



AWS
re:Invent

STG303-R

Deep Dive on Amazon Elastic Block Store

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Consumer



Enterprise Technology



Financial Services / Real Estate



Oil & Gas / Manufacturing / Telecom



Media & Gaming



Govt. / Education / Healthcare



Agenda for the session

Security and Encryption with EBS

Performance Best Practices for EBS

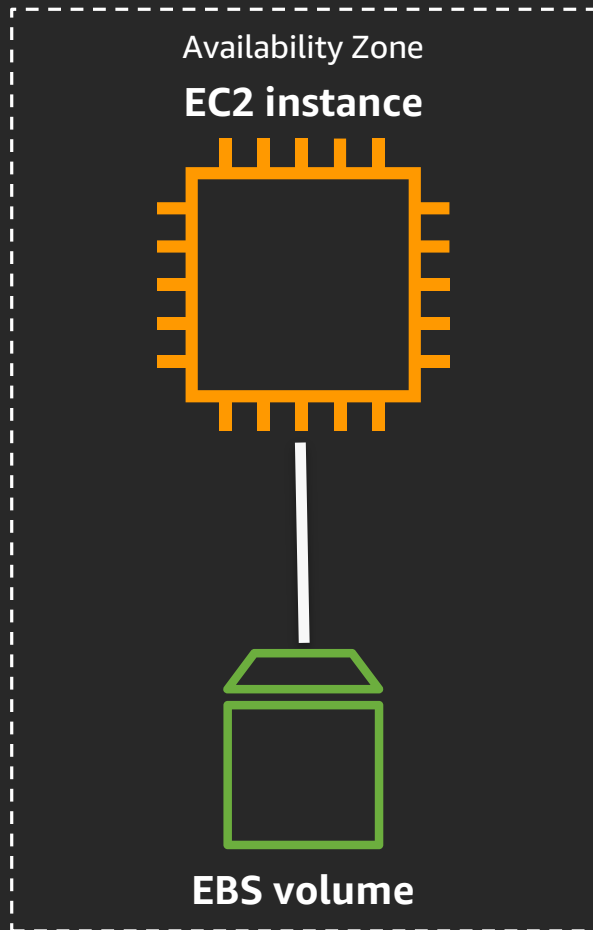
Availability / Durability for EBS

Saving Cost with EBS

How a customer uses EBS – Teradata

Security and Encryption with EBS

Encryption – Amazon EBS



Integrates with Amazon Key Management Service (KMS) – AES-256 Encryption

Uses Customer Master Keys (CMKs)

Encrypted EBS volume implies the following are encrypted:

- **Data at rest** inside the volume
- **Data moving** between the volume and instance
- **Snapshots created** from the volume
- **Volumes created** from such snapshots

EBS Volume encryption



EBS encryption:
data volumes

Volumes > Create Volume

Create Volume

Volume Type General Purpose SSD (gp2) ⓘ

Size (GiB) 100 (Min: 1 GiB, Max: 16384 GiB) ⓘ

IOPS 300 / 3000 (Baseline of 3 IOPS per GiB with a minimum of 100 IOPS, burstable to 3000 IOPS) ⓘ

Availability Zone* us-east-1a ⓘ

Throughput (MB/s) Not applicable ⓘ

Snapshot ID Select a snapshot ⓘ ⓘ

Encryption ☒ Encrypt this volume ⓘ

Master Key (default) aws/eks ⓘ ⓘ

KMS Key Description Default master key that protects my EBS volumes when no other key is defined

KMS Key Account This account ██████████

KMS Key ID bae63fd5-6121-411b-84d1-fd93f8d8b6a4

KMS Key ARN arn:aws:kms:us-east-1:██████████:key/bae63fd5-6121-411b-84d1-fd93f8d8b6a4

Key (127 characters maximum)	Value (255 characters maximum)
Name	Encrypted Volume ⓘ
Application Name	App01 ⓘ
Add Tag 48 remaining (Up to 50 tags maximum)	

