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# AWS Solutions Architect

IAM, EC2, EBS

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Fibo Cloud

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# ICT Guest
# @ICT2024#

# Conclusion

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- Cloud computing - Tech + Business
- How do you compute, Not where
- Iceberg - Cloud Native
- Productivity, Agility, Cost
- X as a service
- Private, Public, Hybrid
- Shared responsibility model
- Region, Availability Zone, Edge locations
- AWS access
    - Web Console GUI
    - CLI
    - SDK

# How to choose an AWS Region?

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- **Compliance with data governance and legal requirements:** data never leaves a region without your explicit permission
- **Proximity to customers:** reduced latency
- **Available services within a Region:** new services and new features aren't available in every Region
- **Pricing:** pricing varies region to region and is transparent in the service pricing page

# Services Accross Regions

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- **AWS has Global Services:**
  - Identity and Access Management (IAM)
  - Route 53 (DNS service)
  - CloudFront (Content Delivery Network)
  - WAF (Web Application Firewall)
- **Most AWS services are Region-scoped:**
  - Amazon EC2 (Infrastructure as a Service)
  - Elastic Beanstalk (Platform as a Service)
  - Lambda (Function as a Service)
  - Rekognition (Software as a Service)
- **Region Table:**
  - https://aws.amazon.com/about-aws/global-infrastructure/regional-product-services

# Interesting

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https://www.concurrencylabs.com/blog/choose-your-aws-region-wisely/

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# AWS Support

# AWS Support

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1:1 support 24/7 from experience technicians

- Technical help, recommendation
- Request limitation
- Billing or Account issue

Basic, Developer, Business & Enterprise

https://aws.amazon.com/premiumsupport/plans/

# AWS Support Plans

| Basic | Developer | Business | Enterprise |
| --- | --- | --- | --- |
| Email Support only For **Billing and Account** | Tech Support via **Email** ~24 hours until reply | | |
| | **No** third party support | Tech Support via **Chat, Phone** Anytime 24/7 | |
| | General Guidance < 24 hrs | | |
| | System Impaired < 12 hrs | | |
| | | Production System Impaired < 4 hrs | |
| | | Production System **DOWN!** < 1 hrs | |
| | | | Business-Critical System **DOWN!** < 15m |
| | | | 😎 Personal Concierge |
| | | | 🤓 TAM |
| **7** Trusted Advisor Checks | | **All** Trusted Advisor Checks | |
| **$0 USD** /month | **$20 USD** /month | **$100 USD** / month | **$15,000 USD** / month |

## Developer

Minimum spend of $29.00

**- or -**

3% of monthly AWS charges

Charges will be at least the minimum charge of $29.00 or the result of the calculation, whichever is higher

## Business

Minimum spend of $100.00

**- or -**

10% of monthly AWS charges for the first $0--$10K

7% of monthly AWS charges from $10K--$80K

5% of monthly AWS charges from $80K--$250K

3% of monthly AWS charges over $250K

Charges will be at least the minimum charge of $100.00 or the result of the calculation, whichever is higher

*AWS Countdown Premium available for an additional fee.

## Enterprise On-Ramp

Minimum spend of $5,500.00

**- or -**

10% of monthly AWS charges

Charges will be at least the minimum charge of $5,500.00 or the result of the calculation, whichever is higher

*AWS Countdown Premium available for an additional fee.

*AWS re:Post Private available for an additional fee.

## Enterprise

Minimum spend of $15,000.00

**- or -**

10% of monthly AWS charges for the first $0--$150K

7% of monthly AWS charges from $150K--$500K

5% of monthly AWS charges from $500K--$1M

3% of monthly AWS charges over $1M

Charges will be at least the minimum charge of $15,000.00 or the result of the calculation, whichever is higher.

*AWS Incident Detection and Response available for an additional fee.

*AWS Countdown Premium available for an additional fee.

*AWS re:Post Private available for an additional fee.

# AWS Support

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AWS Partner network - https://aws.amazon.com/partners/

Forum - https://forums.aws.amazon.com/index.jspa?cu-additional-resource%2F=

FAQ

Community

Re:post - https://repost.aws/

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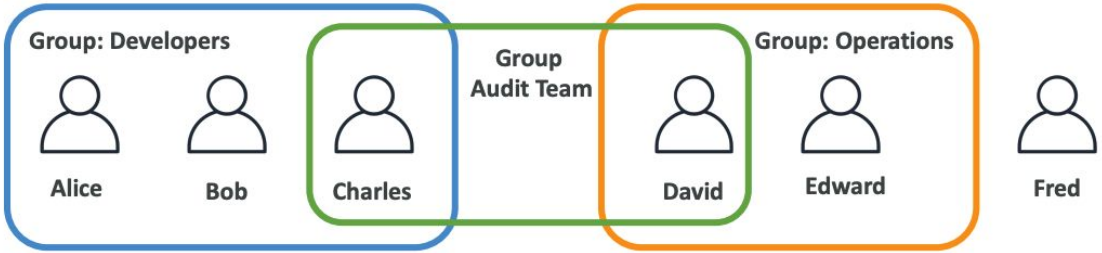
# Identity Access Management

# IAM: Users & Groups

- IAM = Identity and Access Management, **Global** service
- **Root account** created by default, shouldn't be used or shared
- **Users** are people within your organization, and can be grouped
- **Groups** only contain users, not other groups
- Users don't have to belong to a group, and user can belong to multiple groups




