AWSOME DAY
ONLINE CONFERENCE

Module 2
AWS Foundational Services

Module 2 Layout

- Amazon Elastic Compute Cloud (EC2)
- Amazon Virtual Private Cloud (VPC)
- Amazon Storage Services
  - Amazon Simple Storage Service (S3)
  - Amazon Elastic Block Store (EBS)

Amazon Elastic Compute Cloud (EC2)

Amazon Elastic Computer Cloud (EC2)

Amazon EC2

- **Resizable** compute capacity
- Complete control of your computing resources
- **Reduced time required** to obtain and boot new server instances

Amazon EC2 Facts

- **Scale capacity** as your computing requirements change
- Pay only for capacity that you actually use
- Choose **Linux** or **Windows**
- Deploy across **AWS Regions** and **Availability Zones** for reliability
- Use **tags** to help manage your Amazon EC2 resources

Launching an Amazon EC2 Instance via the Management Console

1. **Determine the AWS Region** in which you want to launch the Amazon EC2 instance.
2. **Launch** an Amazon EC2 instance from a pre-configured Amazon Machine Image (AMI).
3. **Choose an instance type** based on CPU, memory, storage, and network requirements.
4. **Configure** network, IP address, security groups, storage volume, tags, and key pair.

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Amazon Machine Image (AMI) Details

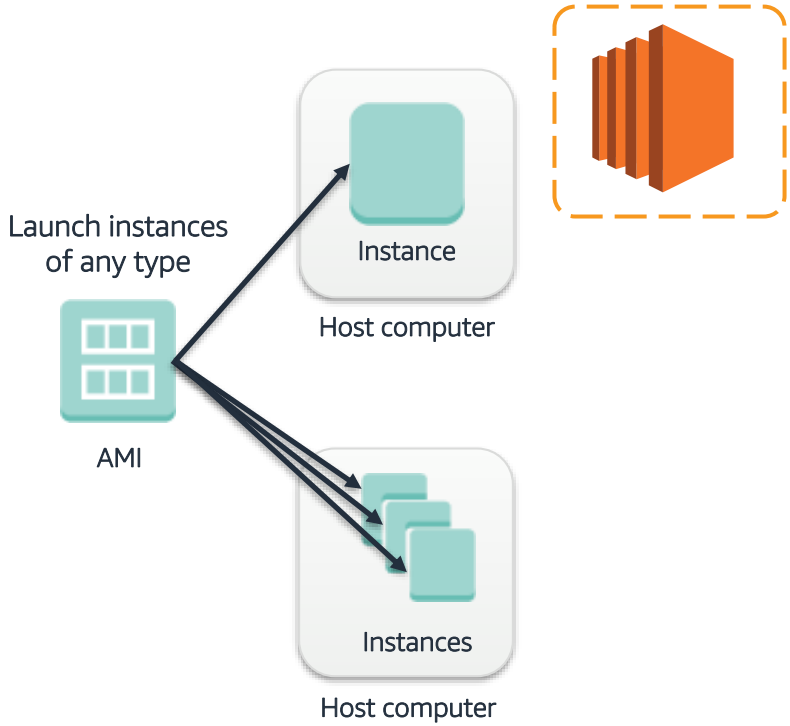
An AMI includes the following:

- A template for the **root volume** for the instance (for example, an operating system, an application server, and applications).
- **Launch permissions** that control which AWS accounts can use the AMI to launch instances.
- A block device mapping that specifies the **volumes to attach** to the instance when it is launched.