Cancel Create Volume

EBS Volume encryption



EBS encryption:
data volumes

Master Key

(default) aws/ebs

KMS Key Description

Default master key that protects my EBS volumes when no other key is defined

KMS Key Account

This account

KMS Key ID

bae63fd5-6121-411b-84d1-fd93f8d8b6a4

KMS Key ARN

arn:aws:kms:us-east-1:::key/bae63fd5-6121-411b-84d1-fd93f8d8b6a4

Key	Value	
Name	Encrypted Volume	✕
Application Name	App01	✕

Add Tag

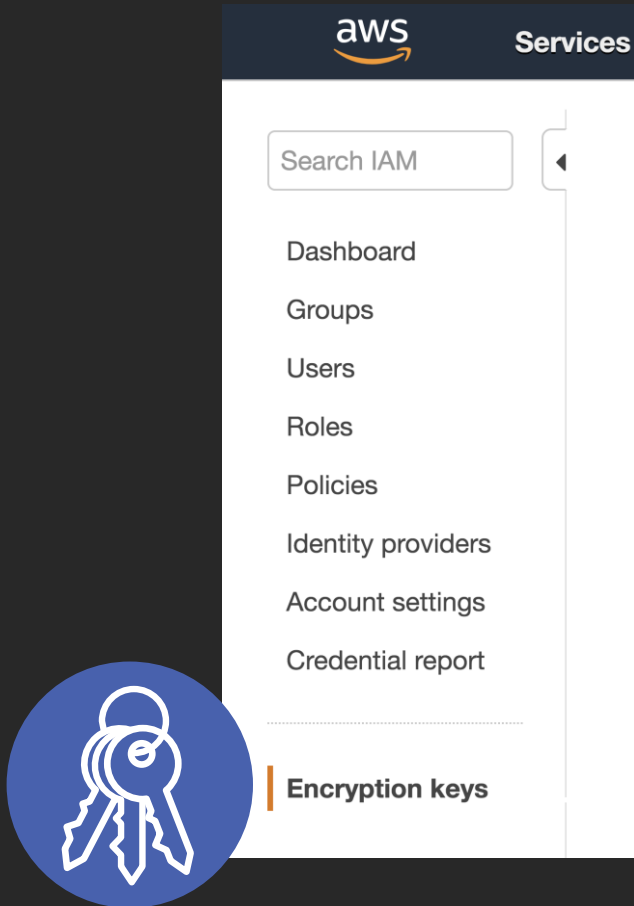
48 remaining

(Up to 50 tags maximum)

Cancel

Create Volume

EBS Volume encryption



Create a new AWS KMS master key for EBS

Create Alias and Description

Provide an alias and a description for this key. These properties of the key can be changed later. [Learn more](#).

Alias (required)

ebs-master

Description

Master EBS Encryption Key



- Define key rotation policy
- Enable AWS CloudTrail auditing
- Control who can use key
- Control who can administer key

EBS Volume encryption



EBS encryption:
data volumes

Encryption ☒ Encrypt this volume

Master Key ebs-master

KMS Key Description Master EBS Encryption Key

KMS Key Account This account ()

KMS Key ID 9b117d93-c37a-495c-baef-404515f2ed7f

KMS Key ARN arn:aws:kms:us-east-1: :key/9b117d93-c37a-495c-baef-404515f2ed7f

Key (127 characters maximum)	Value (255 characters maximum)	
Name	Encrypted Volume	
Application Name	App01	

Add Tag 48 remaining (Up to 50 tags maximum)

[Cancel](#) [Create Volume](#)

RunInstances with custom CMKs



EBS encryption:
data volumes

aws

Services

Resource Groups

dg @ pandas

N. Virginia

Support

1. Choose AMI

2. Choose Instance Type

3. Configure Instance

4. Add Storage

5. Add Tags

6. Configure Security Group

7. Review

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. [Learn more about storage options in Amazon EC2.](#)

Volume type	Device	Snapshot	Size (Gib)	Volume type	IOPS	Throughput (MB/s)	Delete on termination	Encrypted
Root	/dev/xvda	snap-01234123412...	8	General purpose SSD (GP2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not encrypted
EBS	/dev/sdb	Search (case-insensitive)	8	General purpose SSD (GP2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not encrypted

Add new volume

Cancel

Previous

Review and Launch

Next: Add Storage

RunInstances with custom CMKs



EBS encryption:
data volumes

aws

Services

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dg @ pandas

N. Virginia

Support

1. Choose AMI

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Step 4: Add Storage

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Root	/dev/xvda	snap-01234123412...	8	General purpose SSD (GP2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not encrypted
EBS	/dev/sdb	Search (case-insensitive)	8	General purpose SSD (GP2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	1111aa11-012...