# RBAC

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WHO, WHERE, WHAT

## 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

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "ec2:Describe*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": "elasticloadbalancing:Describe*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "cloudwatch:ListMetrics",
                "cloudwatch:GetMetricStatistics",
                "cloudwatch:Describe*"
            ],
            "Resource": "*"
        }
    ]
}
```

# Relation

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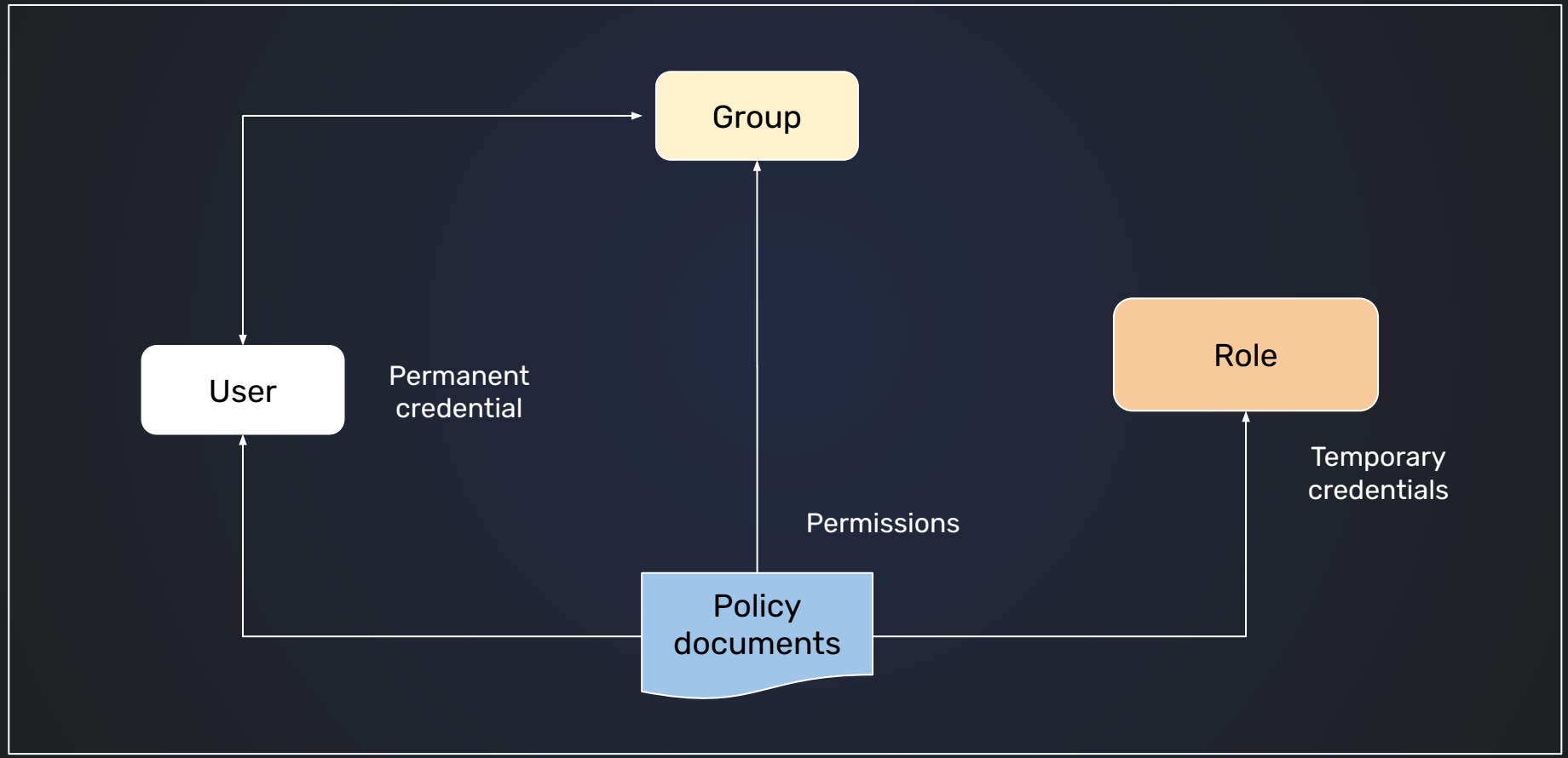
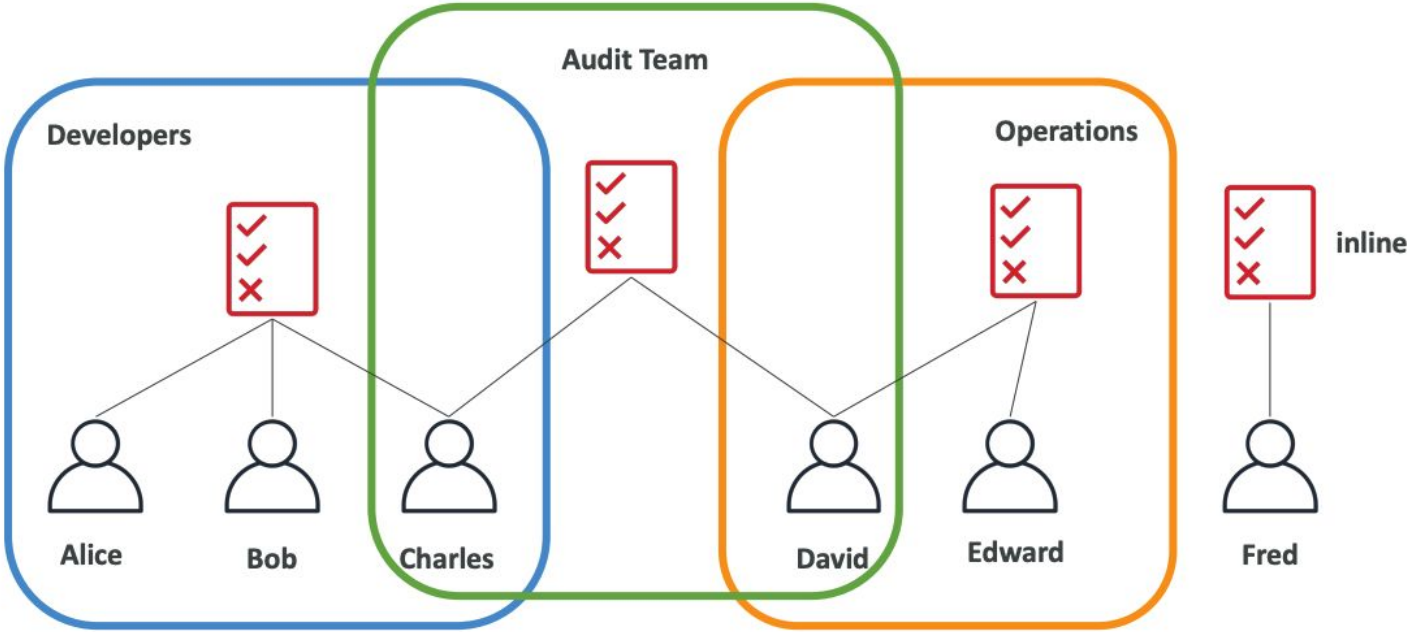


# IAM Policies inheritance



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# IAM – Password Policy

- Strong passwords = higher security for your account
- In AWS, you can setup a password policy:
  - Set a minimum password length
  - Require specific character types:
    - including uppercase letters
    - lowercase letters
    - numbers
    - non-alphanumeric characters
  - Allow all IAM users to change their own passwords
  - Require users to change their password after some time (password expiration)
  - Prevent password re-use

# Multi Factor Authentication - MFA


- Users have access to your account and can possibly change configurations or delete resources in your AWS account
- You want to protect your Root Accounts and IAM users
- MFA = password *you know* + security device *you own*


- Main benefit of MFA:
  if a password is stolen or hacked, the account is not compromised

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# MFA devices options in AWS

## Virtual MFA device


**Google Authenticator**
(phone only)


**Authy**
(multi-device)

Support for multiple tokens on a single device.

## Universal 2nd Factor (U2F) Security Key

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

Support for multiple root and IAM users using a single security key

# How can users access AWS ?

- To access AWS, you have three options:
  - **AWS Management Console** (protected by password + MFA)
  - **AWS Command Line Interface (CLI):** protected by access keys
  - **AWS Software Developer Kit (SDK)** - for code: protected by access keys
- Access Keys are generated through the AWS Console
- Users manage their own access keys
- Access Keys are secret, just like a password. Don't share them
- Access Key ID ~= username
- Secret Access Key ~= password

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A tool that enables you to interact with AWS services using commands in your command-line shell

Direct access to the public APIs of AWS services

ACCESS KEY DEMO