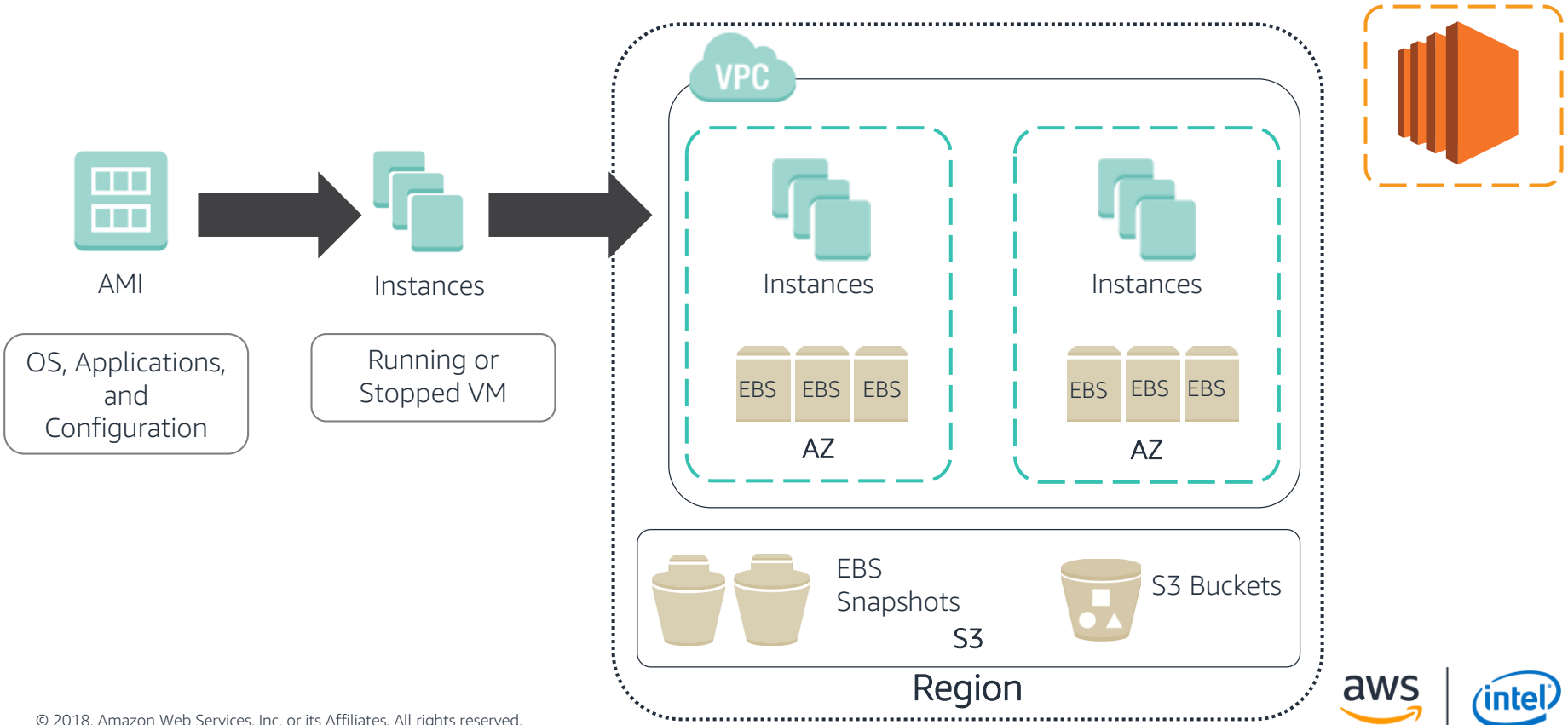
Instances and AMIs

Select an AMI based on:

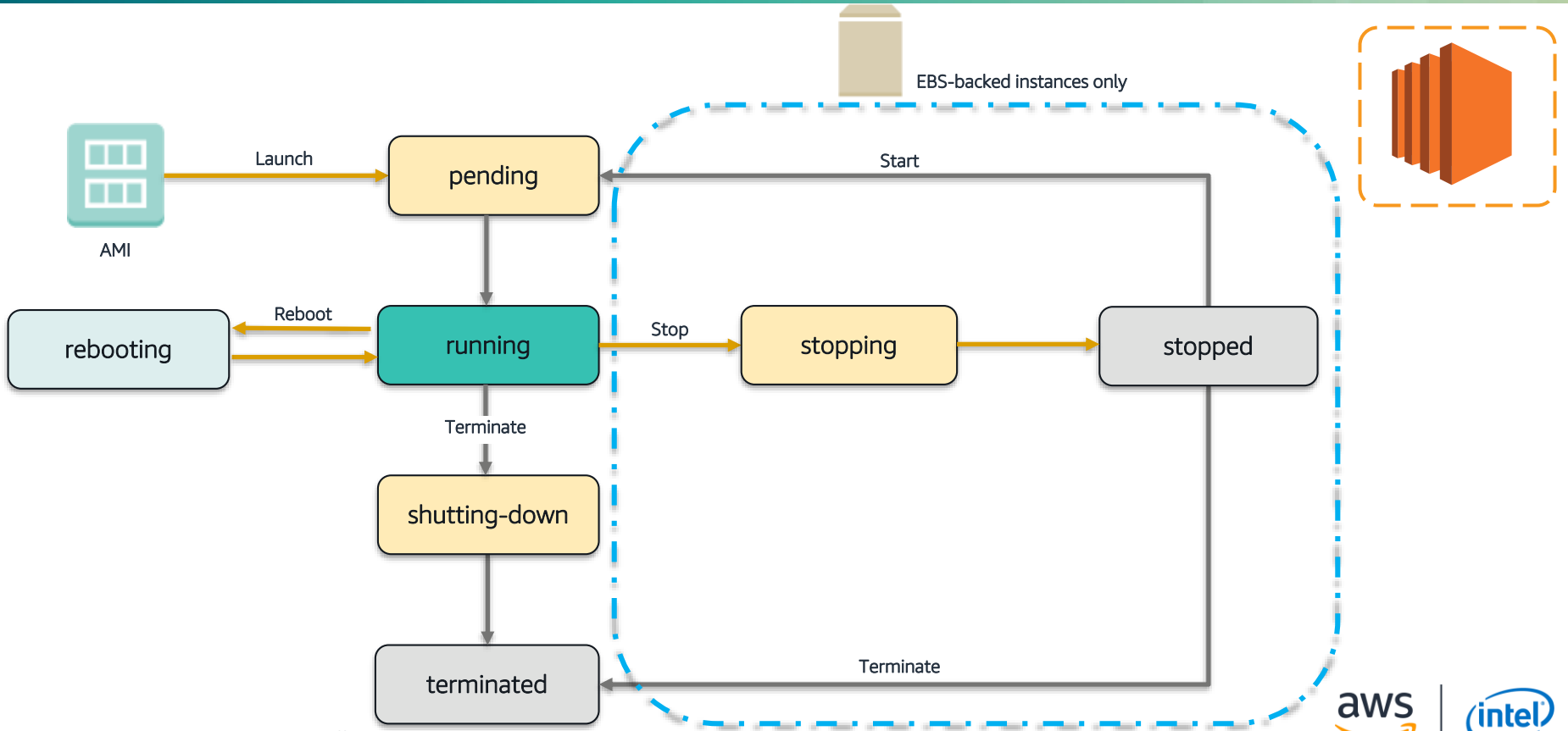
- Region
- Operating system
- Architecture (32-bit or 64-bit)
- Launch permissions
- Storage for the root device



Amazon EC2 Instances



Instance Lifecycle

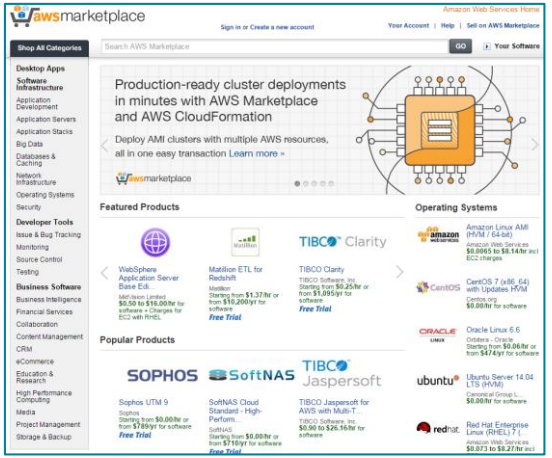


AWS Marketplace – IT Software Optimized for the Cloud

- Online store to discover, purchase, and deploy IT software on top of the AWS infrastructure.
- Catalog of **4000+** IT software solutions including Paid, BYOL, Open Source, SaaS, and free-to-try options.
- Pre-configured to operate on AWS.
- Software checked by AWS for security and operability.
- Deploys to AWS environment in minutes.
- Flexible, usage-based billing models.
- Software charges billed to AWS account.

