# AWS Foundation

**INTRODUCTION TO EC2 , EBS , EFS & AMAZON FSX**

# Agenda

1. Introduction to EC2
2. Regions and Availability Zones
3. EC2 Instance Types
3. What is an AMI?
4. Introduction to EBS
5. Introduction to EFS
6. AWS FSx
7. Instance Tenancy and Reserved and Spot Instances
8. EC2 and EBS Pricing

# What is EC2 ?

# What is EC2 ?

**Amazon Elastic Compute Cloud (Amazon EC2**) is a computing capacity that is scalable in the Amazon Web Services (AWS) Cloud. Using Amazon EC2 eliminates the need to invest in hardware upfront, allowing you to develop and deploy applications more quickly.

# What is EC2 ?

## Features of EC2

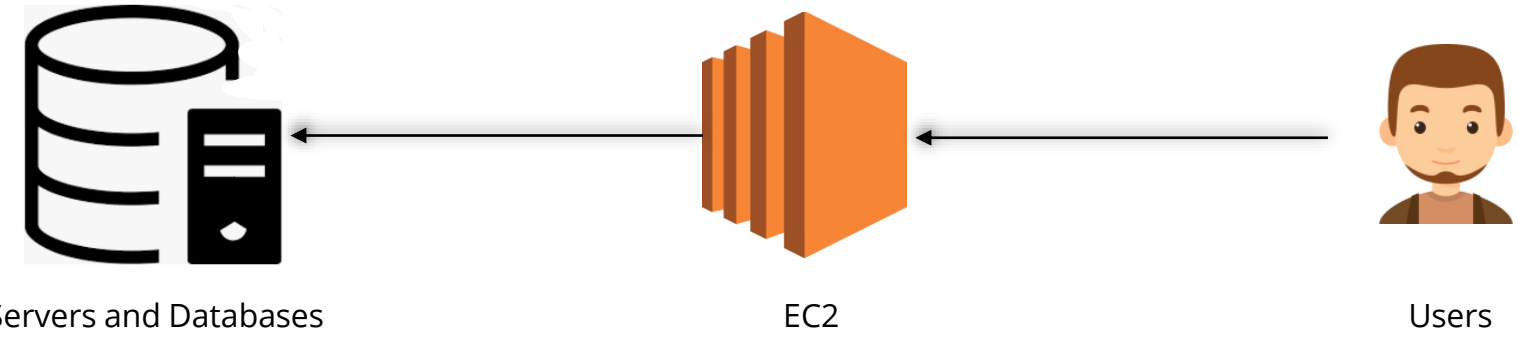
- Instances are virtual computing environments.
- Amazon Machine Images (AMIs) are preconfigured templates for your instances that package the bits you need for your server (including the operating system and additional software)
- Instance types are different configurations of CPU, memory, storage, and networking capacity for your instances.
- Using key pairs, you can secure login information for your instances (AWS stores the public key, and you store the private key in a secure place)

# Introduction is EC2 ?

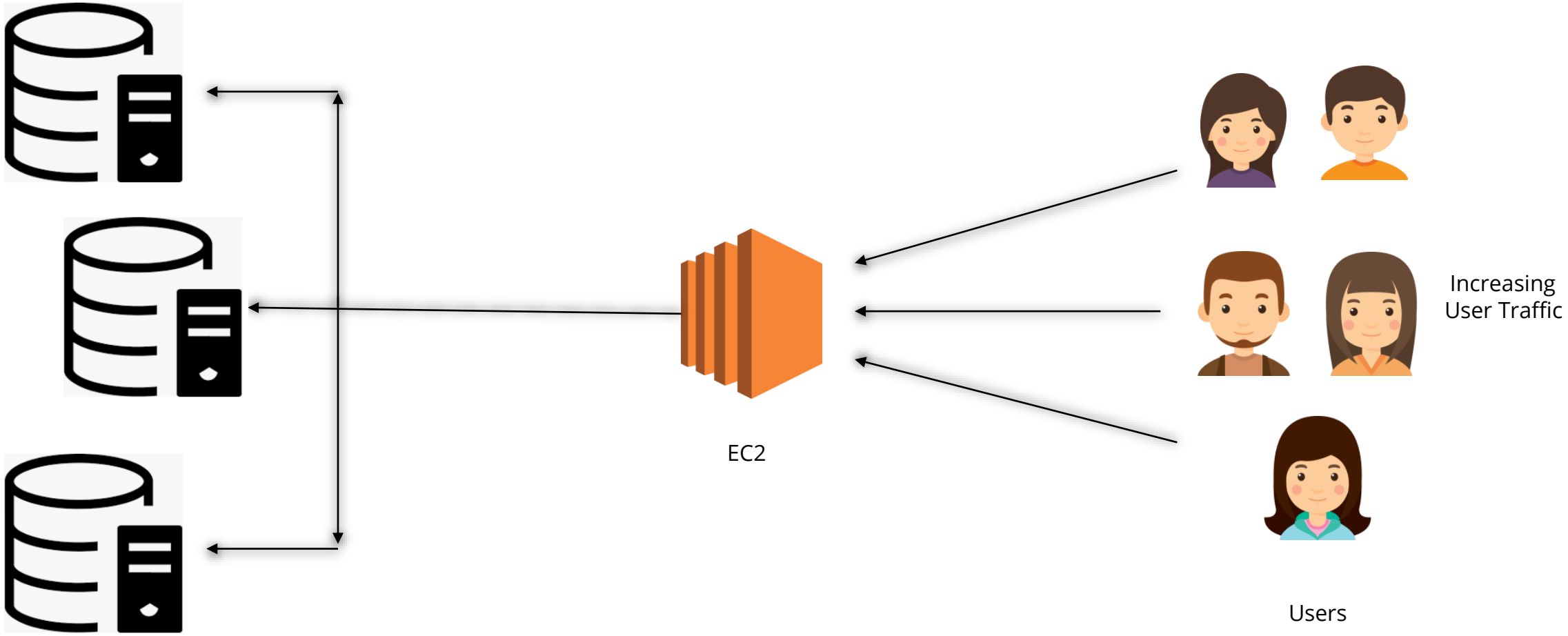
Elastic: It is the level at which a system is able to adapt to workload changes by provisioning and de-provisioning resources such that the resources meet the current demand as closely as possible

**ELASTIC COMPUTE CLOUD**

## Meaning of Elasticity

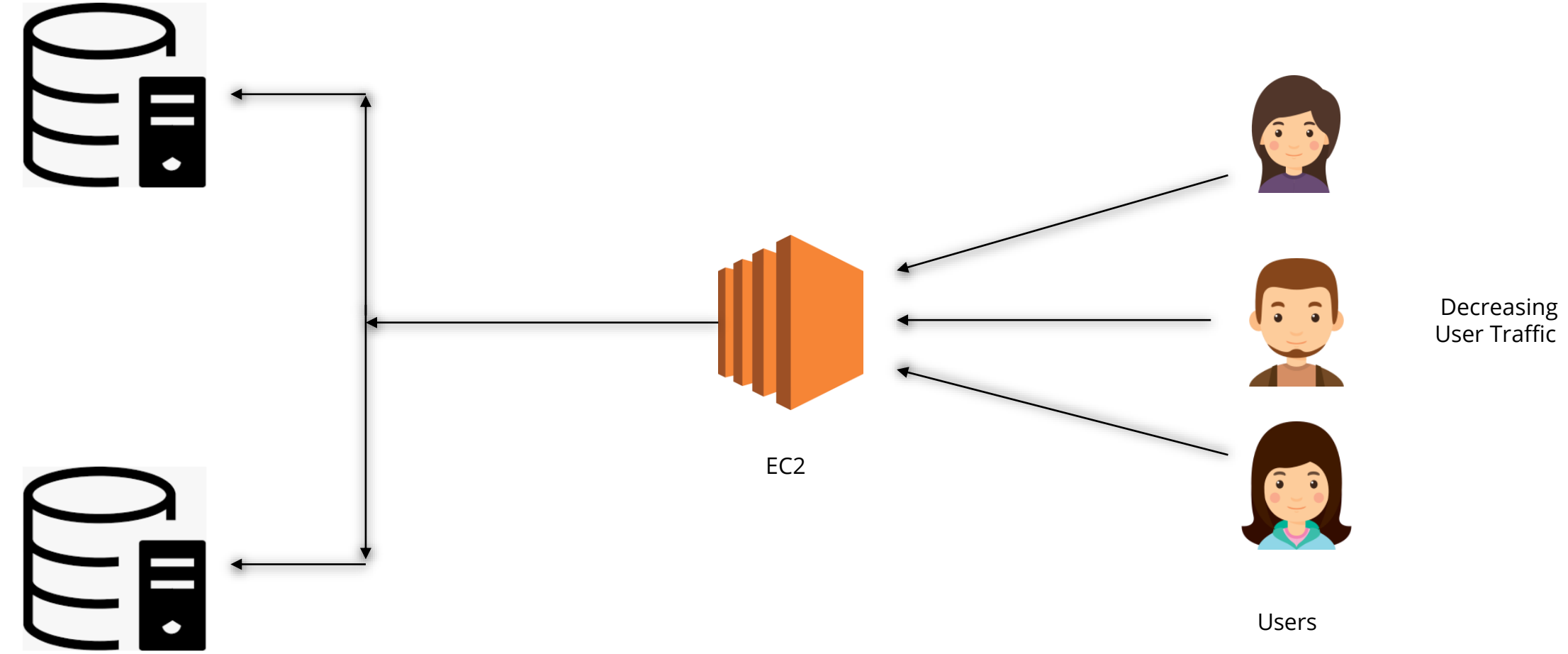


# Meaning of Elasticity




Meeting the Requirements

# Meaning of Elasticity



# Regions and Availability Zones

# Regions and Availability Zones

# Regions and Availability Zones

Regions are geographical locations where AWS data-centers reside. Following are AWS region names and their subdivisions:

**US East: N. Virginia (us-east-1), Ohio (us-east-2)**

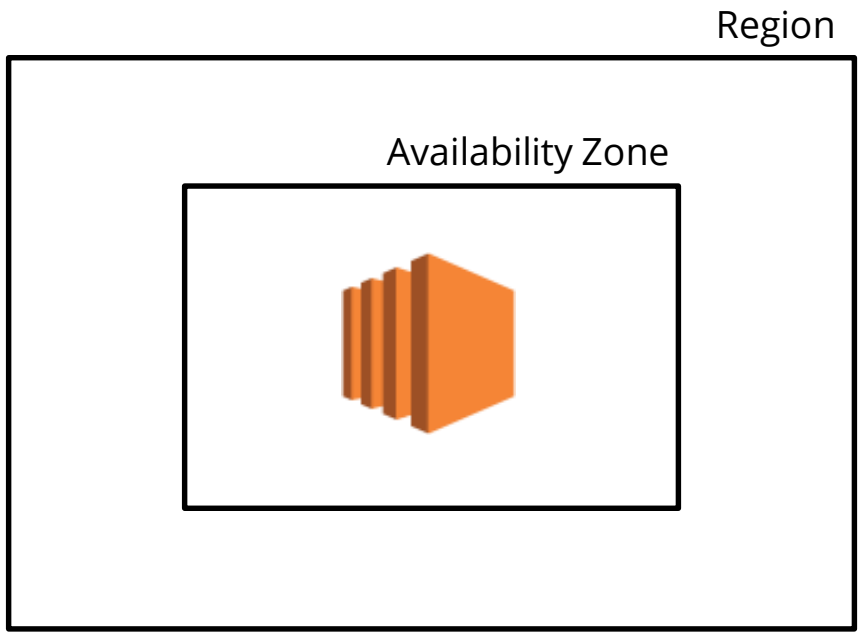
**US West: N. California (us-west-1), Oregon (us- west-2)**

**Asia Pacific: Mumbai (ap-south-1), Seoul (ap- northeast-2), etc**

**EU: Frankfurt (eu-central-1), Ireland (eu-west-1), , etc**

For instance, 'us-east-1' contains 6 data centers or availability zones:

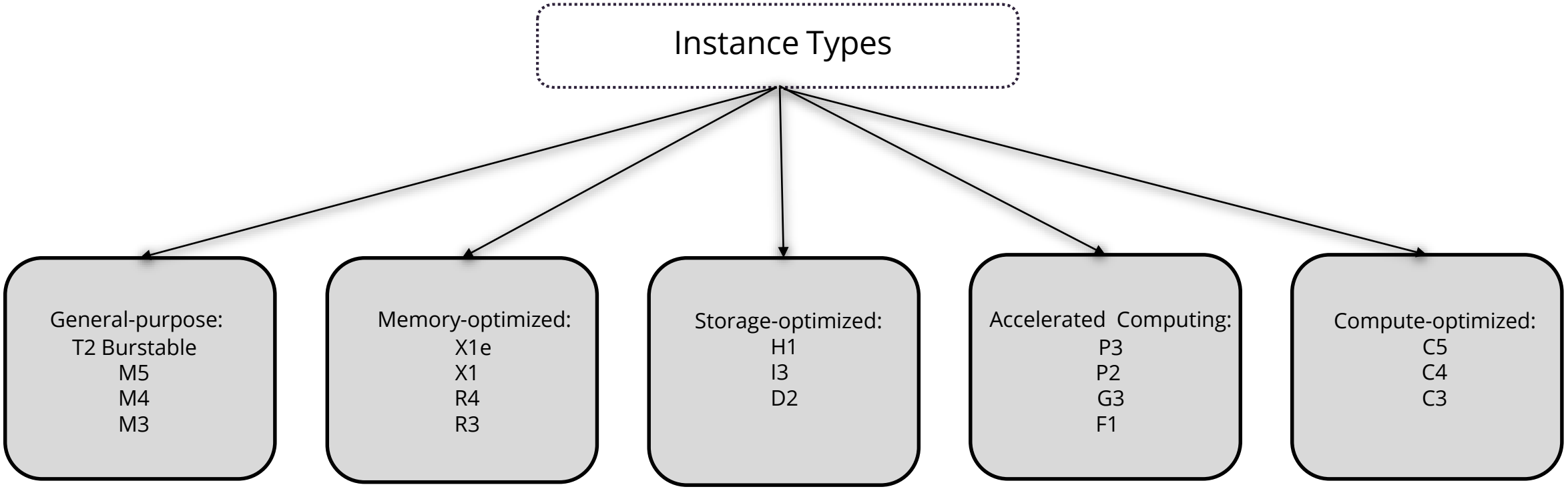
us-east-1a
us-east-1b
us-east-1c
us-east-1d
us-east-1e
us-east-1f



# EC2 Instance Types

# Instance Types

The instance type determines the hardware of the underlying host computer on which EC2 instances are launched

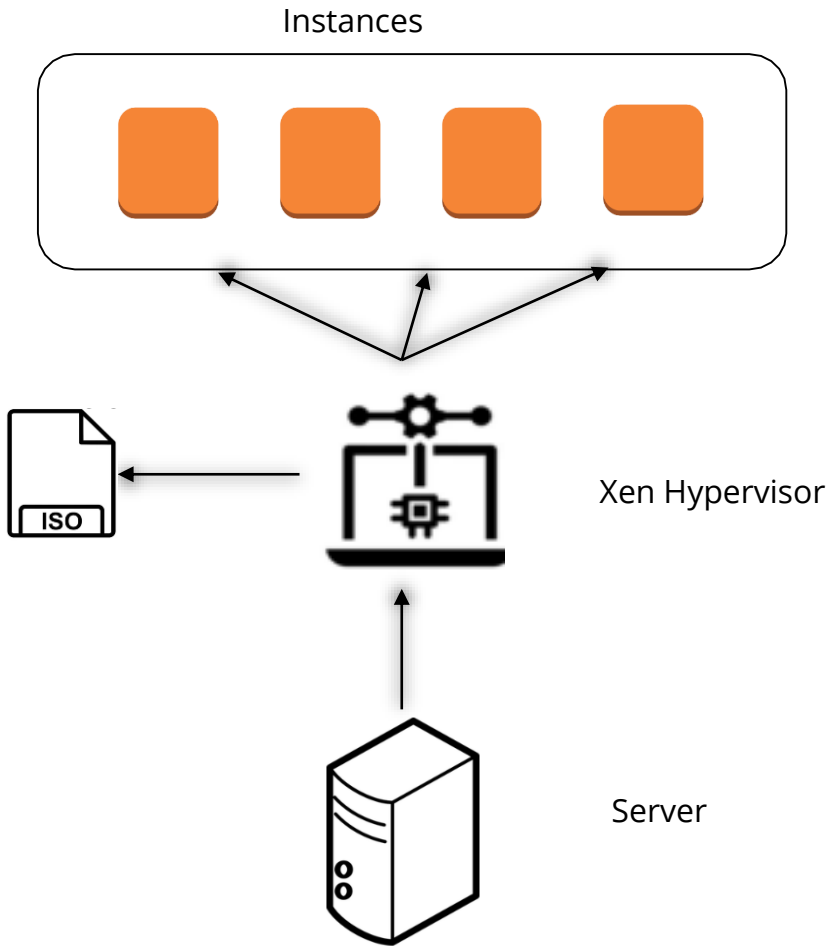


# What is AMI ?

# What is an AMI ?

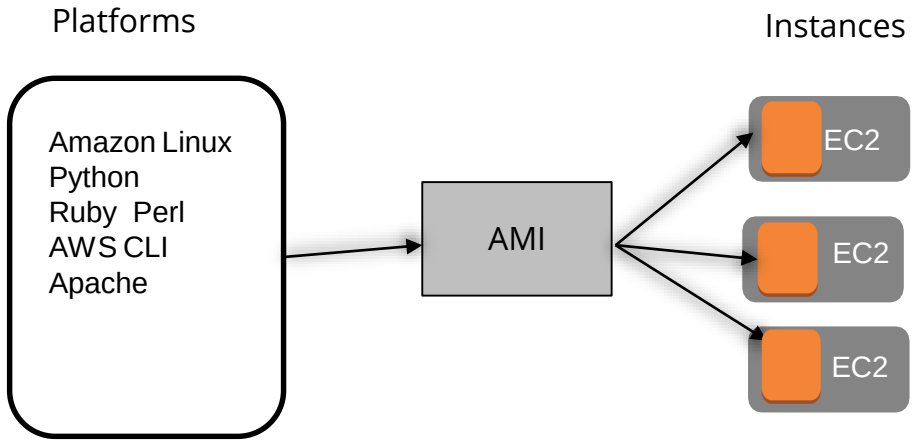
Amazon Machine Image (AMI) contains the information required to launch an instance.

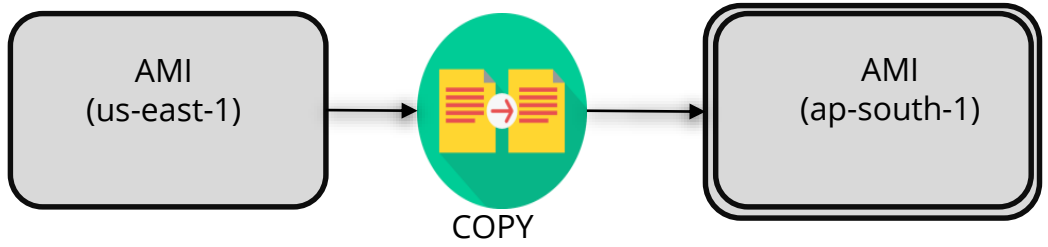
- Operating system
- Architecture
- Storage for the root device (Instance store or EBS-backed)
- Virtualization type (HVM or PV)



# Creating and Copying an AMI

- Create an AMI from an instance
- Launch multiple instances from it
- Copy the AMI
- AMI permissions



# Public IP vs Elastic IP

## Public IP


- It is not associated with an AWS account
- No charges for the public IP, even if it is not being used while the instance is running
- Whenever the instance is re-launched, the public IP changes

## Elastic IP


- It is associated with the AWS account
- Charges will be applied if the same is done with the elastic IP
- The elastic IP is the same and static for every launch until we manually release it