```
➜  ~ aws s3 cp myfile.txt s3://ccp-mybucket/myfile.txt
upload: ./myfile.txt to s3://ccp-mybucket/myfile.txt
➜  ~ aws s3 ls s3://ccp-mybucket
2021-05-14 03:22:52          0 myfile.txt
➜  ~
```

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# IAM Security Tools

- IAM Credentials Report (account-level)
  - a report that lists all your account's users and the status of their various credentials

- IAM Access Advisor (user-level)
  - Access advisor shows the service permissions granted to a user and when those services were last accessed.
  - You can use this information to revise your policies.

# IAM Guidelines & Best Practices

- Don't use the root account except for AWS account setup
- One physical user = One AWS **user**
- **Assign users to groups** and assign permissions to groups
- Create a **strong password policy**
- Use and enforce the use of **Multi Factor Authentication (MFA)**
- Create and use **Roles** for giving permissions to AWS services
- Use Access Keys for Programmatic Access (CLI / SDK)
- Audit permissions of your account using IAM Credentials Report & IAM Access Advisor
- Never share IAM users & Access Keys

# Homework 1

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**Account үүсгээд fiboadmin - user үүсгээд над руу явуулаарай.**

**IAM, User, Group**

1. admin, user1, user2, user3 гэсэн **4 IAM User** үүсгэнэ
2. S3-Support, EC2-Support, EC2-Admin гэсэн **3 User group** үүсгэнэ.
3. admin хэрэглэгчид Administrator permission policy өгнө.
4. User Group тус бүрт дараах эрхүүдийг өгнө:
   a. *S3-Support -> AmazonS3ReadOnlyAccess*
   b. *EC2-Support -> AmazonEC2ReadOnlyAccess*
   c. *EC2-Admin -> Шинэ custom policy үүсгэж дараах эрхийг олгоно.*
      *https://gist.github.com/Ganjiguur/7d5c95448ba21abb88ca6c3d76bf82bb*
5. Үүсгэсэн хэрэглэгчдийг тус тусын групп лүү оруулна:

| User | In Group | Permissions |
|---|---|---|
| user-1 | S3-Support | Read-Only access to Amazon S3 |
| user-2 | EC2-Support | Read-Only access to Amazon EC2 |
| user-3 | EC2-Admin | View, Start and Stop Amazon EC2 instances |

# Homework 1

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6. Admin хэрэглэгчээр нэвтэрч S3 bucket болон EC2 micro хэмжээтэй сервер үүсгэнэ.
7. user1-ээр нэвтэрч ороод:
    a. S3 цэс рүү орж үзнэ. Үйлдэл хийнэ (Шинэ bucket үүсгэх г.м.)
    b. EC2 цэс рүү орж үзнэ. Үйлдэл хийнэ (Шинэ server үүсгэх г.м.)
8. user2-р нэвтэрч ороод:
    a. S3 цэс рүү орж үзнэ. Үйлдэл хийнэ (Шинэ bucket үүсгэх г.м.)
    b. EC2 цэс рүү орж үзнэ. Үйлдэл хийнэ (Шинэ server үүсгэх г.м.)
    c. Server унтраах гэж оролд
9. user3-р нэвтэрч ороод:
    a. S3 цэс рүү орж үзнэ. Үйлдэл хийнэ (Шинэ bucket үүсгэх г.м.)
    b. EC2 цэс рүү орж үзнэ. Үйлдэл хийнэ (Шинэ server үүсгэх г.м.)
    c. Server унтраах гэж оролд
10. Admin-аар ороод User group permission-г өөрчлөөд үз.
11. 6, 7, 8 дээр бичигдсэн үйлдлүүдийг давтаж хий.