Includes AWS Test Drive.

https://aws.amazon.com/marketplace



Choosing the Right Amazon EC2 Instance

- EC2 Instance types are optimized for different use cases, workloads & come in multiple sizes. This allows you to optimally scale resources to your workload requirements.
- AWS utilizes Intel® Xeon® processors for EC2 Instances providing customers with high performance and value.
- Consider the following when choosing your instances: core count, memory size, storage size & type, network performance, I/O requirements & CPU technologies.
- Hurry Up & Go Idle - A larger compute instance can save you time and money, therefore paying more per hour for a shorter amount of time can be less expensive.

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Get the Intel® Advantage

Intel's latest 22nm Skylake microarchitecture on new C4 instances, with custom Intel® Xeon® v3 processors, provides new features:

Skylake microarchitecture has better branch prediction; greater efficiency at prefetching instructions and data; along with other improvements that can **boost existing applications**' performance by **30% or more**

P state and C state control provides the ability to individually tune each cores performance and sleep states to improve application performance

Intel® AVX2.0 instructions can double the floating-point performance for compute-intensive workloads over Intel® AVX, and provide additional instructions useful for compression and encryption

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Intel® Processor Technologies

- Intel® AVX – Get dramatically better performance for highly parallel HPC workloads such as life science engineering, data mining, financial analysis, or other technical computing applications. AVX also enhances image, video, and audio processing.
- Intel® AES-NI – Enhance your security with these new encryption instructions that reduce the performance penalty associated with encrypting/decrypting data.
- Intel® Turbo Boost Technology – Get more computing power when you need it with performance that adapts to spikes in your workload with Intel® Turbo Boost Technology 2.0

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X1 Instance – Tons of Memory

The X1 instance:

- Features up to 2TB of memory and 100 vCPU.
- Uses Intel E7 v3 Haswell processors.
- Is designed for demanding enterprise workloads, including production installations of SAP HANA, Microsoft SQL Server, Apache Spark, and Presto.

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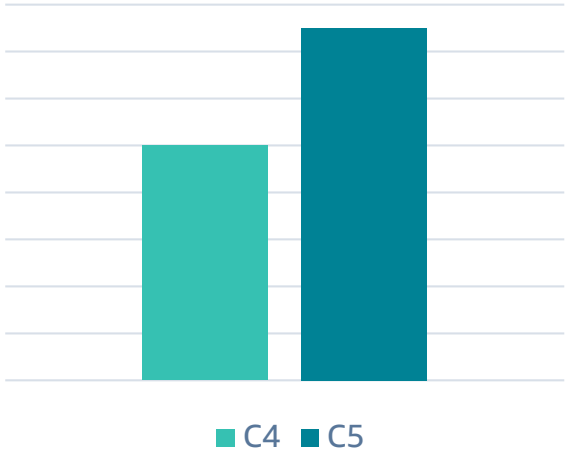
EC2 Instances With Intel® Technologies

EC2 Instance Type	Compute Optimized		General Purpose			Memory Optimized			Storage Optimized		
	C5	C4	M5	M4	T2	X1	X1e	R4	H1	I3	D2
Intel Processor	Xeon Platinum 8175M	Xeon E5 2666 v3	Xeon Platinum 8175M	Xeon E5 2686 v4 2676 v3	Xeon Family	Xeon E7 8880 v3	Xeon E7 8880 v3	Xeon E5 2686 v4	Xeon E5 2686 v4	Xeon E5 2686 v4	Xeon E5 2676 v3
Intel Processor Technology	Skylake	Haswell	Skylake	Broadwell Haswell	Yes	Haswell	Haswell	Broadwell	Broadwell	Broadwell	Haswell
Intel AVX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intel AVX2	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes
Intel AVX-512	Yes	-	Yes	-	-	-	-	-	-	-	-
Intel Turbo Boost	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Storage	EBS-only	EBS-only	EBS-only	EBS-only	EBS-only	SSD EBS-Opt	SSD EBS-Opt	-	HDD	SSD	HDD

C5: Compute Optimized Instances

25% price/performance improvement over C4



- Based on 3.0 GHz Intel Xeon Scalable Processors (Skylake)
- Up to 72 vCPUs and 144 GiB of memory (2:1 Memory:vCPU ratio)
- 25 Gbps NW bandwidth
- Support for Intel AVX-512

NETFLIX

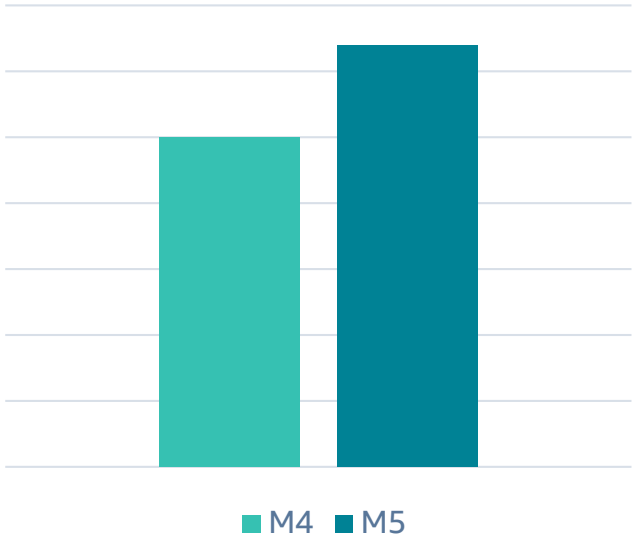
"We saw significant performance improvement on Amazon EC2 C5, with up to a 140% performance improvement in industry standard CPU benchmarks over C4."

GRAIL

"We are eager to migrate onto the AVX-512 enabled c5.18xlarge instance size… . We expect to decrease the processing time of some of our key workloads by more than 30%."