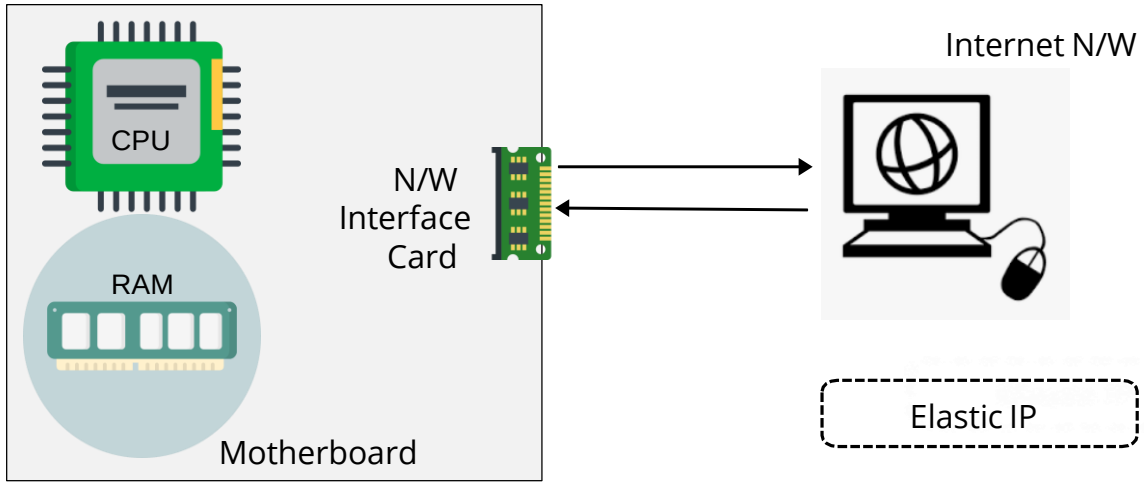
# Elastic Network Interface

A network interface is the interface between a computer and an

Internet network. The network IO happens through n/w interface cards

N/W interfaces contain:

- Elastic IP
- Public  IP
- Private IP
- Security Groups



# What is EBS ?

# What is EBS ?

**EBS (Elastic block storage)** is an Amazon block-level storage service that is intended to be used exclusively with separate EC2 instances; no two instances can have the same EBS volume attached to them. EBS provides a high-performance option for many use cases because it is directly attached to the instance, and it is used for various databases (both relational and non-relational) as well as a wide range of applications such as software testing and development.

**What is Block Storage**

# What is EBS ?

## Features of EBS

- Amazon Elastic Block Store (Amazon EBS) persistent storage volumes, also known as Amazon EBS volumes
- Regions and Availability Zones are multiple physical locations for your resources, such as instances and Amazon EBS volumes.
- Using security groups, you can specify the protocols, ports, and source IP ranges that can reach your instances.
- Elastic IP addresses are static IPv4 addresses used for dynamic cloud computing.