12. Үүсгэсэн бүх resource-уудаа цэвэрлэх.
    a. Users
    b. User-groups
    c. S3 bucket
    d. EC2 server

# Homework 2

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**Create a billing alarm**

https://docs.aws.amazon.com/AmazonCloudWatch/latest/monitoring/monitor_estimated_charges_with_cloudwatch.html

# Usage tips

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- Use FAQ
- Keep access token
- CLI is better than all
- Don’t use root account
- Billing alarm must have

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# Compute

# Compute services


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**EC2**

Virtual server - CPU, Memory, OS

**LightSail**

Low price fixed servers

**Lambda**

Serverless functions

**Elastic Beanstalk**

Orchestrates various AWS services - PAAS

**ECS**

Docker as a Service

**Fargate**

Serverless container orchestrator

**AWS Batch**

planned, scheduled job

**AWS Outpost**

On-prem AWS services

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# EC2


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# Elastic Compute Cloud

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AWS клауд орчин дах виртуал сервер үүсгэх үйлчилгээ.
Өөрийн хэрэгцээ шаардлагад нийцсэн хэмжээ бүхий серверийг хоромын дотор үүсгэж, удирдах боломжтой байна.

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# Purchase types

# On-demand instances

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Least commitment


Default using On-Demand pricing
no up-front payment
no long-term commitment

charged **by the hour** or **by the minute**

Is for **short-term, test, expirement** or **unpredictable** workload

# Reserved instances (RI)

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Best Long-term

Designed for apps that have **steady-state**, **predictable usage**, or require **reserved capacity**

**Team , Class offering , Payment option**

1 year contract
3 year contract

Standard - Up to 75% discount
Convertible - Up to 54% discount
Scheduled - Reserve for specific time periods

All upfront, partial upfront or no upfront

RIs can be share between multiple accounts
Can be sold Reserved Instance Marketplace

# Savings plan

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| | EC2 Instance SP | Compute SP |
|---|---|---|
| **Savings over On-Demand** | ✅ **Relatively high** (Up to 72% off) | **Relatively low** (Up to 66% off) |
| **Instance family** | **Fixed** | ✅ **Flexible** |
| **Region** | **Fixed** | ✅ **Flexible** |
| **Platform, tenancy, instance size, AZ** | ***Not required*** | |
| **Applying to Lambda, Fargate** | **No** | ✅ **Yes** |
| **Modifying/Exchanging purchased instances** | ***No*** | |

# Spot instances

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Biggest savings

Buy unused compute capacity from AWS **90% discount**

Conditions
- Can be terminated by AWS at anytime
