Windows:

**t**

**e**

**p**

**h**

• Putty Lecture

**a**

**n**

**e**

• If Windows 10: SSH on Windows 10 lecture

**M**

**a**

**a**

**r**

**e**

**k**

**w**

• All:

**w**

**w**

• EC2 Instance Connect lecture

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

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**N**

**O**

SSH troubleshooting

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Students have the most problems with SSH

**I**

**B**

**U**

**T**

**I**

**O**

**N**

**©**

• If things don’t work…

**S**

**t**

**e**

1. Re-watch the lecture. You may have missed something

**p**

**h**

**a**

2. Read the troubleshooting guide

**n**

**e**

**M**

3. Try EC2 Instance Connect

**a**

**a**

**r**

**e**

**k**

**w**

• If one method works (SSH, Putty or EC2 Instance Connect) you’re good

**w**

**w**

**.**

**d**

• If no method works, that’s okay, the course won’t use SSH much

**a**

**t**

**a**

**c**

**u**

**m**

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**u**

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**m**

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How to SSH into your EC2 Instance

**N**

**O**

**T**

**F**

**O**

Linux / Mac OS X

**R**

**D**

**I**

**S**

**T**

**R**

• We’ll learn how to SSH into your EC2 instance using Linux / Mac

**I**

**B**

**U**

**T**

• SSH is one of the most important function. It allows you to control a

**I**

**O**

**N**

remote machine, all using the command line.

**©**

**S**

**t**

**e**

**p**

**h**

S

**a**

S

**n**

****WWW

H

–

Po

r

t

22

EC2 Instance Linux

Public IP

**e**

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

**w**

**.**

• We will see how we can configure OpenSSH ~/.ssh/config to facilitate

**d**

**a**

**t**

**a**

the SSH into our EC2 instances

**c**

**u**

**m**

**u**

**l**

**u**

**s**

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**c**

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**m**

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How to SSH into your EC2 Instance

**N**

**O**

**T**

**F**

**O**

Windows

**R**

**D**

**I**

**S**

**T**

**R**

• We’ll learn how to SSH into your EC2 instance using Windows

**I**

**B**

**U**

**T**

• SSH is one of the most important function. It allows you to control a

**I**

**O**

**N**

remote machine, all using the command line.

**©**

**S**

**t**

**e**

**p**

**h**

**a**

S

**n**

S

**e**

****WWW

H

–

Po

r

t

22

EC2 Instance Linux

Public IP

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

**w**

**.**

• We will configure all the required parameters necessary for doing SSH

**d**

**a**

**t**

**a**

on Windows using the free tool Putty.

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

EC2 Instance Connect

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Connect to your EC2 instance within your browser

**I**

**B**

**U**

**T**

• No need to use your key file that was downloaded

**I**

**O**

**N**

**©**

• The “magic” is that a temporary key is uploaded onto EC2 by AWS

**S**

**t**

**e**

**p**

**h**

**a**

**n**

**e**

• Works only out-of-the-box with Amazon Linux 2

**M**

**a**

**a**

**r**

**e**

**k**

**w**

• Need to make sure the port 22 is still opened!

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

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**m**

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**u**

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© Stephane Maarek

**N**

**O**

EC2 Instances Purchasing Options

**T**

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**D**

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**T**

**R**

• On-Demand Instances: short workload, predictable pricing

**I**

**B**

**U**

**T**

• Reserved: (MINIMUM 1 year)

**I**

**O**

**N**

• Reserved Instances: long workloads

**©**

**S**

**t**

• Convertible Reserved Instances: long workloads with flexible instances

**e**

**p**

**h**

• Scheduled Reserved Instances: example – every Thursday between 3 and 6 pm

**a**

**n**

**e**

**M**

• Spot Instances: short workloads, cheap, can lose instances (less reliable)

**a**

**a**

**r**

**e**

• Dedicated Hosts: book an entire physical server, control instance placement

**k**

**w**

**w**

• Dedicated Instances: no other customers will share your hardware

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

EC2 On Demand

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Pay for what you use:

**I**

**B**

**U**

**T**

• Linux - billing per second, after the first minute

**I**

**O**

**N**

• All other operating systems (ex: Windows) - billing per hour

**©**

**S**

• Has the highest cost but no upfront payment

**t**

**e**

**p**

**h**

**a**

• No long-term commitment

**n**

**e**

**M**

**a**

**a**

**r**

**e**

• Recommended for short-term and un-interrupted workloads, where

**k**

**w**

you can't predict how the application will behave

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

EC2 Reserved Instances

**T**

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**R**

**D**

**I**

**S**

**T**

• Up to 72% discount compared to On-demand

**R**

**I**

**B**

**U**

• Reservation period: 1 year = + discount | 3 years = +++ discount

**T**

**I**

**O**

• Purchasing options: no upfront | partial upfront = + | All upfront = ++ discount