# Introduction to EBS

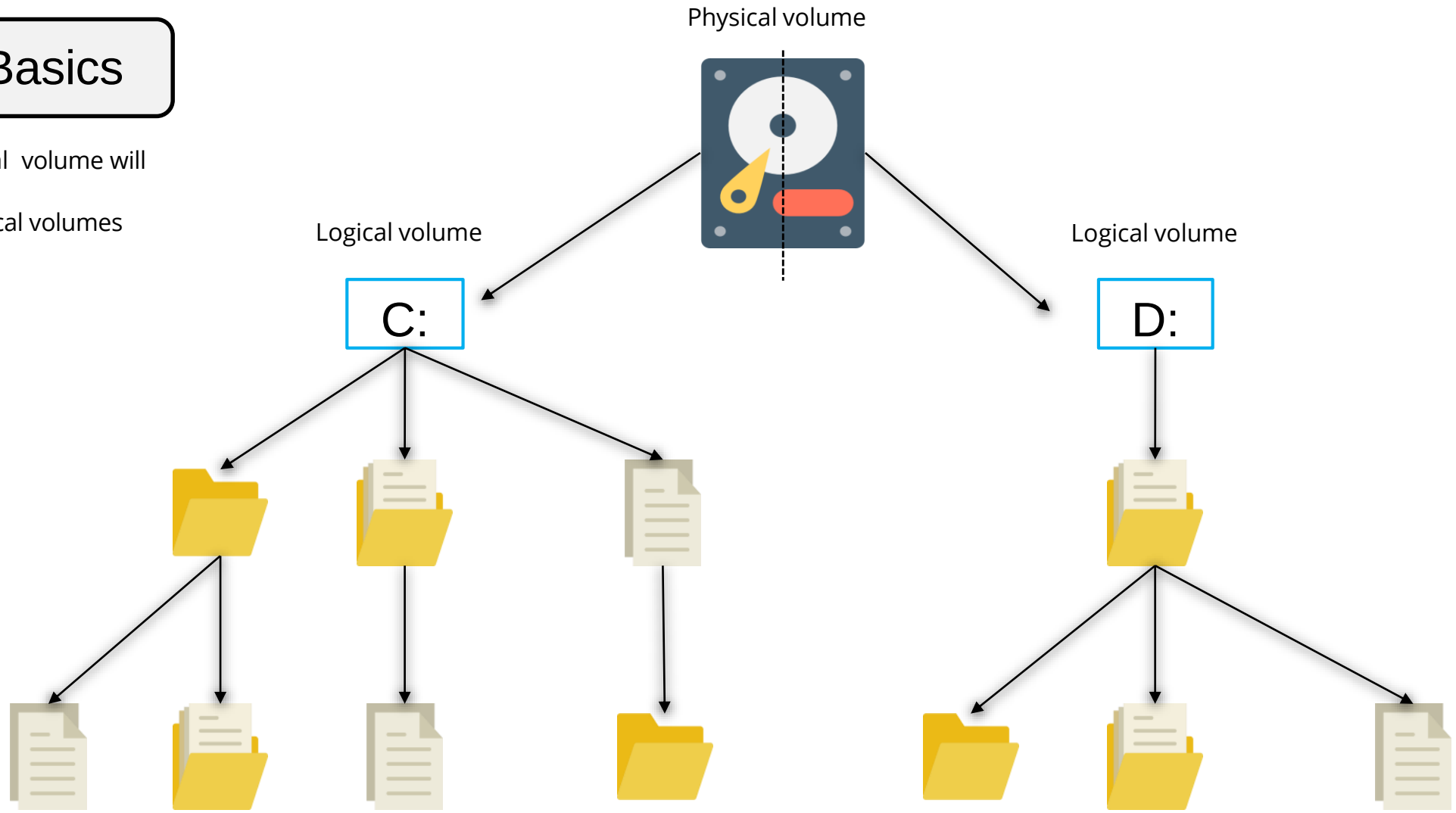
## File System Basics

In simple terms, one physical  volume will

be divided into multiple logical volumes

Directory

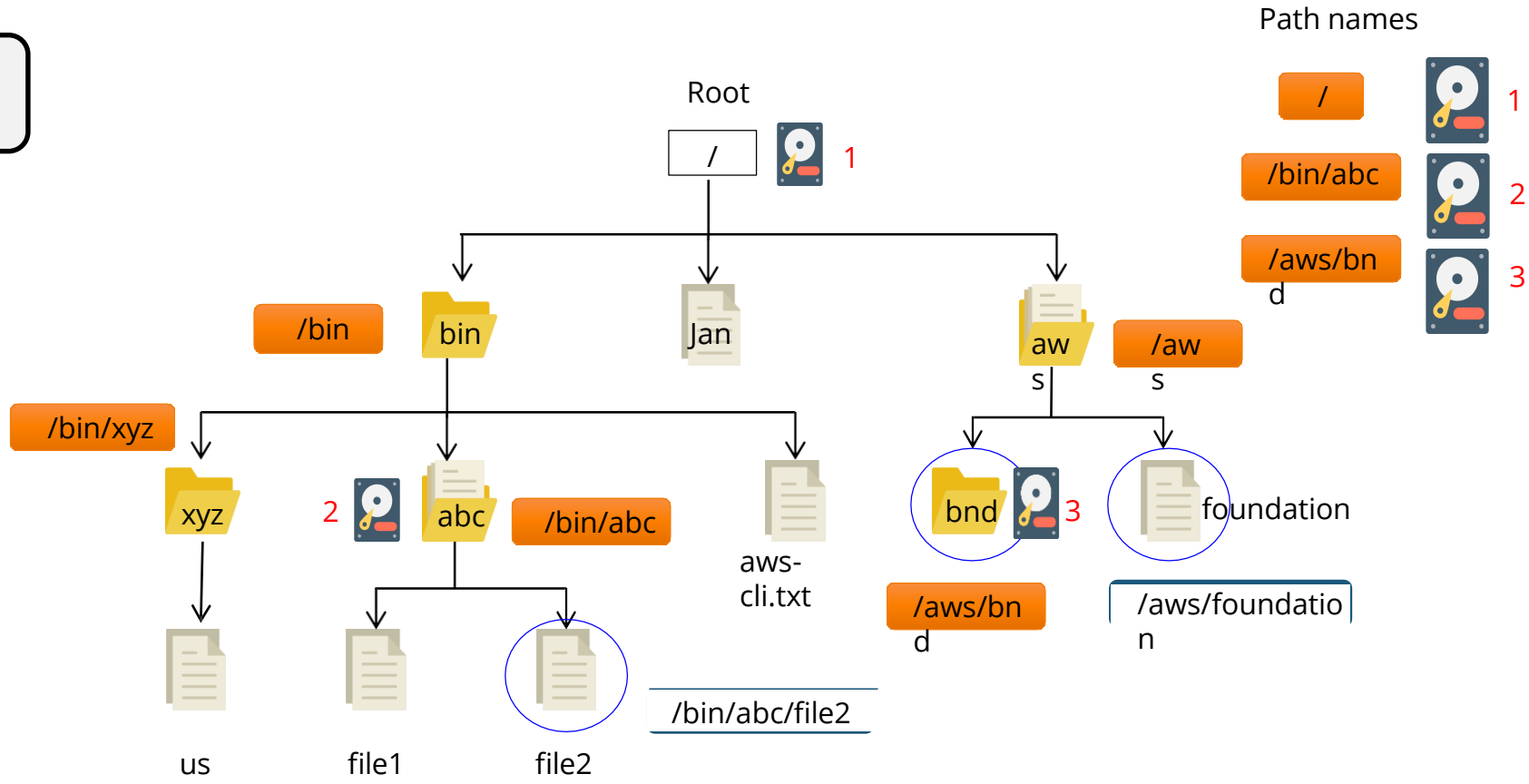
File



# Introduction to EBS

## File System Basics

A file system tree of a Linux or UNIX system



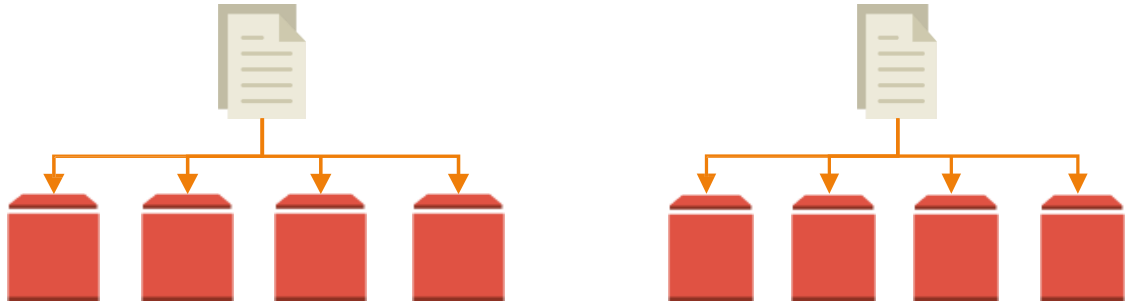
# EBS Concepts

# EBS Concepts

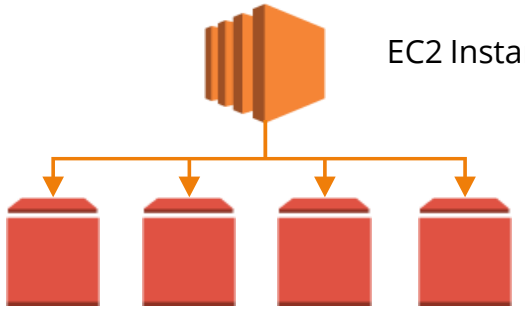
It is the raw unformatted block-level storage; it is exposed as raw device to the EC2 instance EBS volumes persist independently from the life of the EC2 instance

An EBS volume is automatically replicated within an availability zone

**Throughput**: It is the sequential transfer rate that an SSD or HDD will maintain continuously



**IOPS**: It is the measure of the number of I/O operations a drive, SSD, or HDD can handle per second with each block being read from or written to a RANDOM location in the disk



# EBS Concepts

## Volume Types

### GP2: General-purpose SSD

- Baseline performance is 3 IOPS/GB with a min. of 100 IOPS and a max. of 10000 IOPS
- Max. burst performance is 3000 IOPS
- Max. throughput per volume is 160 MB/s (16 KB IO size)

### IO1: Provisioned SSD

- From 100 to 32000 IOPS can be provisioned
- Max. throughput per volume is 500 MB/s

### ST1: Throughput-optimized HDD

- Baseline performance is 40 MB/s per TB with a max. of 500 MB/s per volume
- Burst performance is 250 MB/s per TB with a max. of 500 MB/s per volume

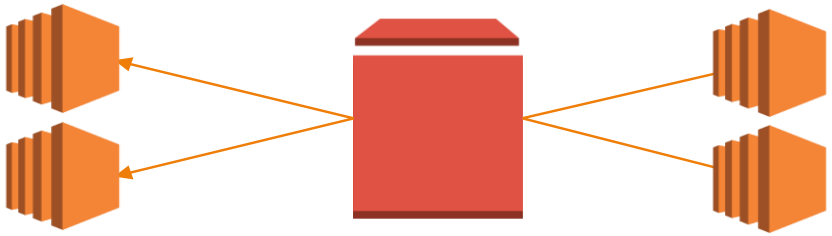
### SC1: Cold Storage HDD

- Baseline performance is 12 MB/s per TB with a max. of 192 MB/s per volume
- Burst performance is 80 MB/s per TB with a max. of 250 MB/s per volume

# EBS Concepts

**New Feature: EBS Multi-Attach**

Amazon EBS Multi-Attach is now available on Provisioned IOPS io1 volumes

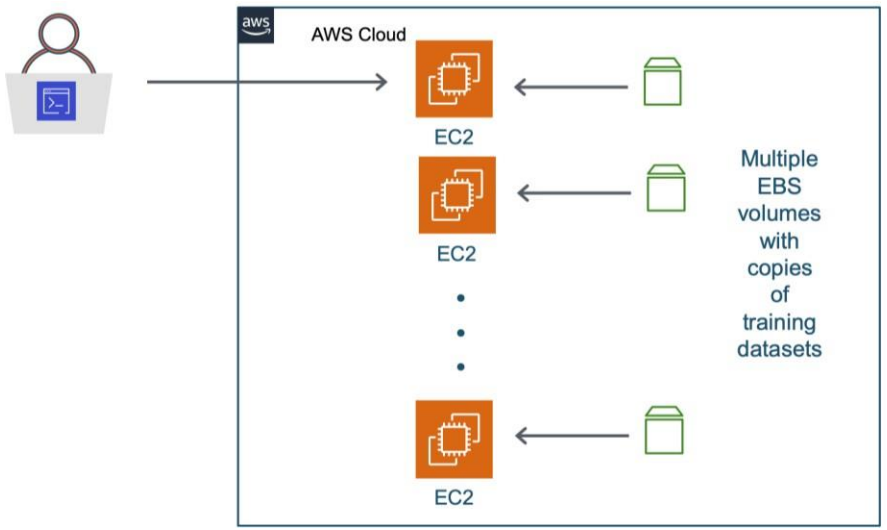


We can now enable Multi-Attach on Amazon EBS Provisioned IOPS io1 volumes to allow a single volume to be concurrently attached to up to 16 AWS Nitro System-based Amazon EC2 instances within the same availability zone