Add new volume

Filter by attributes or search by keyword

KMS Key Aliases	KMS Key ID
Not encrypted	
MyKey	1111aa11-0120-4e9f-b455-1209de31445f
ExampleKey	2222bb22-0230-4g4g-b346-fsdsdas423t23f
AnotherKey	123qf12e1-1420-456g-b226-g2dsfsd23ewf
NewKey	12dqw12e-2220-sdf23-b416-rg23gsfdg44

Cancel

Previous

Review and Launch

Next: Add Storage

RunInstances with custom CMKs



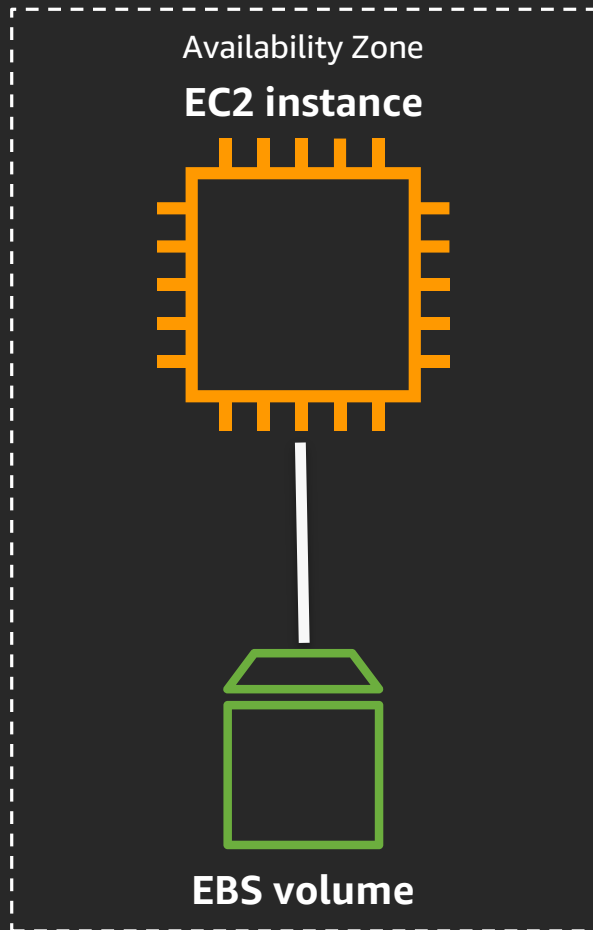
EBS encryption:
data volumes

```
$> aws ec2 run-instances -image-id ami-b42209de -count 1 -  
instance-type m4.large -region us-east-1 -block-device-  
mappings file://mapping.json
```

mapping.json

```
{  
  "DeviceName": "/dev/sda1",  
  "Ebs": {  
    "DeleteOnTermination": true,  
    "VolumeSize": 100,  
    "VolumeType": "gp2",  
    "Encrypted": true,  
    "kmsKeyID": "arn:aws:kms:us-east-1:012345678910:key/abcd1234-  
a123-456a-a12b-a123b4cd56ef"  
  }  
}
```

EBS Optimized Performance and EBS Encryption



Does choosing EBS Encryption reduce EBS Optimized Performance?

- EBS Optimized Performance is the same with and without encryption for the '4' and '5' family of instances
- In other words, encryption does not reduce the rated performance of an instance in the '4' or '5' family.

EBS snapshot encryption



- Snapshots of **encrypted volumes are automatically encrypted**
- Volumes created from encrypted snapshots are automatically encrypted
- You can encrypt an unencrypted snapshot when you copy a snapshot
- You can re-encrypt a snapshot you own with a different key when you copy a snapshot

How are snapshots different?