M5: Next-Gen General Purpose instance

14% price/performance improvement With M5



- Powered by 2.5 GHz Intel Xeon Scalable Processors (Skylake)
- New larger instance size—m5.24xlarge with
  96 vCPUs and 384 GiB of memory
  (4:1 Memory:vCPU ratio)
- Improved network and EBS performance on smaller instance sizes
- Support for Intel AVX-512 offering up to twice the performance for vector and floating point workloads

Current Generation Instances

Instance Family	Some Use Cases
General purpose (t2, m4)	• Low-traffic websites and web applications • Small databases and mid-size databases
Compute-optimized (c4)	• High performance front-end fleets • Video-encoding
Memory-optimized (r4)	• High performance databases • Distributed memory caches
Storage-optimized (i3, d2)	• Data warehousing • Log or data-processing applications
GPU instances (p2, g3)	• 3D application streaming • Machine learning

Complete list at https://aws.amazon.com/ec2/instance-types/

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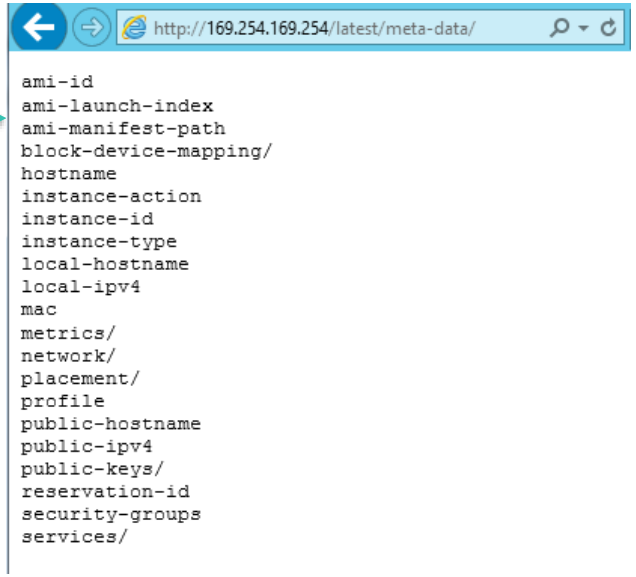
Instance Metadata

- Is **data** about your **instance**.
- Can be used to **configure or manage** a running instance.

Retrieving Instance Metadata

To view all categories of instance metadata from within a running instance, use the following URI:

`http://169.254.169.254/latest/meta-data/`



On a Linux instance, you can use:

- `$ curl http://169.254.169.254/latest/meta-data/`
- `$ GET http://169.254.169.254/latest/meta-data/`

All metadata is returned as text (content type text/plain).

Instance User Data

- Can be passed to the instance **at launch**.
- Can be used to perform common **automated configuration tasks**.
- Runs scripts after the instance starts.

Adding User Data

- You can specify user data when launching an instance.
- User data can be:
  - Linux script – executed by **cloud-init**
  - Windows batch or PowerShell scripts – executed by **EC2Config** service
- User data scripts run once per instance ID by default.

User Data Example Linux

```
#!/bin/sh
yum -y install httpd
chkconfig httpd on
/etc/init.d/httpd start
```

User data shell scripts must start with the #! characters and the path to the interpreter you want to read the script.

Install Apache web server
Enable the web server
Start the web server

User Data Example Windows

```
<powershell>
Import-Module ServerManager

Install-WindowsFeature web-server, web-webserver
Install-WindowsFeature web-mgmt-tools
</powershell>
```

Import the Server Manager module for Windows PowerShell.

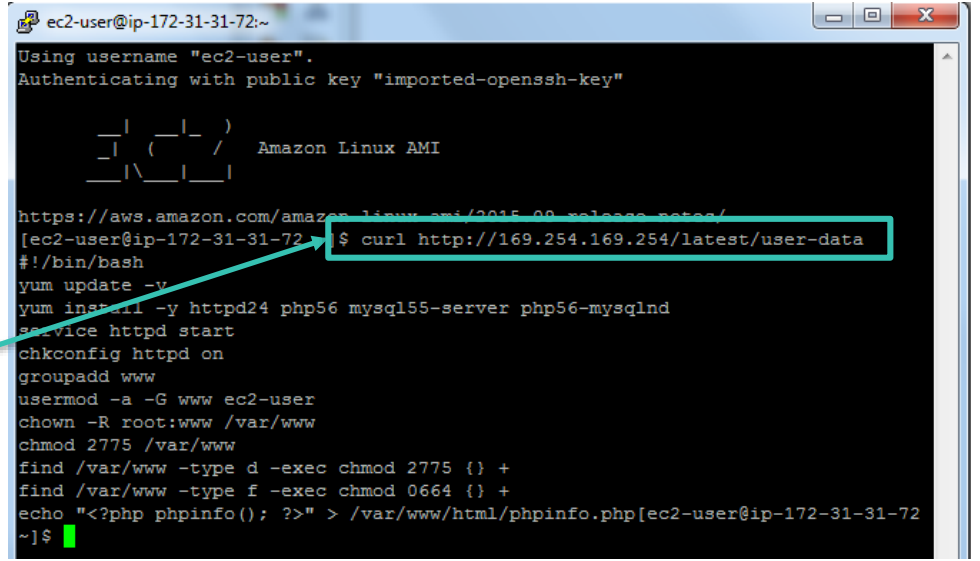
Install IIS
Install Web Management Tools

Retrieving User Data

To retrieve user data, use the following url:
`http://169.254.169.254/latest/user-data`

On a Linux instance, you can use:

```
$ curl http://169.254.169.254/latest/user-data/
$ GET http://169.254.169.254/latest/user-data/
```



Amazon EC2 Purchasing Options

On-Demand Instances

Pay by the hour.

Reserved Instances

Purchase, at a significant discount, instances that are always available

1-year to 3-year terms.

Scheduled Instances

Purchase instances that are always available on the specified recurring schedule, for a one-year term.

Spot Instances

Bid on unused instances, which can run as long as they are available and your bid is above the Spot price.

Dedicated Instances

Pay, by the hour, for instances that run on single-tenant hardware.

Dedicated Hosts

Pay for a physical host that is fully dedicated to running your instances.