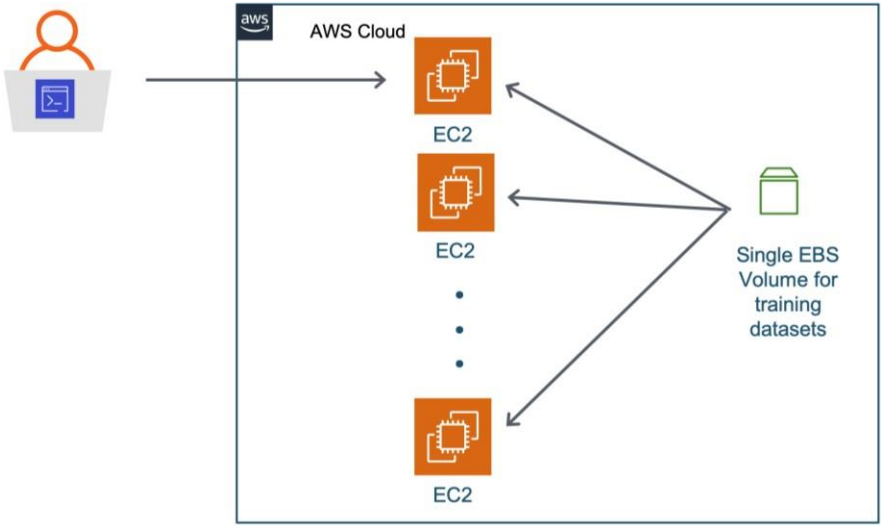
# EBS Concepts

New Feature: EBS Multi-Attach

Without Multi-Attach




With Multi-Attach



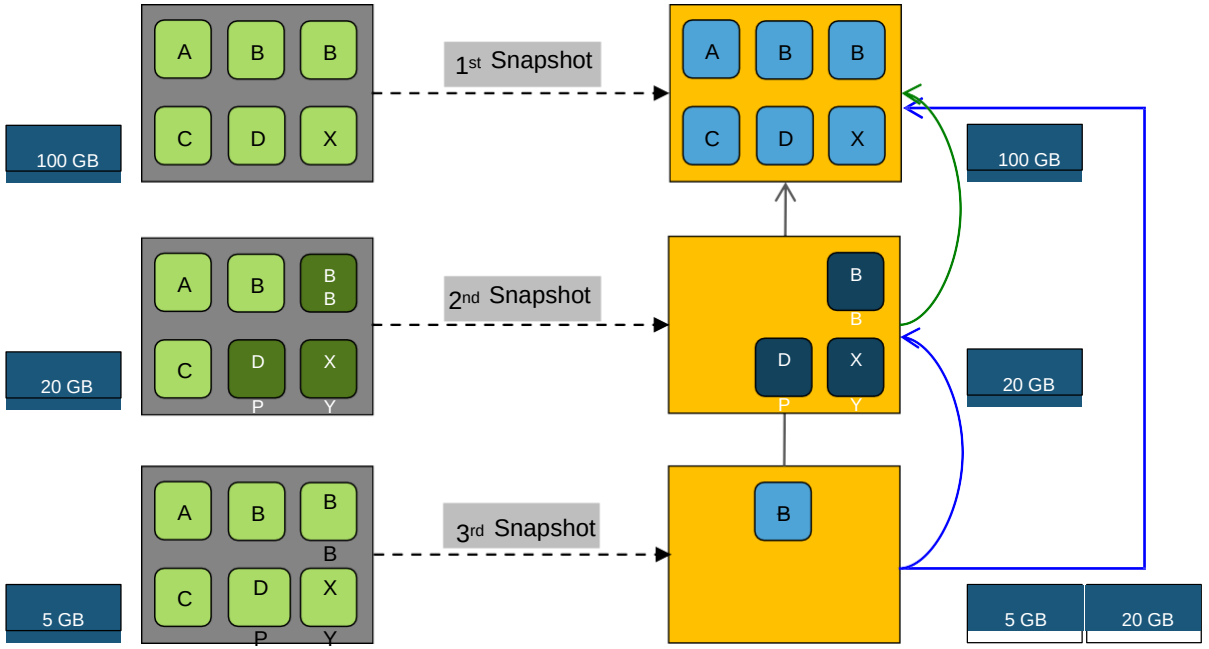
# EBS Snapshots

## Snapshot

Snapshots are used to backup data on EBS volumes

All snapshots are incremental backups except for the first one

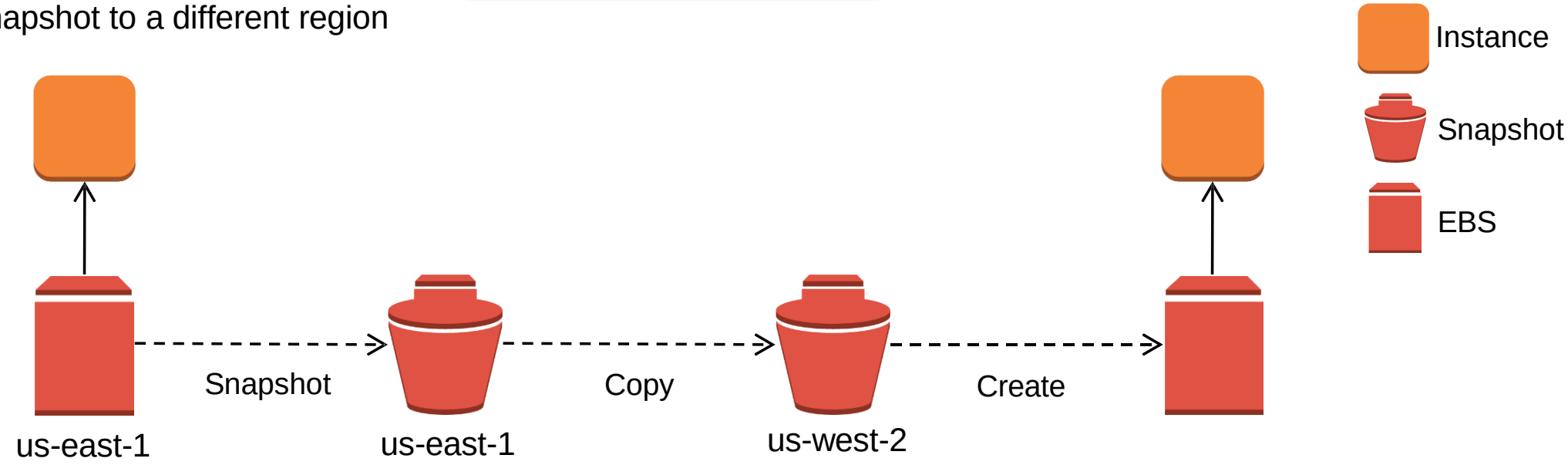
Snapshots are copied to Amazon S3



# EBS Snapshots

## Snapshot Copy

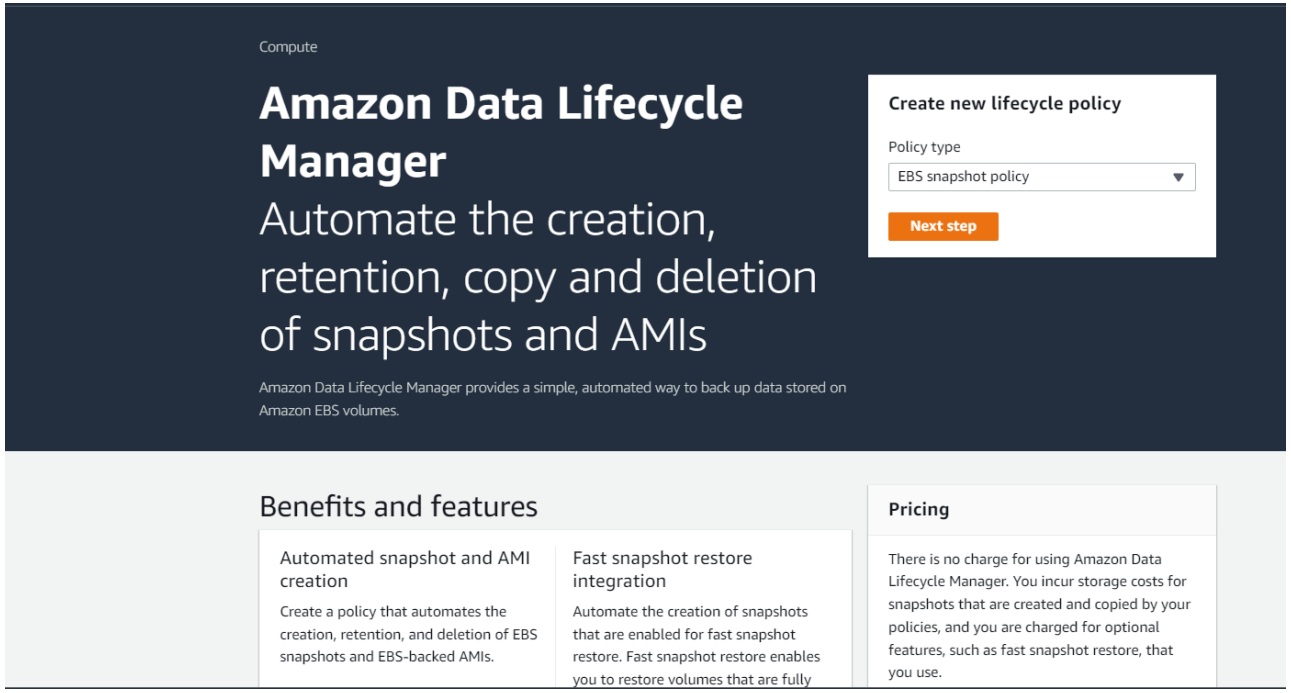
- Copy snapshot to a different region




- Encrypt during copying

# EBS Snapshots

New Feature: Data Lifecycle Manager for Snapshots




- Amazon DLM supports Amazon EBS volumes and snapshots
- We can define backup and retention schedules for EBS snapshots by creating lifecycle policies based on tags
- It is free to use
- We no longer need to create custom scripts for backup and restore

# EBS Snapshots

Automating the snapshot cycle helps with:

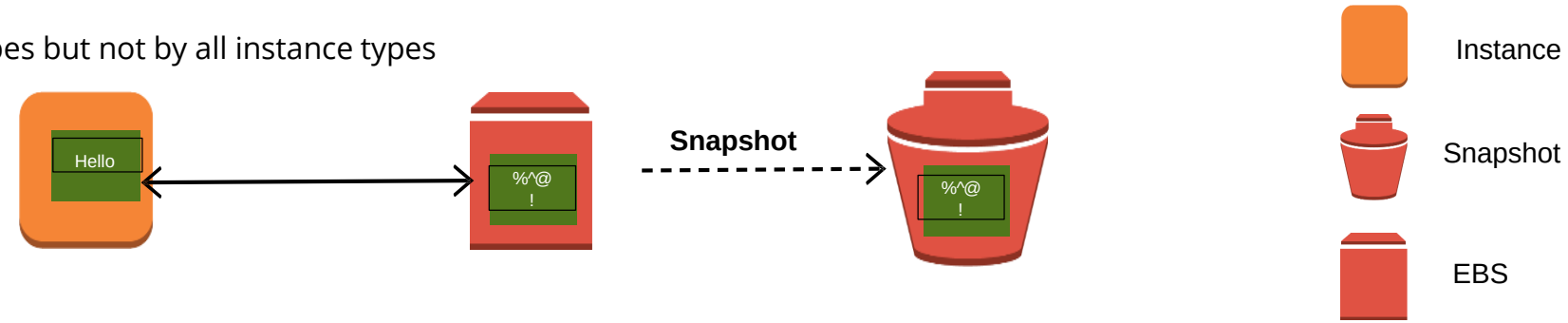
- Protecting valuable data by enforcing a regular backup schedule
- Retaining backups as required by auditors or internal compliance
- Reducing storage costs by deleting outdated backups

Quotas for AWS DLM:

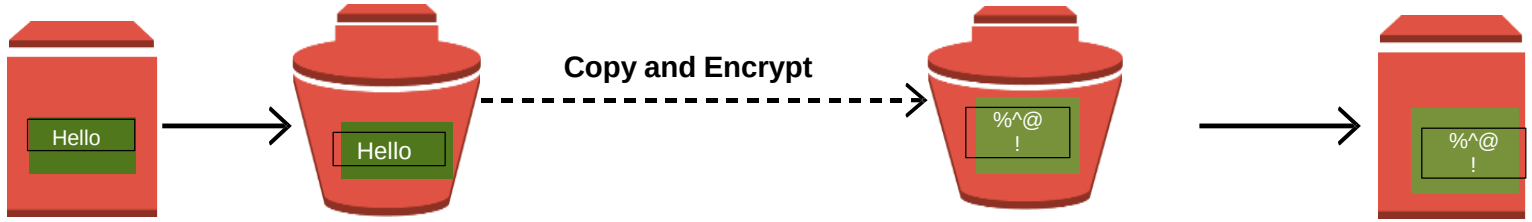
- We can create up to 100 lifecycle policies per region
- We can add up to 45 tags per resource
- We can create one schedule per lifecycle policy

# EBS Encryption

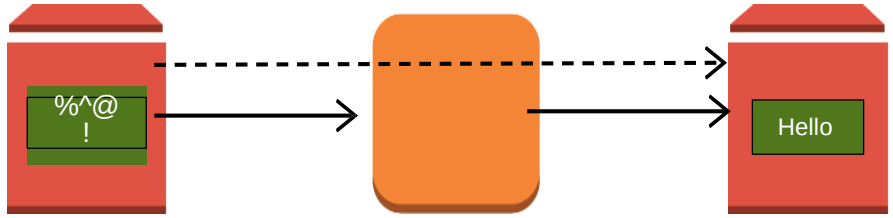
- ☑ Supported by all volume types but not by all instance types




- ☑ Unencrypted to encrypted




- ☑ Encrypted to unencrypted



# What is EFS ?

# What is EFS ?

**EFS (Elastic file system)** is a file-level storage service that provides a shared elastic file system with virtually limitless scalability. EFS is a highly available storage system that can be used by multiple servers at the same time. Amazon Web Services EFS is a fully managed service that provides on-demand scalability. This means that the user does not have to be concerned about their workload increasing or decreasing. If the workload suddenly increases, the storage will automatically scale up, and if the workload decreases, the storage will automatically scale down.