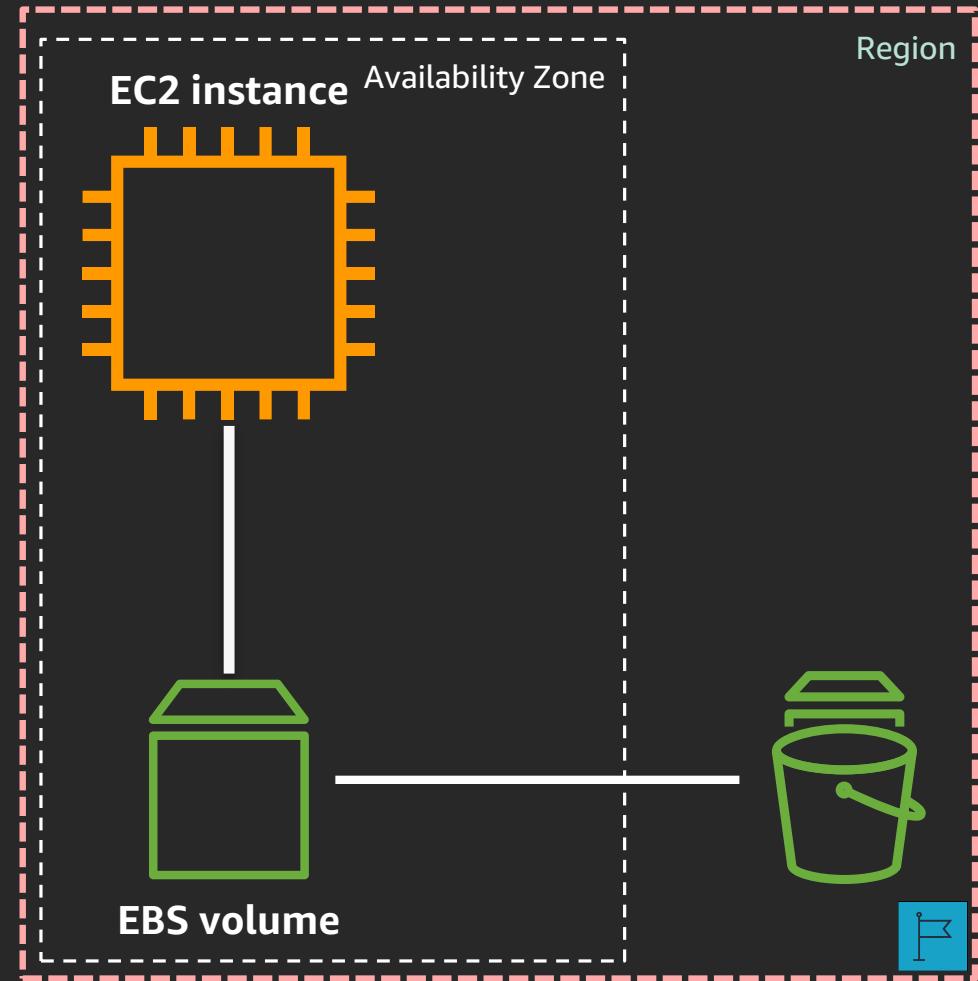
Snapshots can be shared across accounts

Snapshots can be copied across accounts

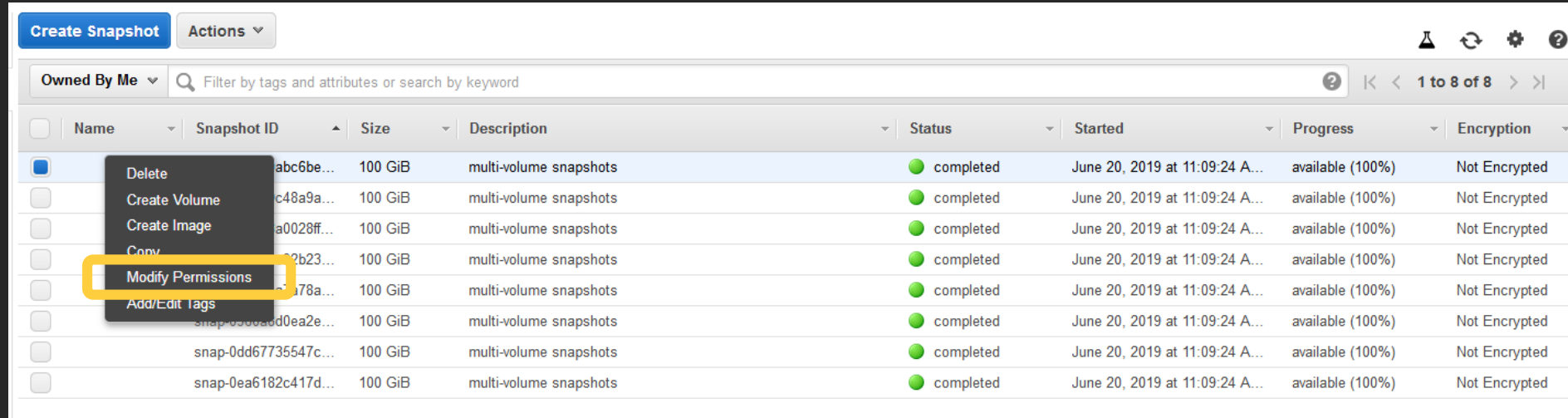
Snapshots can be copied within accounts

Snapshots can be copied across regions

Snapshots are used to create AMIs



Sharing Snapshots and AMIs



```
aws ec2 describe-snapshot-attribute --snapshot-id snap-00d820abc6be8d639 --attribute createVolumePermission
```

```
aws ec2 modify-snapshot-attribute --snapshot-id snap-00d820abc6be8d639 --attribute createVolumePermission
```

```
{
  "SnapshotId": "snap-00d820abc6be8d639",
  "CreateVolumePermissions": []
}
```