- If terminated by AWS, we don't get charged hourly
- If we terminate, we will still be charged hourly

Useful for workloads that are resilient to failure
- Batch jobs
- Data analysis
- Image processing
- Any distributed workloads
- Workloads with a flexible start and end time

# Dedicated host

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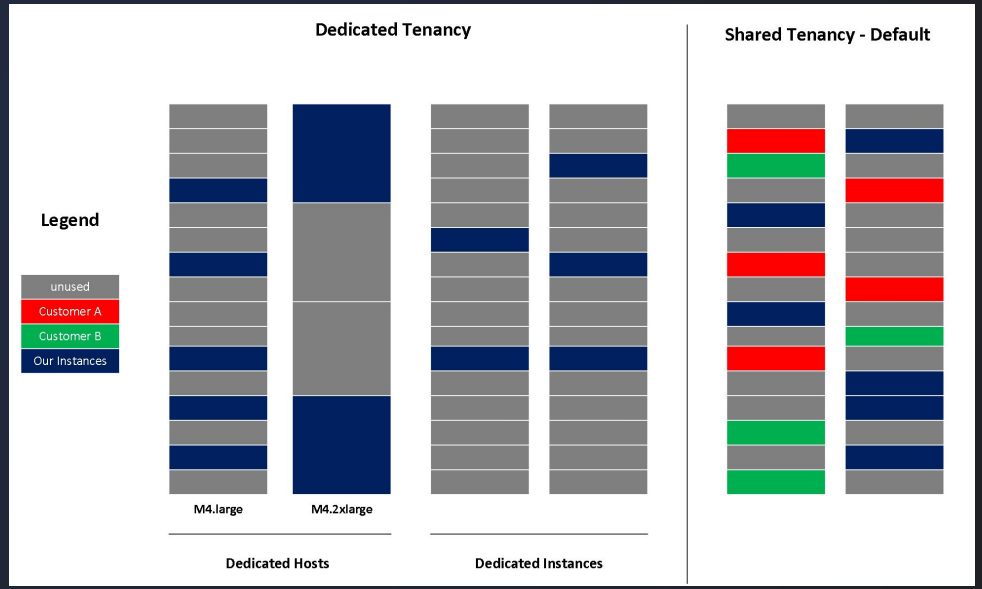
Most expensive

| Characteristic | Dedicated Instances | Dedicated Hosts |
|---|---|---|
| Enables the use of dedicated physical servers | X | X |
| Per instance billing (subject to a $2 per region fee) | X | |
| Per host billing | | X |
| Visibility of sockets, cores, host ID | | X |
| Affinity between a host and instance | | X |
| Targeted instance placement | | X |
| Automatic instance placement | X | X |
| Add capacity using an allocation request | | X |



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# AWS Marketplace

# AWS Marketplace

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AWS Marketplace is a curated digital catalogue with thousands of software listing from independent software vendors.

- free
- associated charge

# Security Groups

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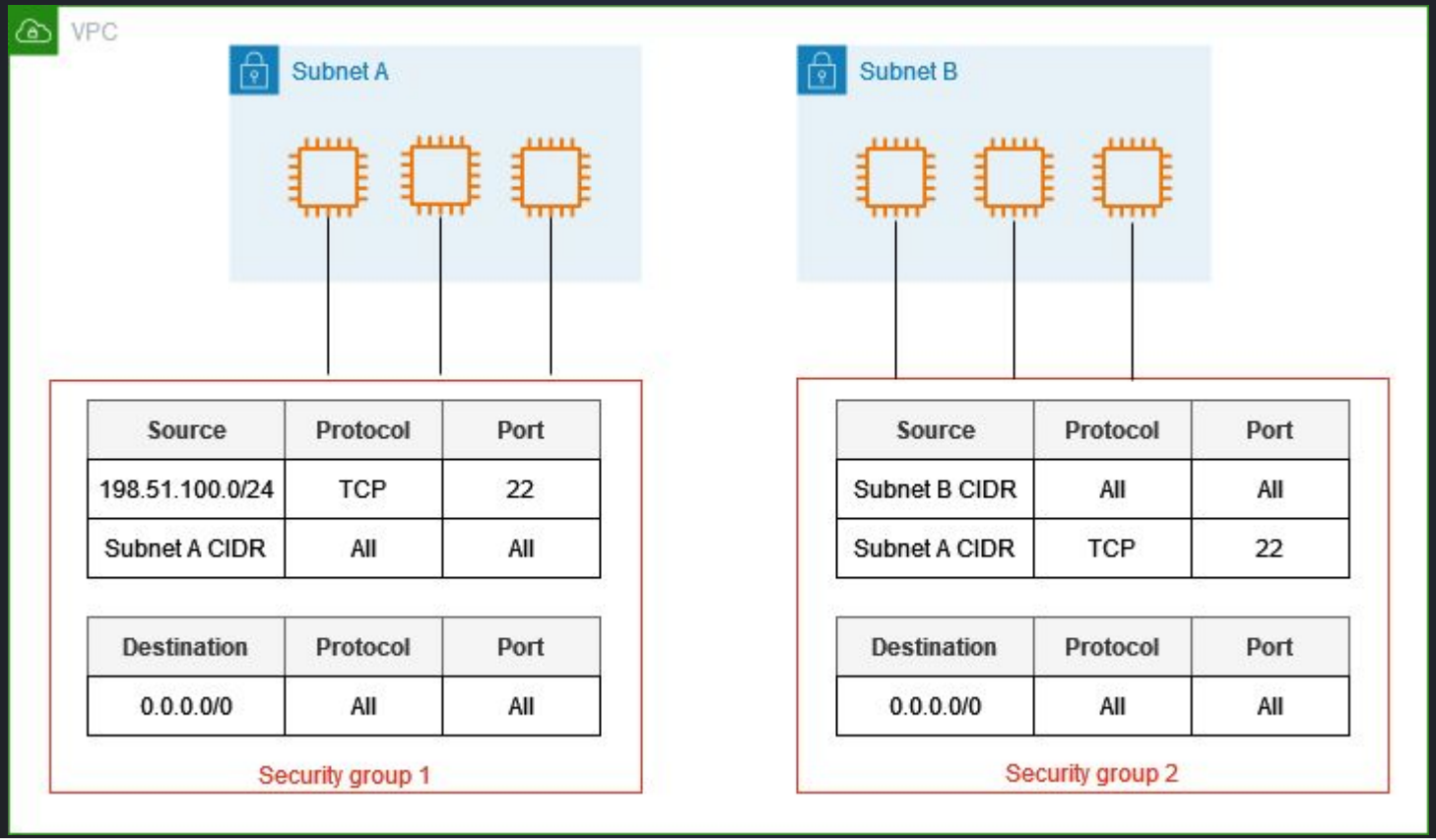

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# Instance types

# Instance types

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| | Type | Description | Mnemonic |
|---|---|---|---|
| General Purpose | a1 | Good for scale-out workloads, supported by Arm | **a** is for Arm processor – or as light as **A1** steak sauce |
| | t-family: t3, t3a, t2 | Burstable, good for changing workloads | **t** is for **tiny** or **turbo** |
| | m-family: m6g, m5, m5a, m5n, m4 | Balanced, good for consistent workloads | **m** is for **main** or happy **medium** |
| Compute Optimized | c-family: c5, c5n, c4 | High ratio of compute to memory | **c** is for **compute** |
| Memory Optimized | r-family: r5, r5a, r5n, r4 | Good for in-memory databases | **r** is for **RAM** |
| | x1-family: x1e, x1 | Good for full in-memory applications | **x** is for **xtreme** |
| | High memory | Good for large in-memory databases | High memory is for... high memory. |
| | z1d | Both high compute and high memory | **z** is for **zippy** |
| Accelerated Computing | p-family: p3, p2 | Good for graphics processing and other GPU uses | **p** is for **pictures** |
| | Inf1 | Support machine learning inference applications | **Inf** is for **inference** |
| | g-family: g4, g3 | Accelerate machine learning inference and graphics-intensive workloads | **g** is for **graphics** |
| | f1 | Customizable hardware acceleration with field programmable gate arrays (FPGAs) | **f** is for **FPGA** or **feel** as in hardware |
| Storage Optimized | i-family: i3, i3en | SDD-backed, balance of compute and memory | **i** is for **IOPS** |