# What is EFS ?

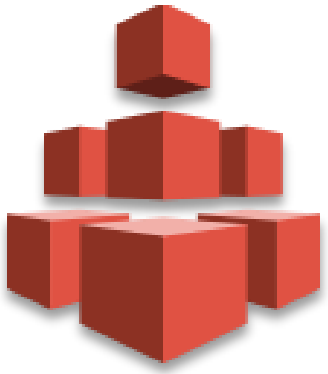
**Features of EFS**

- Completely managed
- Data security that is both accessible and long-lasting
- Lifecycle management and storage classes
- Compliance and security
- Performance that scales
- Serverless file storage and containers

# What is EFS ?

Amazon Elastic File System

**Amazon EFS** (**Elastic File System**) is a cloud-based file storage service for applications and workloads that run in the **Amazon Web Services** (**AWS**) public cloud



Why do we need EFS?

- If our application is running on Amazon EC2 and needs a file system or in any use case where a file system is needed

# EBS Vs EFS

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# Differences


| EBS | EFS |
| --- | --- |
| EBS Stands for **Elastic Book Store** | EFS stands for **Elastic File system** |
| It provides the block-level storage volumes for the of EC2 instances. | It is easy to use. |
| It is used by database applications those who depends upon random reads and random reply. | It is used by the companies for improving content management systems |
| It is primarily used for data that must be quickly accessible while also being long-lasting. | It is employed in the modernization of application development. |
| EFS is a fully managed service.This means that your company's file system will never need to be patched, deployed, or maintained. | On contrary , EFS is not a fully managed service |

# What is Fsx ?

# What is Fsx ?

Amazon FSx is a fully managed third-party file system solution. It makes use of SSD storage to provide fast performance with low latency.

# What is Fsx ?


## Use cases of Fsx

- File systems that can establish permissions at the file or folder level and are accessible by multiple users.
- Application workloads that use the SMB protocol and require shared file storage provided by Windows-based file systems (NTFS).
- It is compatible with the following compute services:
- Amazon Elastic Compute Cloud ,Instances of Amazon Workspaces , Instances of Amazon AppStream 2.0 & VMWare Cloud VMs running on AWS Environments.

# Introduction to Amazon FSx

Using FSx, we can launch and run high-performing file systems with just a few clicks while avoiding tasks such as provisioning hardware, configuring software, or taking backups

**AWS FSx provides two file systems to choose from:**


Amazon FSx
for Windows File Server


Amazon FSx
for Lustre

# Introduction to Amazon FSx

**Why should we use AWS FSx?**

Simple and fully managed

Fast delivery

Highly available and durable

Pay only for the used resources

Secure and complaint

Easy integration with other AWS services

# Features of FSx

# Features of Fsx

DFS (Distributed File System) Namespaces allow you to group file shares from multiple file systems into a single common folder structure (a namespace) from which you can access the entire file dataset.

# Features of Fsx

Using Windows' Robust File Copy (RoboCopy) to copy your files (both the data and the full set of metadata like ownership and Access Control Lists) directly to Amazon FSx.

# Features of Fsx

Supports identity-based authentication via Microsoft Active Directory over the Server Message Block (SMB) protocol.

Amazon FSx automatically encrypts your data in transit and at rest using AWS KMS and SMB Kerberos session keys.

Amazon FSx is ISO, PCI-DSS, and SOC compliant, as well as HIPAA compliant

# Amazon FSx for Windows File Server


For Windows File Server

A native Microsoft Windows file system so that we can move our windows-based apps to this shared storage in AWS. Built on a Windows server, it has great compatibility with Microsoft products

We get full support for the SMB protocol, Windows NTFS, and Microsoft Active Directory (AD) integration. Also, FSx uses SSD for fast performance

# Amazon FSx for Windows File Server

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**Features of AWS FSx for Windows File Server**

01 **Native Windows compatible:** FSx supports all Windows versions starting from Windows 7

02 **Broadly accessible:** It can connect our file system to Amazon EC2, Workspaces, and even VMware cloud on AWS

03 **Fully managed:** It is very simple to launch and use the shared file storage for our Windows applications that run on AWS

04 **Built on SSD storage:** It is designed for fast and consistent delivery and provides up to 2 GB/s of throughput per file system

# Amazon FSx for Windows File Server

**Use Cases**

Lift-and-shift Application Workloads

Windows-based applications and workloads, such as ERP, CRM, and custom-built .NET applications, require shared file storage

Software Development Environments

Development environments include source code and build repositories residing on shared file storage that support many developers working on the same projects

# Amazon FSx for Windows File Server

**How does FSx for Windows File Server work?**

# Amazon FSx for Windows File Server

**Supported Clients, Access methods and Environments**

## Clients

1. Amazon EC2 instances
2. Amazon WorkSpaces instances
3. Amazon AppStream 2.0 instances
4. VMware Cloud on AWS

## Access methods

1. Using DNS names
2. Distributed File System Namespaces

## Environments

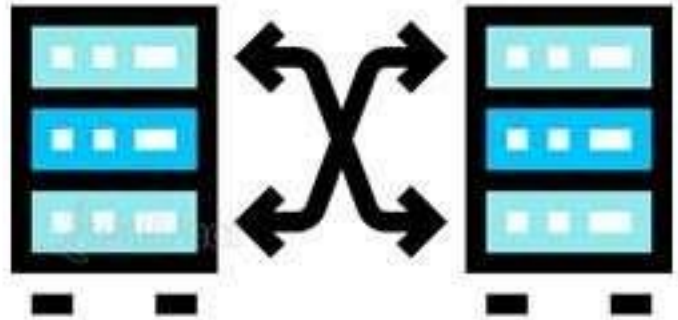
1. From an on-premises environment
2. From an AWS account, another VPC or region

# Amazon FSx for Windows File Server

## Failover Process

The Multi-AZ file system will start failover automatically if any of the below conditions prevail:

1. An availability zone outage
2. The preferred file server is unavailable
3. The preferred file server undergoes planned maintenance



# Amazon FSx for Windows File Server

**Failover Process**

What exactly happens when a failover process starts?

1. When failing over from a file system server to another, the new file system will start serving all read and write requests
2. Once all resources are available in the required subnet, FSx automatically goes back to the preferred file server
3. For a failover to complete, it takes around 30 seconds from when it detected a failure

# Amazon FSx for Lustre

# Amazon FSx for Lustre


For Lustre

FSx for Lustre makes it very easy to launch and run the world's most popular file system

Lustre®

The Lustre file system is an open-source, parallel file system that supports many requirements of leadership-class HPC simulation environments

# Amazon FSx for Lustre

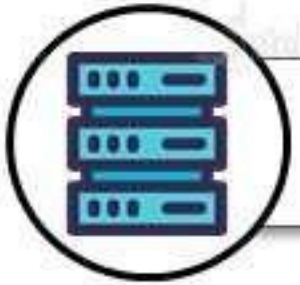
**Features of Amazon FSx for Lustre**

Most popular high-performance file system

Multiple deployment options

Seamless integration with our Amazon S3 data

Data accessible to other AWS services



Accessible from on-premises

Simple and fully managed

# Amazon FSx for Lustre

We can integrate it with S3 that makes it easier to process datasets. When linked with S3, Lustre shows all S3 objects as files, and any change made will reflect in the S3 bucket as well

# Amazon FSx for Lustre

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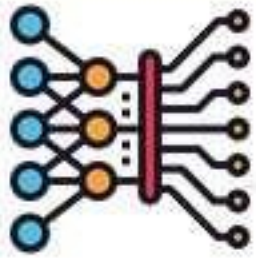
**Use Cases**

Machine Learning



ML workloads use massive amounts of training data. Multiple instances need to process this training data simultaneously, so a shared file storage is very helpful

Media Processing and Transcoding

Media workflows, such as video rendering and visual effects, need compute and storage resources to handle the massive amounts of data being created

# Amazon FSx Pricing

**For Windows File Server**

**For Lustre**

## Pricing

Region: US East (N. Virginia)

| | Single-AZ Deployment | Multi-AZ-Deployment |
|---|---|---|
| **SSD storage capacity** | $0.130 per GB-month | $0.230 per GB-month |
| **HDD storage capacity** | $0.013 per GB-month | $0.025 per GB-month |
| **Throughput capacity** | $2.200 per MBps-month | $4.500 per MBps-month |
| **Backup storage** | $0.050 per GB-month | $0.050 per GB-month |

# Amazon FSx Pricing

**For Windows File Server**

**For Lustre**

**Pricing Example**

Assume, we want to store 10 TB of general-purpose file share data using HDD storage in the US East (N. Virginia) region. Based on the typical deduplication savings of 50–60%, we provision a 5 TB multi-AZ file system with 16 MBps of throughput capacity. Also, assume that we have an average backup storage of 5 TB during the month

**Total monthly charge:**

**Storage:** 5 TB x $0.025 GB-month= $128/mo

**Throughput:** 16 MBps x $4.50/MBps-month= $72/mo

**Backup:** 5 TB x $0.050/GB-month = $256/mo

**Total monthly charge: $456 ($0.045/GB-mo for 10TB of data)**

# Amazon FSx Pricing

**For Windows File Server**

**For Lustre**

## Pricing

Region: US East (N. Virginia)

| Storage options | Pricing per GB-month |
|---|---|
| Scratch (200 MB/s/TiB baseline, up to 1.3 GB/s/TiB burst) | $0.14 |
| Persistent (200 MB/s/TiB baseline, up to 1.3 GB/s/TiB burst) | $0.29 |
| Persistent (100 MB/s/TiB baseline, up to 1.3 GB/s/TiB burst) | $0.19 |
| Persistent (50 MB/s/TiB baseline, up to 1.3 GB/s/TiB burst) | $0.14 |

# Amazon FSx Pricing

**For Windows File Server**

**For Lustre**

**Pricing Example**

Assume, we have a scratch file system in the US East (N. Virginia) region, which has been provisioned with 4,800 GB of storage capacity, and we spin up our file system for an 8-hour workload every day and then shut it down. We do this for 30 days (a month)