Sharing Snapshots and AMIs

The screenshot displays the AWS Management Console interface for managing snapshots. A modal dialog titled "Modify Permissions" is open, allowing the user to share an unencrypted snapshot. The dialog includes a warning about sharing unencrypted snapshots, a section to select the current permission level (Public or Private), and a section to add permissions by entering an AWS Account Number. The background shows a table of snapshots with columns for Name, Snapshot ID, Size, Description, Status, Started, Progress, and Encryption.

Create Snapshot **Actions** Filter by tags and attributes or search by keyword 1 to 8 of 8

Name	Snapshot ID	Size	Description	Status	Started	Progress	Encryption
<input checked="" type="checkbox"/>	snap-00d820abc6be...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-010bb9c48a9a...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-027798a0028ff...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-041d...				20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-06e3...				20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-0960...				20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-0dd6...				20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>	snap-0ea6...				20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted

Modify Permissions

This is an unencrypted snapshot. When you share an unencrypted snapshot, you give another account permission to both copy the snapshot and create a volume from it.

This snapshot is currently: ☐ Public ☒ Private

AWS Account Number

This snapshot currently has no permissions.

AWS Account Number **Add Permission**

Cancel **Save**

Snapshot: snap-00d820abc6be

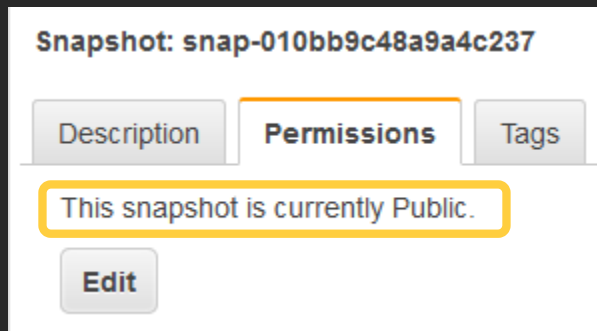
Description **Permissions**

Sharing Snapshots and AMIs

Public sharing: Reasonable use case for AMIs – Marketplace AMIs

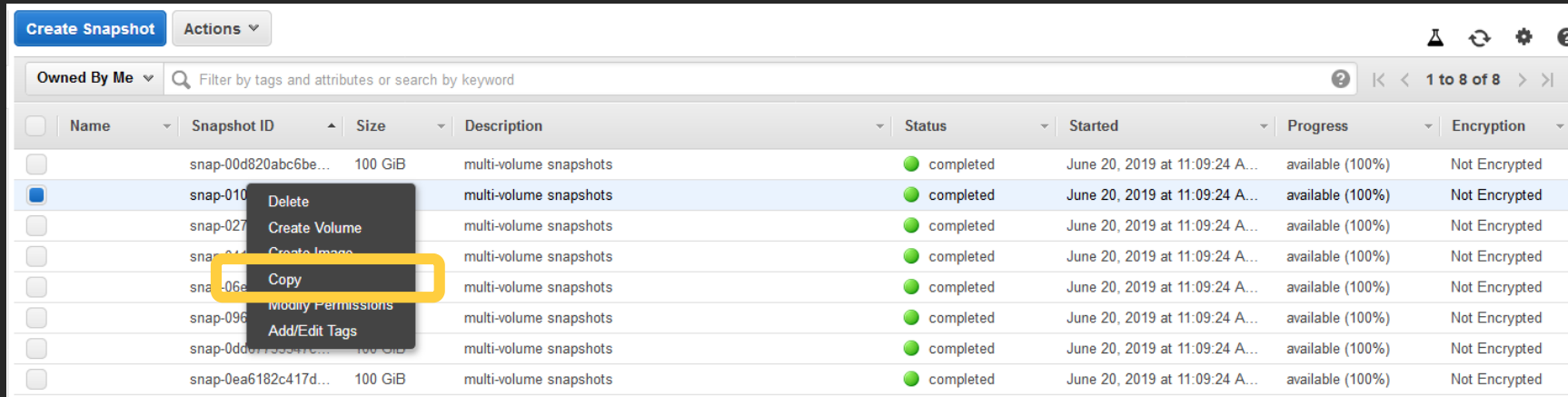
Share non-AMI snapshots with specific accounts