**N**

**©**

• Reserve a specific instance type

**S**

**t**

• Recommended for steady-state usage applications (think database)

**e**

**p**

**h**

**a**

**n**

**e**

• Convertible Reserved Instance

**M**

**a**

• can change the EC2 instance type

**a**

**r**

**e**

• Up to 45% discount

**k**

**w**

• Scheduled Reserved Instances

**w**

**w**

• launch within time window you reserve

**.**

**d**

• When you require a fraction of day / week / month

**a**

**t**

**a**

• Commitment for 1 year only

**c**

**u**

**m**

**u**

**l**

**u**

**s**

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**c**

**o**

**m**

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**N**

**O**

EC2 Spot Instances 

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

• Can get a discount of up to 90% compared to On-demand

**R**

**I**

**B**

**U**

• Instances that you can “lose” at any point of time if your max price is less than the

**T**

**I**

current spot price

**O**

**N**

• The MOST cost-efficient instances in AWS

**©**

**S**

**t**

**e**

**p**

**h**

• Useful for workloads that are resilient to failure

**a**

**n**

**e**

• Batch jobs

**M**

• Data analysis

**a**

**a**

**r**

• Image processing

**e**

**k**

• Any distributed workloads

**w**

**w**

• Workloads with a flexible start and end time

**w**

**.**

**d**

**a**

**t**

• Not suitable for critical jobs or databases

**a**

**c**

**u**

**m**

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**l**

**u**

**s**

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**c**

**o**

**m**

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**N**

**O**

EC2 Dedicated Hosts

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

• An Amazon EC2 Dedicated Host is a physical server with EC2 instance

**R**

**I**

**B**

capacity fully dedicated to your use. Dedicated Hosts can help you

**U**

**T**

**I**

**O**

address compliance requirements and reduce costs by allowing you to use your existing server-bound software licenses.

**N**

**©**

**S**

**t**

**e**

• Allocated for your account for a 3-year period reservation

**p**

**h**

**a**

**n**

• More expensive

**e**

**M**

**a**

**a**

**r**

**e**

**k**

• Useful for software that have complicated licensing model (BYOL – Bring Your Own License)

**w**

**w**

**w**

**.**

**d**

**a**

• Or for companies that have strong regulatory or compliance needs

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

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**c**

**o**

**m**

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**N**

**O**

EC2 Dedicated Instances

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

• Instances running on

**I**

**B**

**U**

hardware that’s dedicated to

**T**

**I**

**O**

you

**N**

**©**

**S**

• May share hardware with

**t**

**e**

**p**

**h**

other instances in same

**a**

**n**

**e**

account

**M**

**a**

**a**

• No control over instance

**r**

**e**

**k**

placement (can move

**w**

**w**

**w**

hardware after Stop / Start)

**.**

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

**.**

**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

Which purchasing option is right for me?

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

• On demand: coming and staying in resort

**R**

**I**

**B**

whenever we like, we pay the full price

**U**

**T**

**I**

**O**

• Reserved: like planning ahead and if we plan to 

**N**

**©**

stay for a long time, we may get a good

**S**

**t**

**e**

discount.

**p**

**h**

**a**

**n**

• Spot instances: the hotel allows people to bid

**e**

**M**

for the empty rooms and the highest bidder

**a**

**a**

**r**

keeps the rooms. You can get kicked out at any

**e**

**k**

time

**w**

**w**

**w**

• Dedicated Hosts: We book an entire building

**.**

**d**

**a**

**t**

of the resort

**a**

**c**

**u**

**m**

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**s**

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**c**

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**m**

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Price Comparison

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**T**

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**O**

Example – m4.large – us-east-1

**R**

**D**

**I**

**S**

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**R**

**Price Type Price (per hour)**

**I**

**B**

**U**

On-demand $0.10

**T**

**I**

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Spot Instance (Spot Price) $0.032 - $0.045 (up to 90% off)

**©**

Spot Block (1 to 6 hours) ~ Spot Price

**S**

**t**

**e**

**p**

Reserved Instance (12 months) – no upfront $0.062

**h**

**a**

**n**

Reserved Instance (12 months) – all upfront $0.058

**e**

**M**

Reserved Instance (36 months) – no upfront $0.043

**a**

**a**

**r**

Reserved **Convertible** Instance (12 months) – no upfront $0.071

**e**

**k**

**w**

Reserved **Scheduled** Instance (recurring schedule on 12 months term) $0.090 – $0.095 (5%-10% off) **w**