**Total workload charge:**

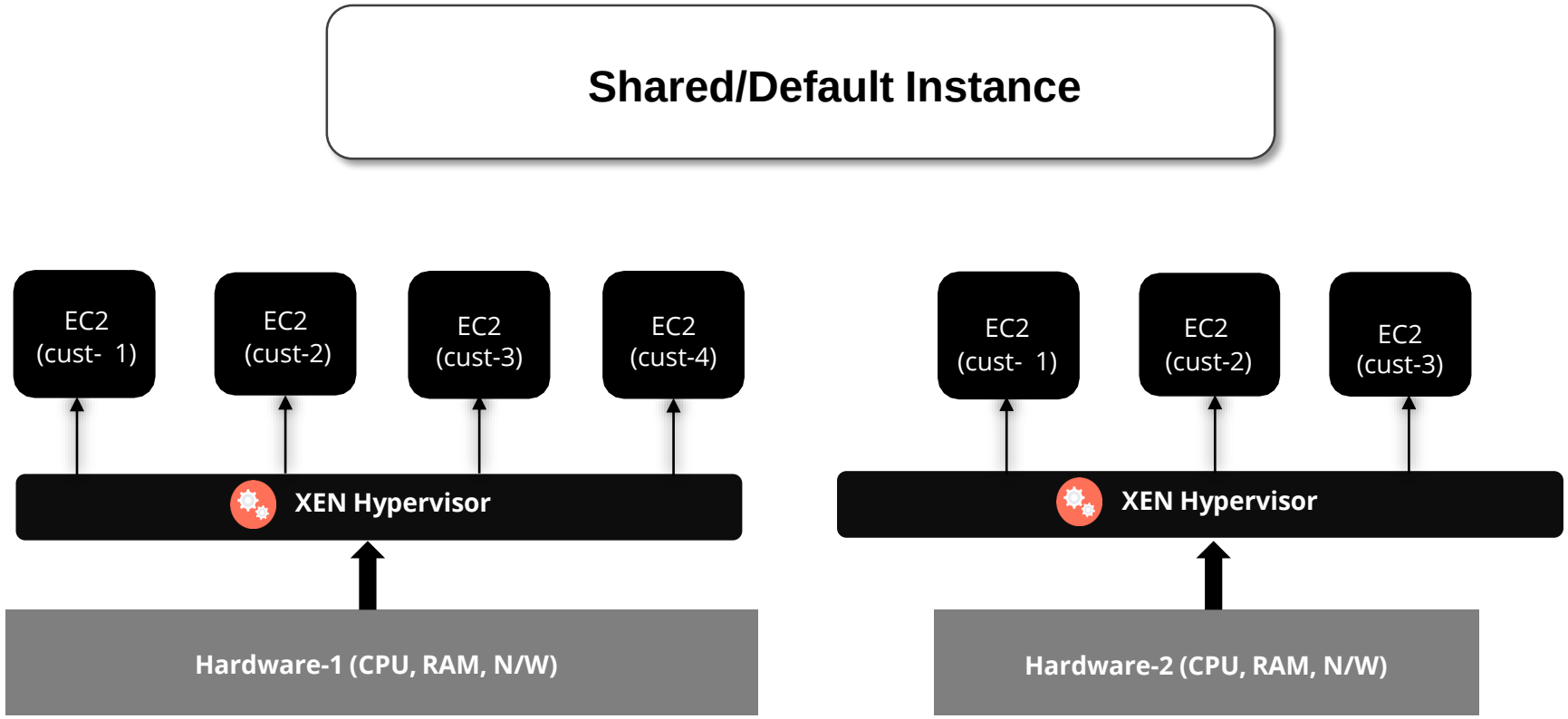
$0.14 GB-month / 30 / 24 = $0.000194/GB-hour

4800 GB x $0.000194/GB-hour x 8 hours x 30 days = $224

**Total FSx for Lustre charge for the month: $224**

# Instance Tenancy and Reserved and Spot Instances

# Instance Tenancy and Reserved and Spot Instances



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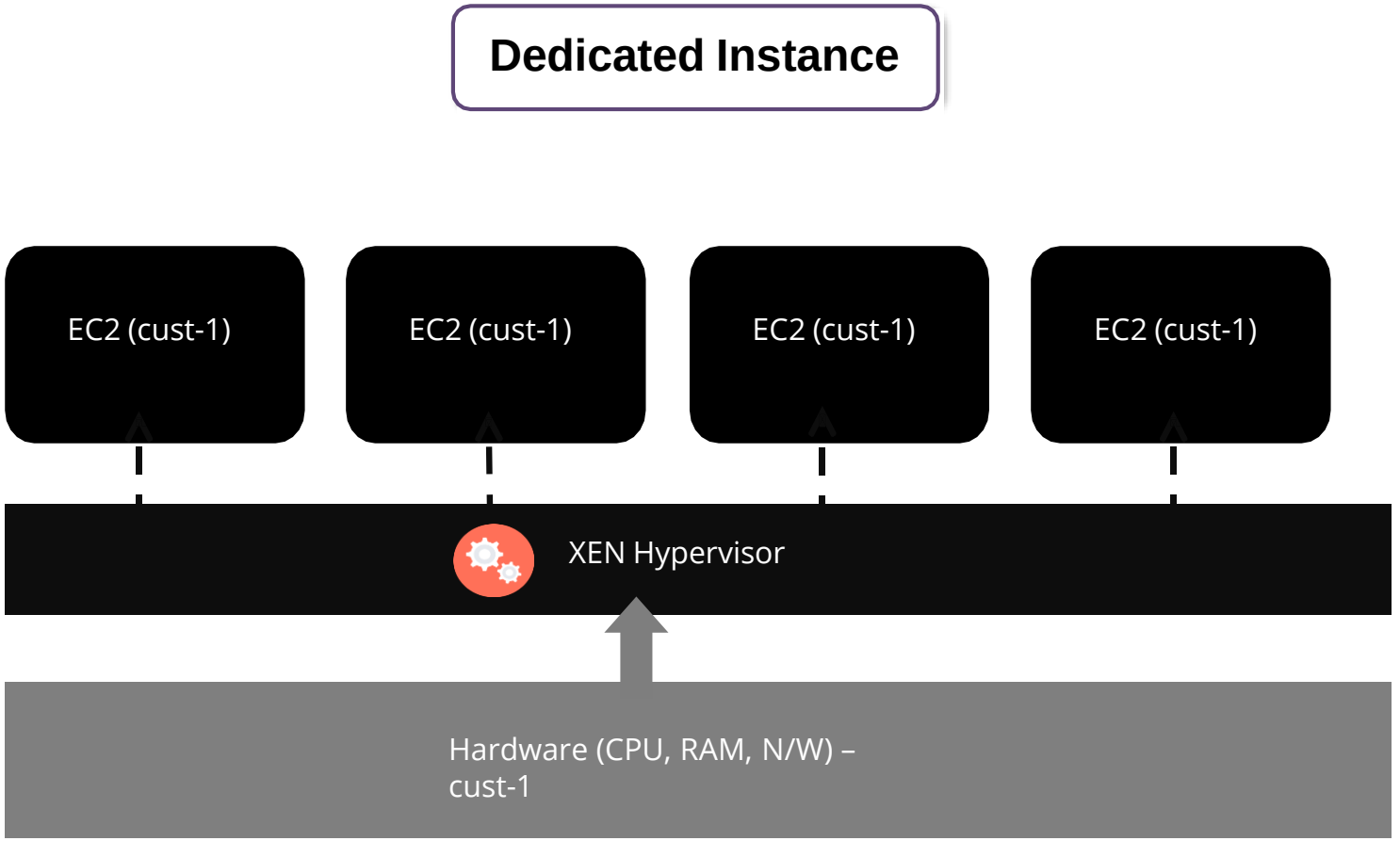
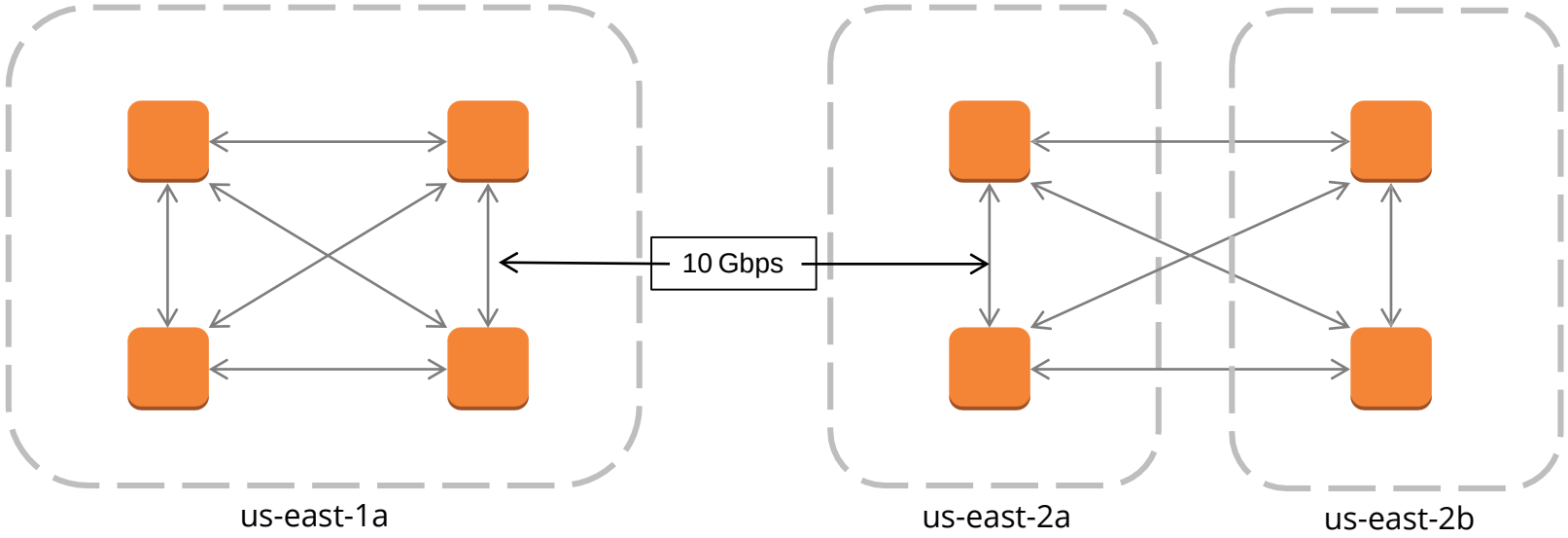


# Placement Group

**Cross-platform PG**

EC2 instances should support enhanced N/W



# Reserved and Spot Instances

## Reserved Instances

Regional RI – AZ and Instance Size Flexibility (Both default and dedicated tenancy)