| | d2 | Highest disk ratio | **d** is for **dense** |
| | h1 | HDD-backed, balance of compute and memory | **H** is for **HDD** |

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# Private vs Public IP (IPv4)

- Networking has two sorts of IPs. IPv4 and IPv6:
  - IPv4: `1.160.10.240`
  - IPv6: `3ffe:1900:4545:3:200:f8ff:fe21:67cf`

- In this course, we will only be using IPv4.
- IPv4 is still the most common format used online.
- IPv6 is newer and solves problems for the Internet of Things (IoT).

- IPv4 allows for 3.7 billion different addresses in the public space
- IPv4: [0-255].[0-255].[0-255].[0-255].

# Elastic IPs

- When you stop and then start an EC2 instance, it can change its public IP.
- If you need to have a fixed public IP for your instance, you need an Elastic IP
- An Elastic IP is a public IPv4 IP you own as long as you don't delete it
- You can attach it to one instance at a time

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# EBS

# EBS

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EBS is replicated within its AZ
offer component failure, HA,
durability

General purpose (SSD)
Provisioned IOPS (SSD)
Throughput Optimised HDD
Cold Hard Disk drive
Magnetic

# EBS Volume

- It's a network drive (i.e. not a physical drive)
  - It uses the network to communicate the instance, which means there might be a bit of latency
  - It can be detached from an EC2 instance and attached to another one quickly
- It's locked to an Availability Zone (AZ)
  - An EBS Volume in us-east-1a cannot be attached to us-east-1b
  - To move a volume across, you first need to snapshot it
- Have a provisioned capacity (size in GBs, and IOPS)
  - You get billed for all the provisioned capacity
  - You can increase the capacity of the drive over time

# EBS Volume Types

- EBS Volumes come in 6 types
  - gp2 / gp3 (SSD): General purpose SSD volume that balances price and performance for a wide variety of workloads
  - io1 / io2 Block Express (SSD): Highest-performance SSD volume for mission-critical low-latency or high-throughput workloads
  - st1 (HDD): Low cost HDD volume designed for frequently accessed, throughput-intensive workloads
  - sc1 (HDD): Lowest cost HDD volume designed for less frequently accessed workloads
- EBS Volumes are characterized in Size | Throughput | IOPS (I/O Ops Per Sec)
- When in doubt always consult the AWS documentation – it's good!
- Only gp2/gp3 and io1/io2 Block Express can be used as boot volumes

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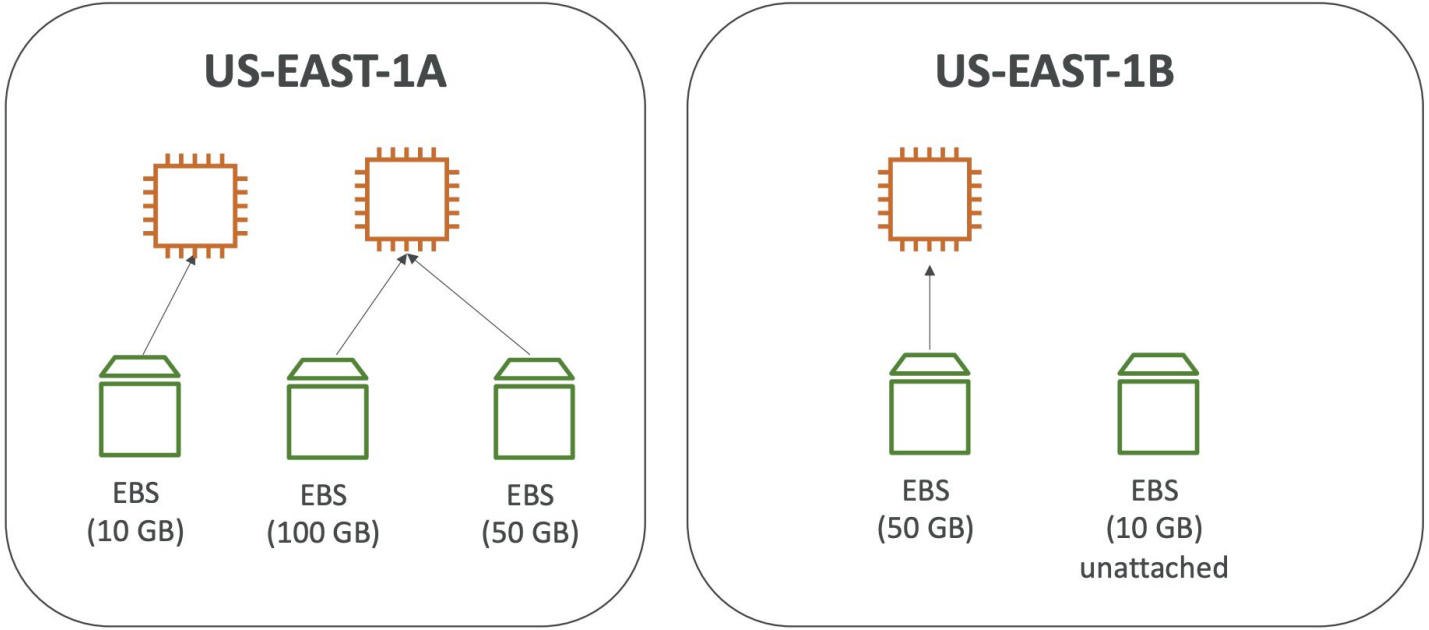
# EBS volume type limitations

https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ebs-volume-types.html

# EBS Volume - Example



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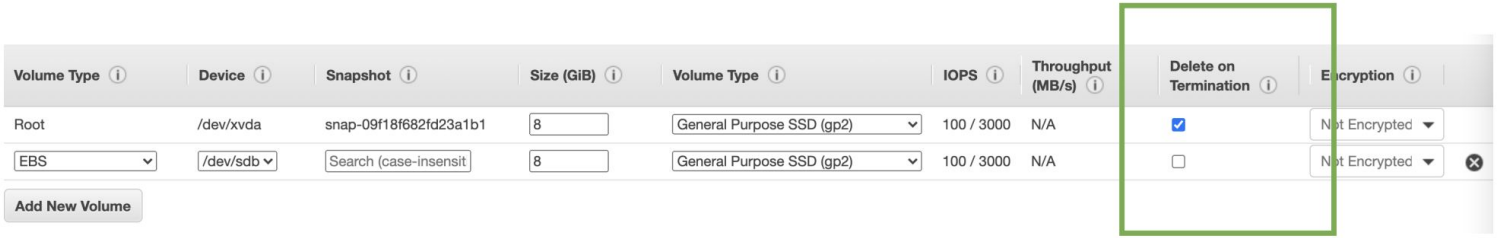
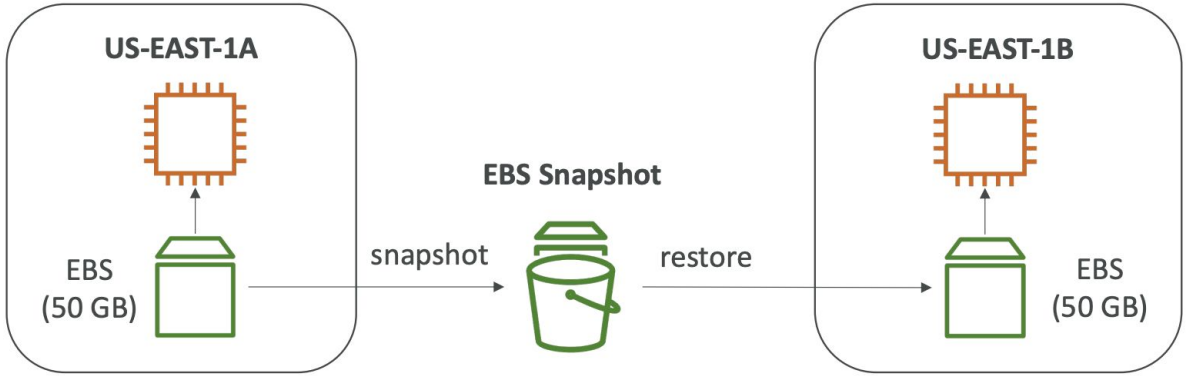
# EBS – Delete on Termination attribute




- Controls the EBS behaviour when an EC2 instance terminates