Networking – Amazon VPC

Amazon Virtual Private Cloud (VPC)

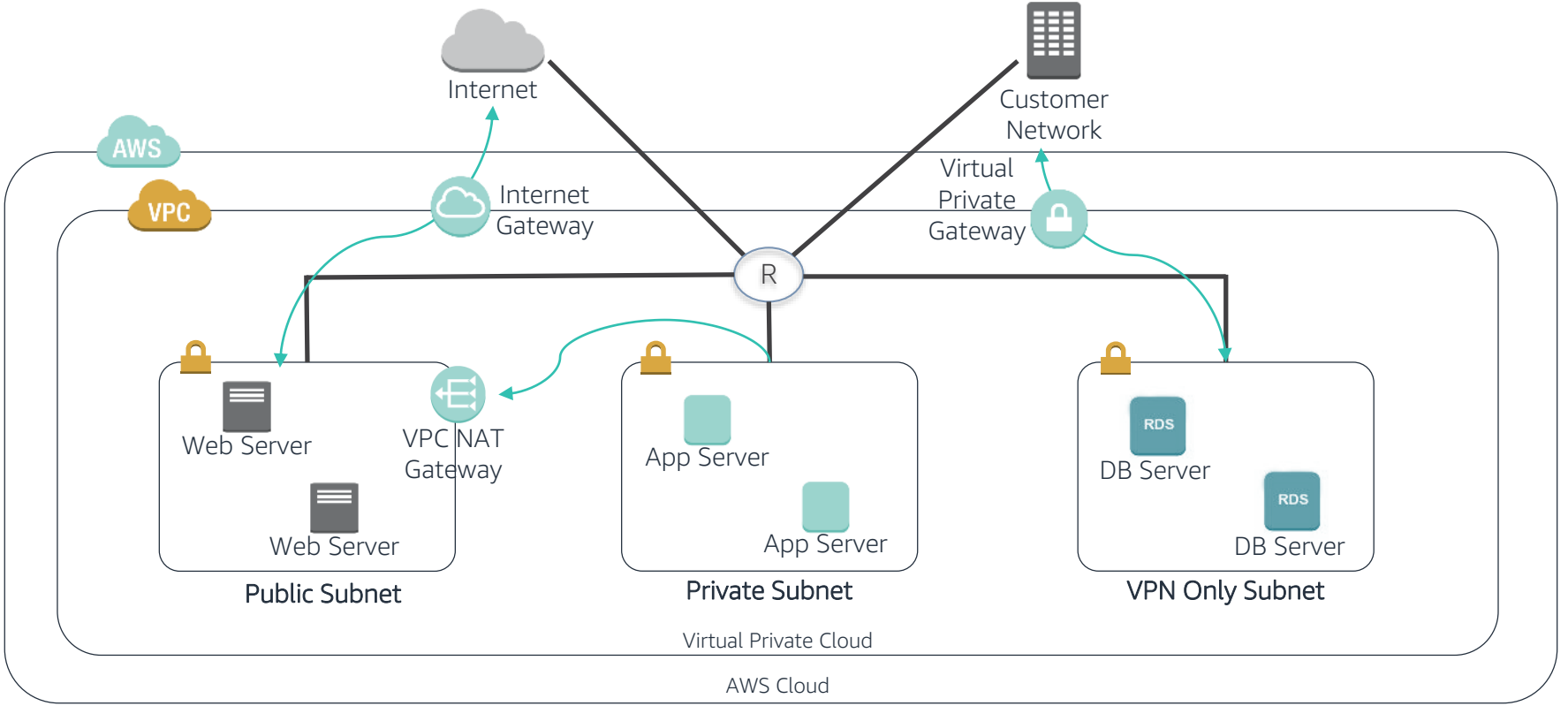
Amazon VPC

- Provision a **private, isolated virtual network** on the AWS cloud.
- Have complete control over your virtual networking environment.

VPCs and Subnets

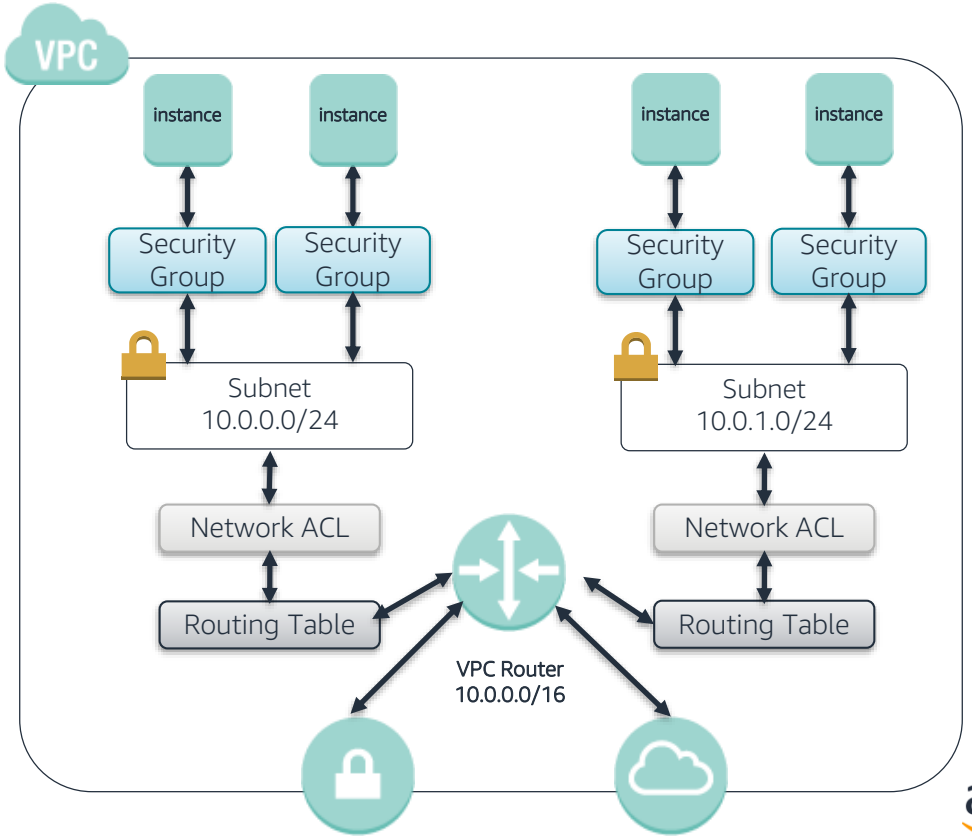
- A **subnet** defines a range of IP addresses in your VPC.
- You can launch AWS resources into a subnet that you select.
- A **private subnet** should be used for resources that won't be accessible over the Internet.
- A **public subnet** should be used for resources that will be accessed over the Internet.
- Each subnet must reside entirely within one Availability Zone and cannot span zones.