**w**

Dedicated Host On-demand price

**.**

**d**

**a**

**t**

Dedicated Host Reservation Up to 70% off

**a**

**c**

**u**

**m**

**u**

**l**

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**c**

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**O**

Shared Responsibility Model for EC2

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**F**

**O**

**R**

**D**

**I**

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**T**

**R**

**I**

**B**

**U**

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**I**

**O**

**N**

**©**

• Security Groups rules

**S**

• Infrastructure (global

**t**

**e**

**p**

network security)

• Isolation on physical hosts • Replacing faulty hardware • Compliance validation

• Operating-system patches and updates

**h**

**a**

**n**

**e**

**M**

• Software and utilities installed

**a**

**a**

on the EC2 instance

**r**

**e**

**k**

**w**

• IAM Roles assigned to EC2 &

**w**

IAM user access management

**w**

**.**

**d**

**a**

• Data security on your instance

**t**

**a**

**c**

**u**

**m**

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© Stephane Maarek

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**O**

EC2 Section – Summary 

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**I**

**S**

**T**

**R**

• EC2 Instance: AMI (OS) + Instance Size (CPU + RAM) + Storage +

**I**

**B**

**U**

security groups + EC2 User Data

**T**

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• Security Groups: Firewall attached to the EC2 instance

**©**

**S**

**t**

• EC2 User Data: Script launched at the first start of an instance

**e**

**p**

**h**

**a**

**n**

• SSH: start a terminal into our EC2 Instances (port 22)

**e**

**M**

**a**

• EC2 Instance Role: link to IAM roles

**a**

**r**

**e**

**k**

• Purchasing Options: On-Demand, Spot, Reserved (Standard +

**w**

**w**

**w**

Convertible + Scheduled), Dedicated Host, Dedicated Instance

**.**

**d**

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**a**

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**c**

**o**

**m**

© Stephane Maarek

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**R**

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**R**

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**©**

**S**

**t**

**e**

**p**

**h**

**a**

**n**

**e**

EC2 Instance Storage Section

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

**w**

**.**

**d**

**a**

**t**

**a**

**c**

**u**

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© Stephane Maarek

**N**

**O**

What’s an EBS Volume? 

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**R**

**D**

**I**

**S**

**T**

**R**

• An EBS (Elastic Block Store) Volume is a network drive you can attach

**I**

**B**

**U**

to your instances while they run

**T**

**I**

**O**

**N**

• It allows your instances to persist data, even after their termination

**©**

**S**

**t**

• They can only be mounted to one instance at a time (at the CCP level)

**e**

**p**

**h**

**a**

**n**

• They are bound to a specific availability zone

**e**

**M**

**a**

**a**

**r**

**e**

**k**

• Analogy: Think of them as a “network USB stick”

**w**

**w**

**w**

**.**

• Free tier: 30 GB of free EBS storage of type gp2 per month

**d**

**a**

**t**

**a**

**c**

**u**

**m**

**u**

**l**

**u**

**s**

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**c**

**o**

**m**

© Stephane Maarek

**N**

**O**

EBS Volume

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

• It’s a network drive (i.e. not a physical drive)

**R**

**I**

**B**

**U**

• It uses the network to communicate the instance, which means there might be a bit of

**T**

**I**

**O**

latency

**N**

• It can be detached from an EC2 instance and attached to another one quickly

**©**

**S**

**t**

**e**

**p**

**h**

• It’s locked to an Availability Zone (AZ)

**a**

**n**

**e**

• An EBS Volume in us-east-1a cannot be attached to us-east-1b

**M**

**a**

• To move a volume across, you first need to snapshot it

**a**

**r**

**e**

**k**

**w**

**w**

• Have a provisioned capacity (size in GBs, and IOPS)

**w**

**.**

**d**

• You get billed for all the provisioned capacity

**a**

**t**

**a**

**c**

• You can increase the capacity of the drive over time

**u**

**m**

**u**

**l**

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**s**

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**c**

**o**

**m**

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**N**

**O**

EBS Volume - Example

**T**

**F**

**O**

**R**

**D**

**I**

**S**

**T**

**R**

**I**

**B**

**US-EAST-1A US-EAST-1B**

**U**

**T**

**I**

**O**

**N**

**©**



**S**

**t**

**e**

**p**

**h**

**a**

**n**

**e**

**M**

**a**

**a**

**r**

**e**

**k**

**w**

**w**

EBS

(10 GB)

EBS

(100 GB)

EBS

(50 GB)

EBS

(50 GB)

EBS

(10 GB)

unattached

**w**

**.**

**d**

**a**

**ta**

**c**

**u**

**m**

**u**

**lu**

**s**

**.**

**c**

**o**

**m**

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