  - By default, the root EBS volume is deleted (attribute enabled)
  - By default, any other attached EBS volume is not deleted (attribute disabled)
- This can be controlled by the AWS console / AWS CLI
- Use case: preserve root volume when instance is terminated

# EBS Snapshots

- Make a backup (snapshot) of your EBS volume at a point in time
- Not necessary to detach volume to do snapshot, but recommended
- Can copy snapshots across AZ or Region

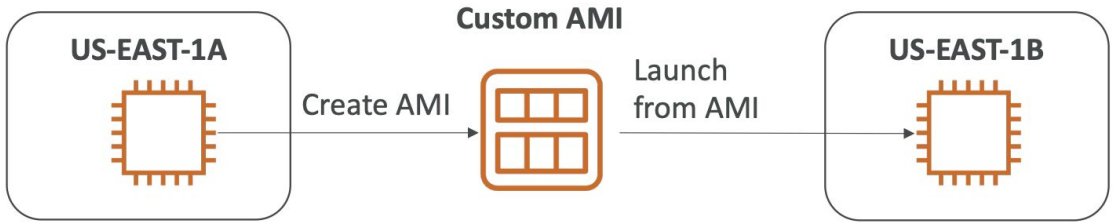


# AMI Overview

- AMI = Amazon Machine Image
- AMI are a **customization** of an EC2 instance
  - You add your own software, configuration, operating system, monitoring…
  - Faster boot / configuration time because all your software is pre-packaged
- AMI are built for a **specific region** (and can be copied across regions)
- You can launch EC2 instances from:
  - A Public AMI: AWS provided
  - Your own AMI: you make and maintain them yourself
  - An AWS Marketplace AMI: an AMI someone else made (and potentially sells)

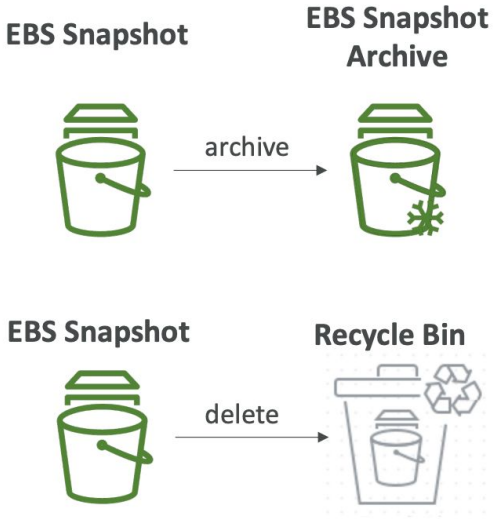
# AMI Process (from an EC2 instance)

- Start an EC2 instance and customize it
- Stop the instance (for data integrity)
- Build an AMI – this will also create EBS snapshots
- Launch instances from other AMIs



# EBS Snapshots Features

- EBS Snapshot Archive
  - Move a Snapshot to an "archive tier" that is 75% cheaper
  - Takes within 24 to 72 hours for restoring the archive
- Recycle Bin for EBS Snapshots
  - Setup rules to retain deleted snapshots so you can recover them after an accidental deletion
  - Specify retention (from 1 day to 1 year)
- Fast Snapshot Restore (FSR)
  - Force full initialization of snapshot to have no latency on the first use ($$$)



# EC2 hibernation

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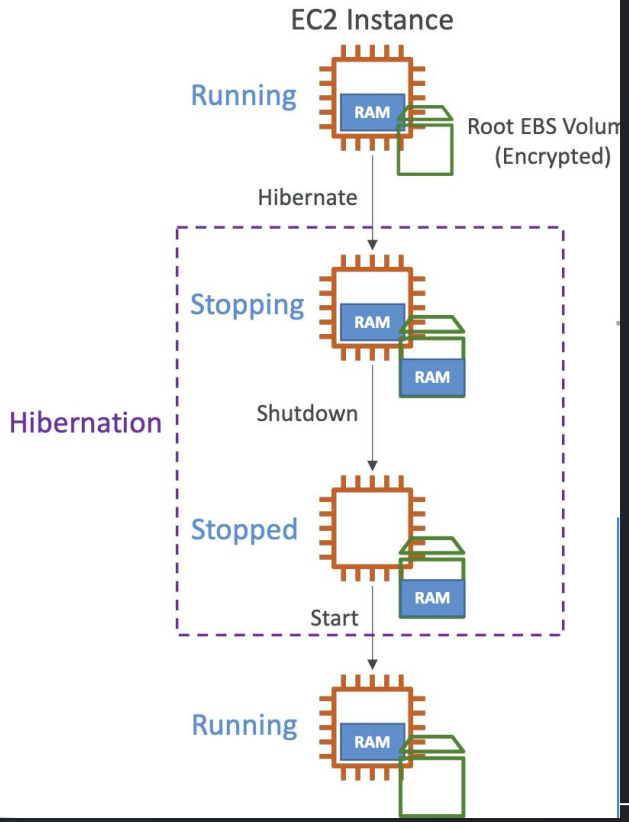
## EC2 Hibernate

- Introducing EC2 Hibernate:
  - The in-memory (RAM) state is preserved
  - The instance boot is much faster! (the OS is not stopped / restarted)
  - Under the hood: the RAM state is written to a file in the root EBS volume
  - The root EBS volume must be encrypted
- Use cases:
  - Long-running processing
  - Saving the RAM state
  - Services that take time to initialize



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# EC2 Hibernate – Good to know

- Supported Instance Families – C3, C4, C5, I3, M3, M4, R3, R4, T2, T3, …
- Instance RAM Size – must be less than 150 GB.
- Instance Size – not supported for bare metal instances.
- AMI – Amazon Linux 2, Linux AMI, Ubuntu, RHEL, CentOS & Windows…
- Root Volume – must be EBS, encrypted, not instance store, and large
- Available for On-Demand, Reserved and Spot Instances

- An instance can NOT be hibernated more than 60 days

# Userdata

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## Bootstrap scripts