Amazon VPC Example



Security in Your VPC

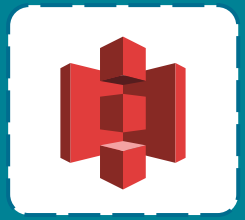
- Security groups
- Network access control lists (ACLs)
- Key Pairs



Instructor Demo Amazon EC2

Storage Services Amazon S3 and Amazon EBS

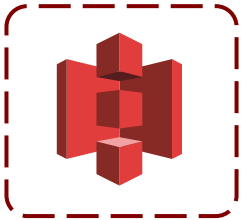
Amazon Simple Storage Service (S3)



Amazon S3

- Storage for the Internet
- Natively online, HTTP access
- Storage that allows you to store and retrieve **any amount of data**, any time, from anywhere on the web
- **Highly scalable**, reliable, fast and durable

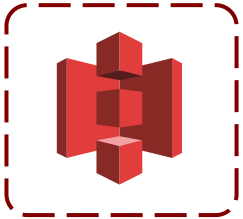
Amazon S3 Facts



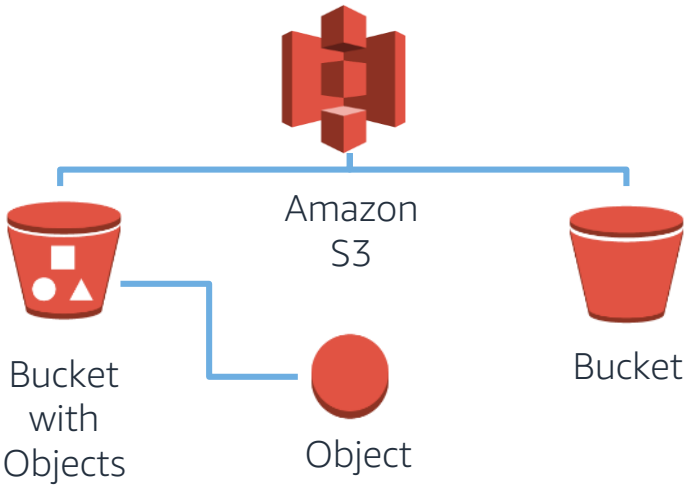
- Can store an **unlimited number of objects** in a bucket
- Objects can be **up to 5 TB**; no bucket size limit
- Designed for **99.999999999%** durability and **99.99%** availability of objects over a given year
- Can use **HTTP/S** endpoints to store and retrieve any amount of data, at any time, from anywhere on the web
- Is highly scalable, reliable, fast, and inexpensive
- Can use optional server-side **encryption** using AWS or customer-managed provided client-side encryption
- Auditing is provided by access logs
- Provides standards-based **REST** and SOAP interfaces

Common Use Scenarios

- Storage and backup
- Application file hosting
- Media hosting
- Software delivery
- Store AMIs and snapshots



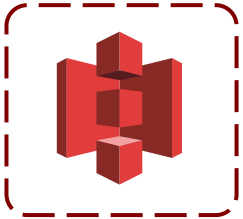
Amazon S3 Concepts



- Amazon S3 stores data as objects within **buckets**
- An object is composed of a file and optionally any **metadata** that describes that file
- You can have **up to 100 buckets** in each account
- You can **control access** to the bucket and its objects

Object Keys

An object key is the unique identifier for an object in a bucket.

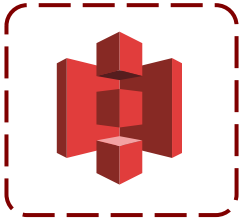


http://doc.s3.amazonaws.com/2006-03-01/AmazonS3.html

Bucket

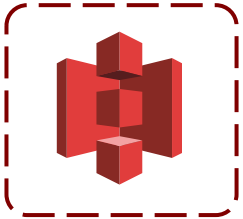
Object/Key

Amazon S3 Security



- You can **control access** to buckets and objects with:
  - Access Control Lists (ACLs)
  - Bucket policies
  - Identity and Access Management (IAM) policies
- You can upload or download data to Amazon S3 via **SSL** encrypted endpoints.
- You can **encrypt data** using AWS SDKs.

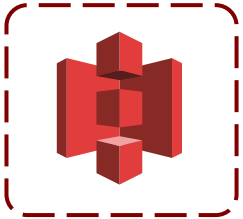
Amazon S3 Versioning



- Protects from **accidental overwrites and deletes** with no performance penalty.
- Generates a **new version with every upload**.
- Allows easily retrieval of deleted objects or **roll back** to previous versions.
- Three states of an Amazon S3 bucket
  - Un-versioned (default)
  - Versioning-enabled
  - Versioning-suspended

Versioning Enabled

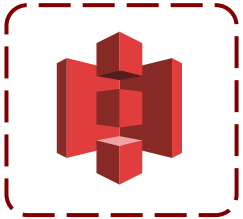
Amazon S3 Object Lifecycle



Lifecycle management defines how Amazon S3 manages objects during their lifetime. Some objects that you store in an Amazon S3 bucket might have a well-defined lifecycle:

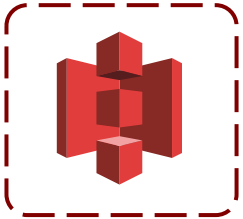
- Log files
- Archive documents
- Digital media archives
- Financial and healthcare records
- Raw genomics sequence data
- Long-term database backups
- Data that must be retained for regulatory compliance