Resources and capacity is reserved until the contract

period ends Scheduled RI

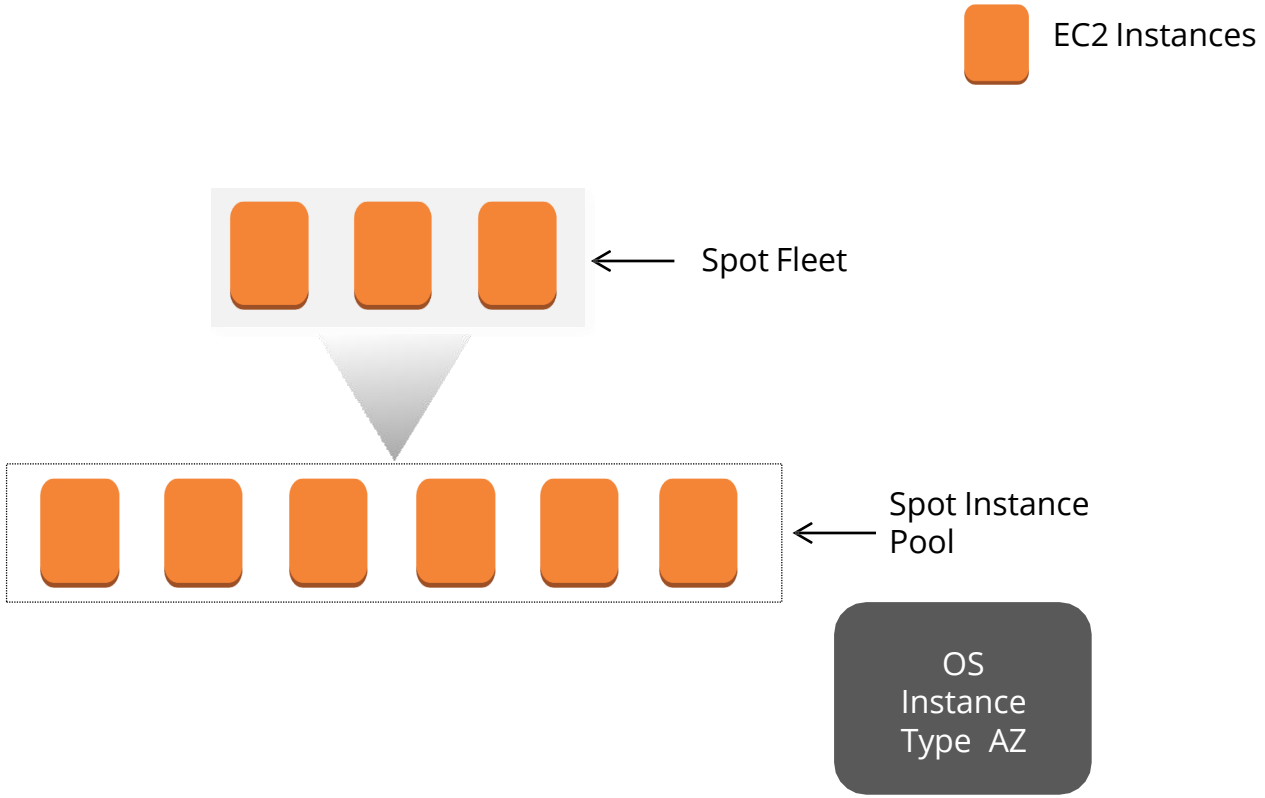
| Running Instance | RI bought |
|---|---|
| 4 m3.large Linux, default tenancy in AZ us-east-1a | 4 m3.large, Linux, default tenancy, AZ us-east-1a |
| 2 m4.4xlarge Amazon Linux, default tenancy in us-east-1b | 4 m4.large, Amazon Linux, default tenancy, region us-east-1 |
| c4.xlarge RHEL dedicated tenancy in AZ us-east-1c | C4.large, RHEL, default tenancy, region us-east-1 |

| Instance size | Normalization factor |
|---|---|
| nano | 0.25 |
| micro | 0.5 |
| small | 1 |
| medium | 2 |
| large | 4 |
| xlarge | 8 |
| 2xlarge | 16 |
| 4xlarge | 32 |
| 8xlarge | 64 |
| 9xlarge | 72 |
| 10xlarge | 80 |
| 12xlarge | 96 |
| 16xlarge | 128 |
| 18xlarge | 144 |
| 24xlarge | 192 |
| 32xlarge | 256 |

# Reserved and Spot Instances

## Spot Instances

- Unused EC2 instances available for lesser price than the on-demand price
- Instances are terminated if the spot price increases than the bid price
- Significant price reduction



# Pricing

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EC2 Pricing (us-east-1)

Pay as you use

Free Tier: 750 hours per month of Amazon Linux, RHEL, SLES, Windows t2.micro single instance usage

On-demand price:

- m5.large = US$0.096/hour
- c5.large = US$0.085/hour
- r4.large = US$0.133/hour

Data Transfer IN:

FREE from anywhere

SLA = 99.99% Uptime

Data Transfer OUT:

From EC2 to

-S3, Glacier, DynamoDB, SES, and SQS in same region = FREE

- S3, Glacier, DynamoDB, SES, and SQS in different region = US$0.020/GB
- EC2, RDS, Redshift, Elasticache, ELB, and ENI in same AZ = FREE with private IP and US$0.010/GB with public IP
- EC2, RDS, Redshift, Elasticache, ELB, and ENI in different AZ = US$0.010/GB

# Pricing

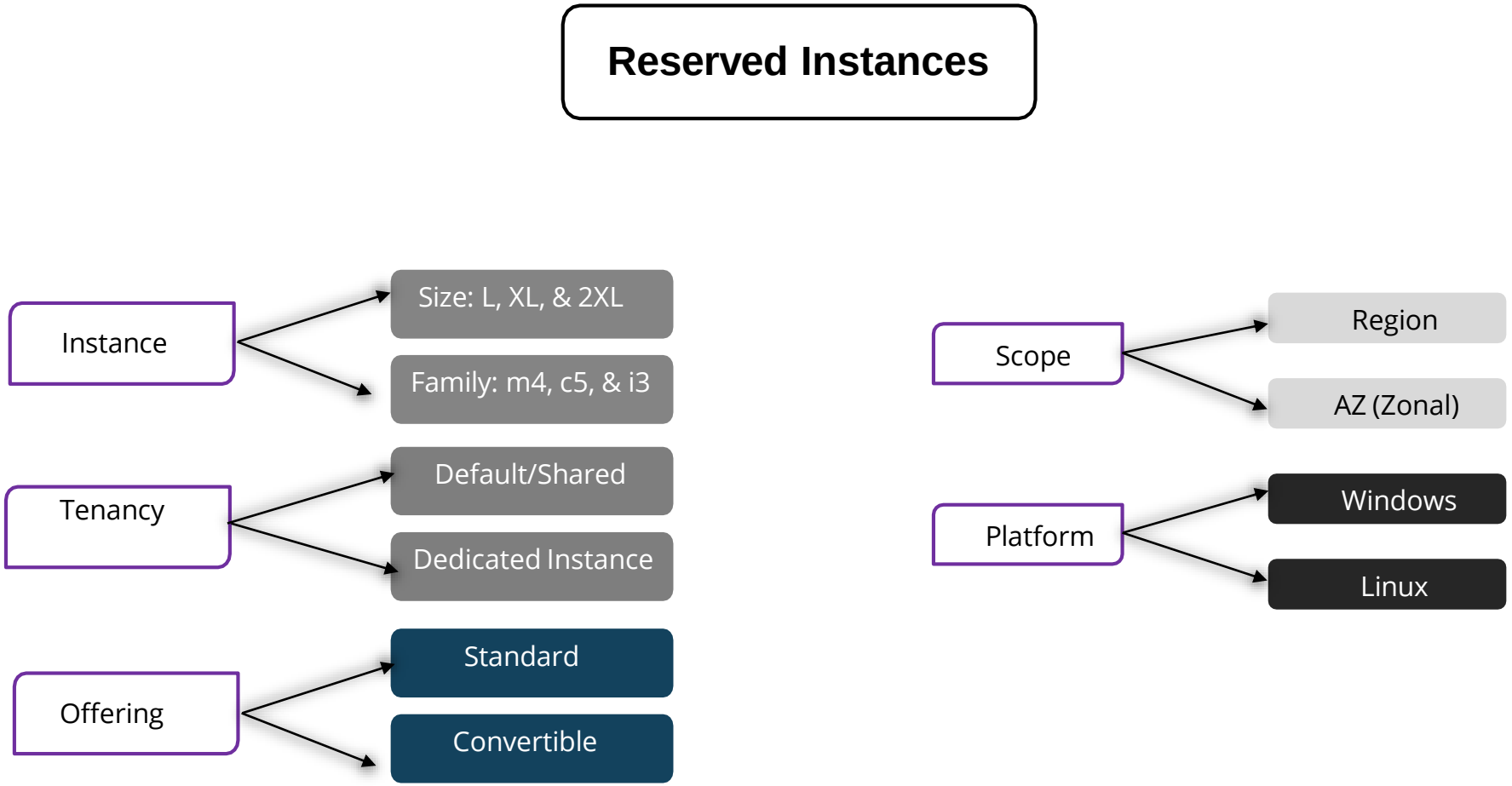
Reserved Instance: 1 to 3-year terms Pricing
(on-demand us-east-1 region)

**M5.XLARGE = US$0.192/hr**

**Yearly = US$1681.92**

| Payment Type | One Time Payment | Total Yearly Cost | Savings |
|---|---|---|---|
| No Upfront | US$0 | US$89.79*12 = US$1077.48 | 36% |
| Partial Upfront | US$512 | US512 + (42.34*12) = US$1020.08 | 39% |
| Full Upfront | US$1003 | US$1003 | 40% |

# EC2 Purchasing Options (RI)



# EBS Pricing

- gp2: US$0.1 per GB per month
- io1: US$0.125 per GB per month and US$0.065 per provisioned IOPS per month st1: US$0.045 per GB per month
- sc1: US$0.025 per GB per month
- EBS snapshot to Amazon S3: US$0.05 per GB per month

- Free Tier: 30 GB/month, a combination of gp2 and magnetic. 2,000,000 IO with magnetic, 1 GB of snapshot storage

Uptime SLA: 99.99%

India : +91-7847955955

US : 1-800-216-8930 (TOLL FREE)

support@intellipaat.com

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