```
#!/bin/bash
apt-get update -y
apt-get install -y apache2
echo "AWS course #2" > index.html
cp index.html /var/www/html
```

# Metadata

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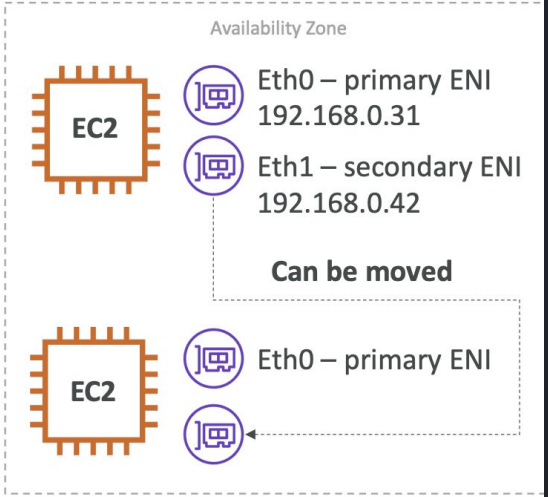
## Instance informations

http://169.254.169.254/latest

# Elastic Network Interfaces (ENI)

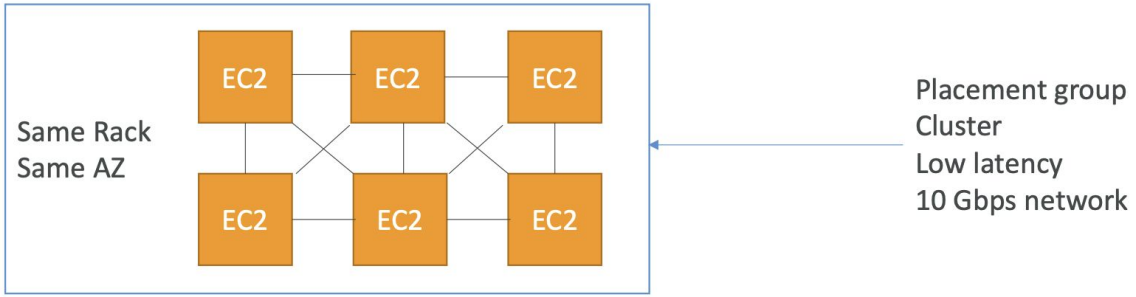
- Logical component in a VPC that represents a **virtual network card**
- The ENI can have the following attributes:
  - Primary private IPv4, one or more secondary IPv4
  - One Elastic IP (IPv4) per private IPv4
  - One Public IPv4
  - One or more security groups
  - A MAC address
- You can create ENI independently and attach them on the fly (move them) on EC2 instances for failover
- Bound to a specific availability zone (AZ)



# Placement Groups

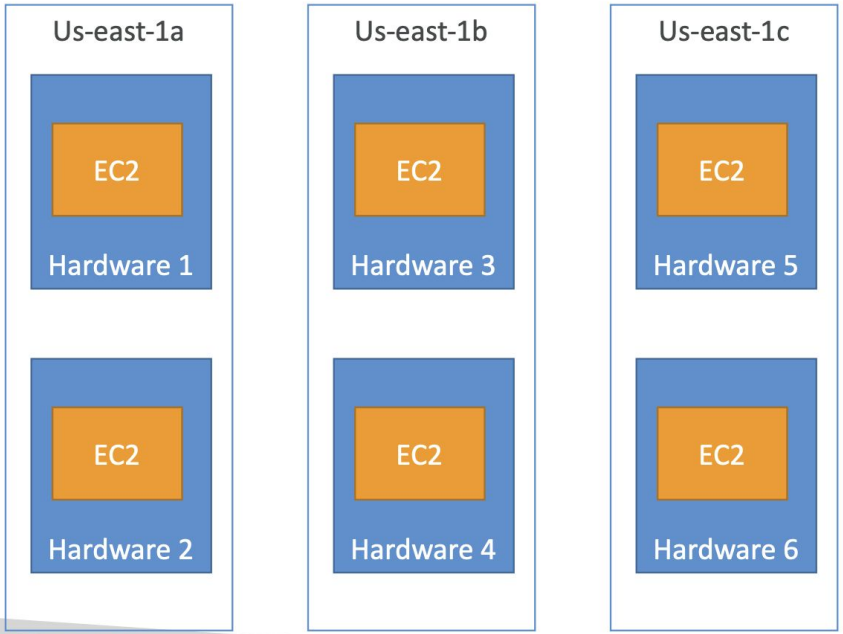
- Sometimes you want control over the EC2 Instance placement strategy
- That strategy can be defined using placement groups
- When you create a placement group, you specify one of the following strategies for the group:
  - *Cluster*—clusters instances into a low-latency group in a single Availability Zone
  - *Spread*—spreads instances across underlying hardware (max 7 instances per group per AZ)
  - *Partition*—spreads instances across many different partitions (which rely on different sets of racks) within an AZ. Scales to 100s of EC2 instances per group (Hadoop, Cassandra, Kafka)

# Placement Groups
# Cluster



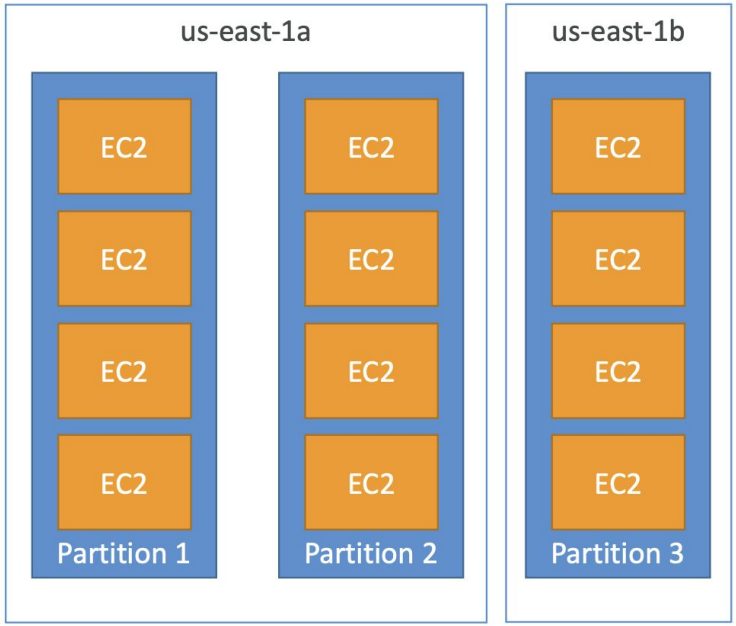

- Pros: Great network (10 Gbps bandwidth between instances with Enhanced Networking enabled - recommended)
- Cons: If the rack fails, all instances fails at the same time
- Use case:
  - Big Data job that needs to complete fast
  - Application that needs extremely low latency and high network throughput

# Placement Groups Spread




- Pros:
  - Can span across Availability Zones (AZ)
  - Reduced risk is simultaneous failure
  - EC2 Instances are on different physical hardware
- Cons:
  - Limited to 7 instances per AZ per placement group
- Use case:
  - Application that needs to maximize high availability
  - Critical Applications where each instance must be isolated from failure from each other

# Placements Groups Partition




- Up to 7 partitions per AZ
- Can span across multiple AZs in the same region
- Up to 100s of EC2 instances
- The instances in a partition do not share racks with the instances in the other partitions
- A partition failure can affect many EC2 but won't affect other partitions
- EC2 instances get access to the partition information as metadata
- Use cases: HDFS, HBase, Cassandra, Kafka

# Free tier

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

# Homework 3

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ДААЛГАВАР 1:

Fixed IP бүхий 2 сервер үүсгэнэ. (micro хэмжээтэй сервер үүсгээрэй)

1. Windows, Linux
2. Сервер лүүгээ файл хуулах эсрэг үйлдлийг бас хийх.
3. Тус бүрт нь 80-р порт дээр ямар нэг веб асаа
4. Үүсгэсэн серверээ өөр AZ, Region дээр clone-дож асаа

ДААЛГАВАР 2:

2 сервер дээрээ үүсгэсэн

- Hard дискний хэмжээг нэмэгдүүлэх (Систем дээрээ нэмэх)
- Шинэ Volume үүсгэж түүнийгээ систем дээрээ оруулж ирэх

БОНУС ДААЛГАВАР:

1. Үүсгэсэн линукс серверийн private key алга болгосон тохиолдолд EC2 серверийн хандалтаа хэрхэн эргүүлж олж авах вэ?

2.