Amazon S3 Pricing



- Pay only for what you use
- No minimum fee
- Prices based on location of your Amazon S3 bucket
- Estimate monthly bill using the **AWS Simple Monthly Calculator**
- Pricing is available as:
  - Storage Pricing
  - Request Pricing
  - Data Transfer Pricing: data transferred out of Amazon S3

Amazon Glacier

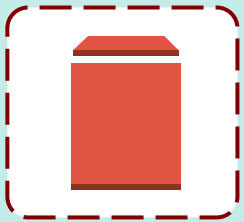


- Long term low-cost archiving service
- Optimal for infrequently accessed data
- Designed for 99.999999999% durability
- Three to five hours' retrieval time
- Less than $0.01 per GB/month (depending on region)

Amazon S3 Storage Classes

Storage Class	Durability	Availability	Other Considerations
Amazon S3 Standard	99.999999999%	99.99%	
Amazon S3 Standard - Infrequent Access (IA)	99.999999999%	99.9%	• Retrieval fee associated with objects • Most suitable for infrequently accessed data
Glacier	99.999999999%	99.99% (once restored)	• Not available for real-time access • Must restore objects before you can access them • Restoring objects can take 3-5 hours

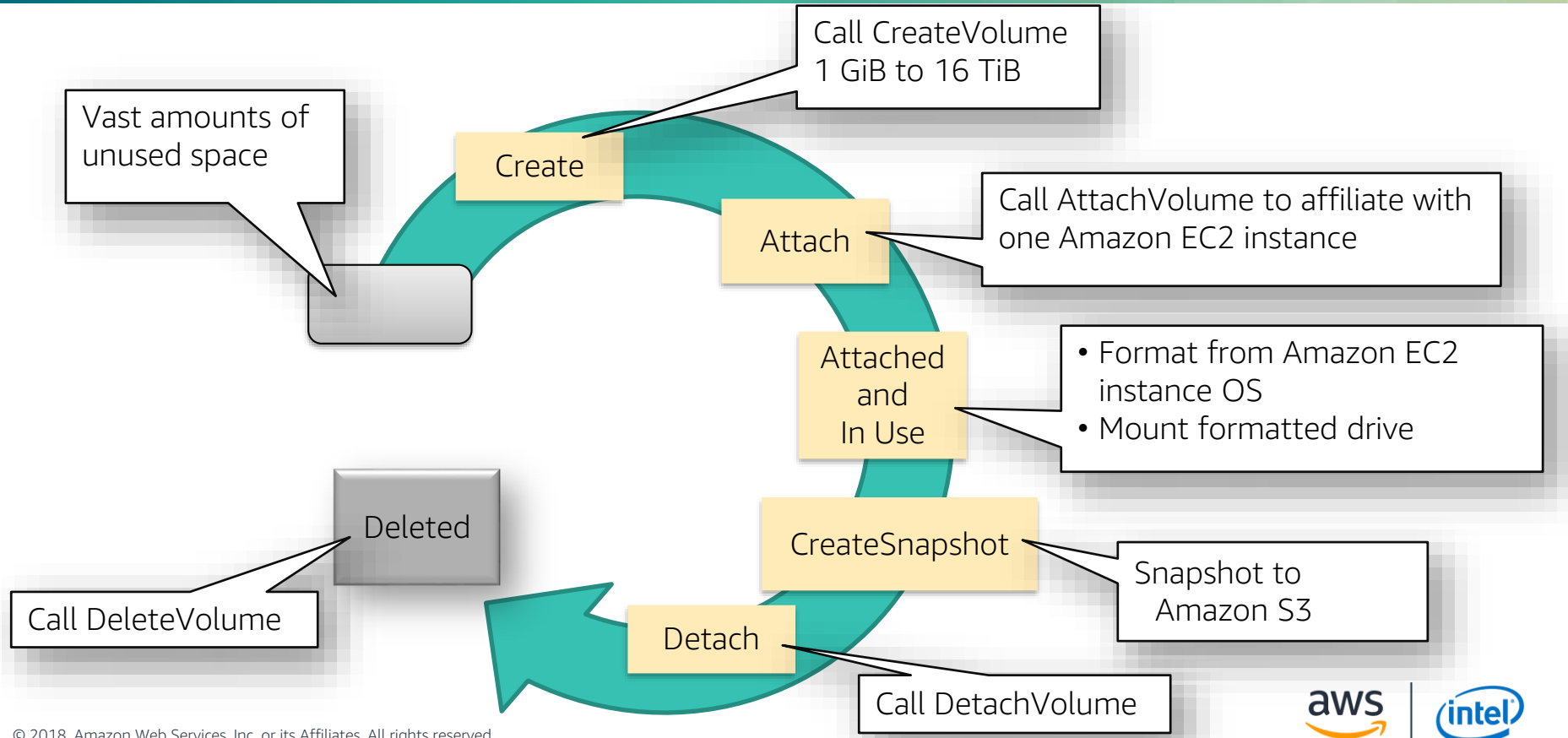
Amazon Elastic Block Store (EBS)



Amazon EBS

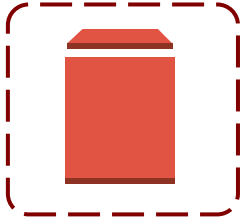
- **Persistent block level storage** volumes offer consistent and low-latency performance.
- Stored data is automatically replicated within its Availability Zone.
- Snapshots are stored durably in Amazon S3.

Amazon EBS Lifecycle



Amazon EBS Volume Types

- SSD-backed volumes are
  - Optimized for **transactional** workloads that involve **frequent read/write** operations with **small I/O** size.
  - Dominant in **IOPS** performance.
- HDD-backed volumes are
  - Optimized for **large streaming** workloads.
  - Dominant in **throughput** (measured in MiB/s).

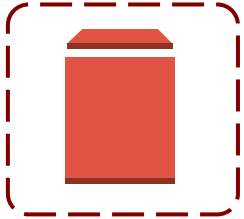


Amazon EBS Volume Types

	SSD		HDD	
Volume Type	General Purpose SSD (gp2)	Provisioned IOPS SSD (io1)	Throughput Optimized HDD (st1)	Cold HDD (sc1)
Description	Balances price and performance for a wide variety of **transactional** loads.	**Highest-performance** SSD volume designed for **mission-critical** applications.	**Low-cost** HDD designed for **frequently accessed**, **throughput-intensive** workloads.	**Lowest cost** HDD designed for less frequently accessed workloads.
Volume Sizes	1 GiB – 16 TiB	4 GiB – 16 TiB	500 GiB – 16 TiB	500 GiB – 16 TiB
Dominant Performance Attribute	IOPS	IOPS	MiB/s	MiB/s

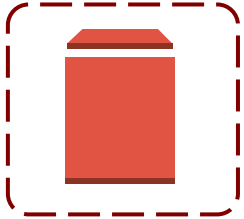
Amazon EBS Facts

- EBS is recommended when data must be **quickly accessible** and requires **long-term persistence**.
- You can launch your EBS volumes as **encrypted** volumes – data stored at rest on the volume, disk I/O, and snapshots created from the volume are all encrypted.
- You can create **point-in-time snapshots** of EBS volumes, which are persisted to Amazon S3.

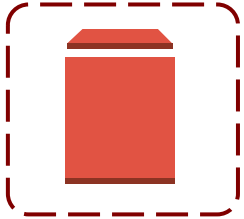


Amazon EBS Use Cases

- **OS:** Use for boot/root volume, secondary volumes
- **Databases:** Scales with your performance needs
- **Enterprise applications:** Provides reliable block storage to run mission-critical applications
- **Business continuity:** Minimize data loss and recovery time by regularly backing up using EBS Snapshots
- **Applications:** Install and persist any application



Amazon EBS Pricing



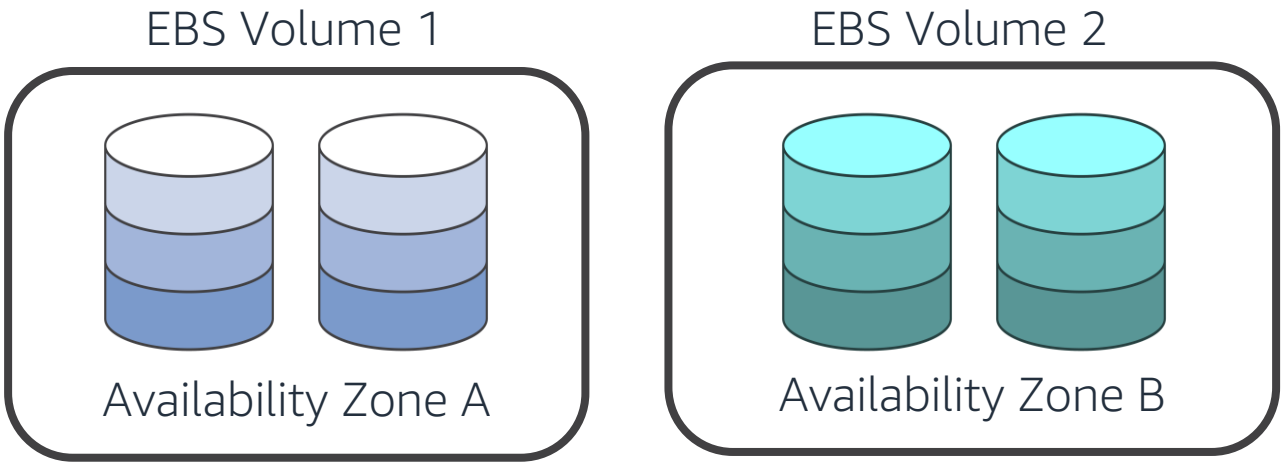
Pay for what you provision:

- Pricing based on region
- Review Pricing Calculator online
- Pricing is available as:
  - Storage
  - IOPS

** Check Amazon EBS Pricing page for current pricing for all regions.*

Amazon EBS Scope

Amazon EBS volumes are in a single Availability Zone



Volume data is replicated across multiple servers in an Availability Zone.

Amazon EBS and Amazon S3

	Amazon EBS 	Amazon S3 
Paradigm	Block storage with file system	Object store
Performance	Very fast	Fast
Redundancy	Across multiple servers in an Availability Zone	Across multiple facilities in a Region
Security	EBS Encryption – Data volumes and Snapshots	Encryption
Access from the Internet?	No (1)	Yes (2)
Typical use case	It is a disk drive	Online storage

(1) Accessible from the Internet if mounted to server and set up as FTP, etc.
(2) Only with proper credentials, unless ACLs are world-readable

Amazon EC2 Instance Storage

- Is local, complimentary **direct attached block storage**.
- Includes availability, number of disks, and size **based on EC2 instance type**.
- Is optimized for **up to 365,000 Read IOPS** and 315,000 First Write IOPS.
- Is SSD or magnetic.
- Has **no persistence**.
- A**utomatically deletes** data when an EC2 instance stops, fails or is terminated.

Amazon EBS vs. Amazon EC2 Instance Store

Amazon EBS

- Data stored on an Amazon EBS volume can persist independently of the life of the instance.
- Storage is **persistent**.

Amazon EC2 Instance Store

- Data stored on a local instance store persists only as long as the instance is alive.
- Storage is **ephemeral**.

Reboot vs. Stop vs. Terminate

Characteristic	Reboot	Stop/Start (EBS-backed instances only)	Terminate
Host computer	The instance **stays on the same host computer**.	The instance runs on a **new host computer**.	
Public IP address	No change	**New address assigned**	
Elastic IP addresses (EIP)	EIP remains associated with the instance.	EIP remains associated with the instance.	EIP is **disassociated** from the instance.
Instance store volumes	Preserved	Erased	Erased
EBS volume	Preserved	Preserved	Boot volume is **deleted by default**.
Billing	Instance billing hour doesn't change.	You **stop incurring charges** as soon as state is changed to *stopping*.	You **stop incurring charges** as soon as state is changed to *shutting-down*.

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