To launch a volume from a snapshot, you need a copy of snapshot in-region



```
snap-010bb9c48a9a4c237 --attribute createVolumePermission
{
  "SnapshotId": "snap-010bb9c48a9a4c237",
  "CreateVolumePermissions": [
    {
      "Group": "all"
    }
  ]
}
```

Copy Snapshots: Encrypt or Re-encrypt



	Name	Snapshot ID	Size	Description	Status	Started	Progress	Encryption
<input type="checkbox"/>		snap-00d820abc6be...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input checked="" type="checkbox"/>		snap-010bb9c48a9a4c237	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-027...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-044...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-066...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-096...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-0dd...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-0ea6182c417d...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted

Copy Snapshot

This snapshot, **snap-010bb9c48a9a4c237**, will be copied to a new snapshot. Set the new snapshot settings below:

Destination Region US West (Oregon)

Description [Copied snap-010bb9c48a9a4c237 from us-west-2] multi-volun

Encryption ☒ Encrypt this snapshot

Master Key (default) aws/ebs

Key Details

Description Default master key that protects my EBS volumes when no other key is defined

Account This account (448018168445)

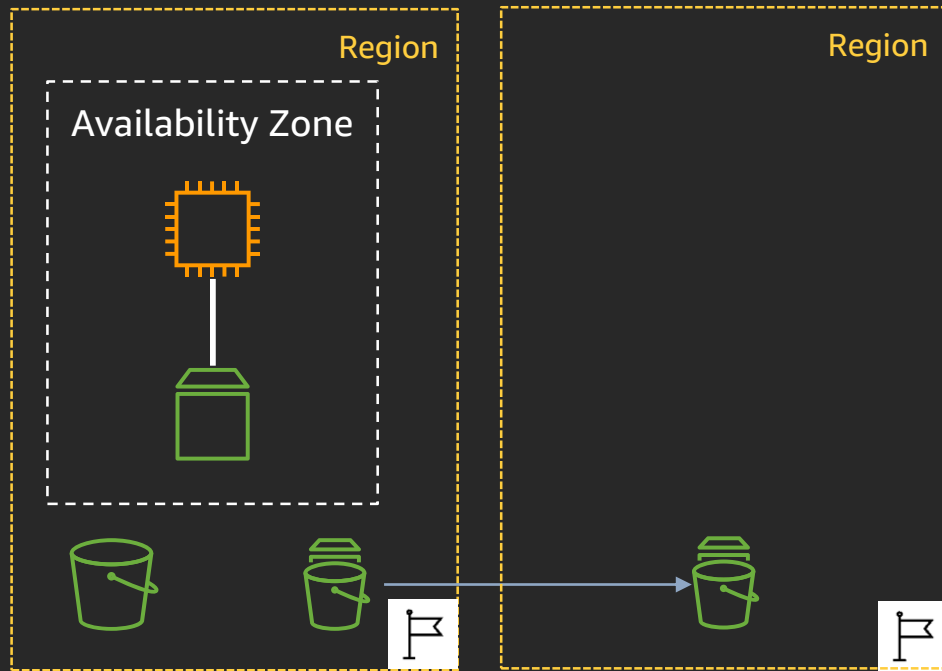
KMS Key ID arn:aws:kms:us-west-2:448018168445:key/1234abcd-12ab-34cd-56ef-1234567890ab

KMS Key ARN arn:aws:kms:us-west-2:448018168445:key/1234abcd-12ab-34cd-56ef-1234567890ab

Cancel Copy

```
aws ec2 copy-snapshot --source-snapshot-id  
snap-010bb9c48a9a4c237 --destination-region  
us-west-1 --encrypted --kms-key-id  
key/1234abcd-12ab-34cd-56ef-1234567890ab
```

Copy Snapshots Across Regions



Copy Snapshots across accounts across regions

Lock down resource level permissions on target snapshot copy

Multi-region = Protection against regional events

Permission lock down = malicious or unintentional deletes of data

Three new features to make encryption easier

- Launch encrypted volumes from unencrypted snapshots / AMIs
 - Launch volumes encrypted with different CMK from encrypted snapshots / AMIs
- Share snapshots encrypted with custom CMKs across accounts
- Encryption By Default for EBS for an account in a region with a single setting

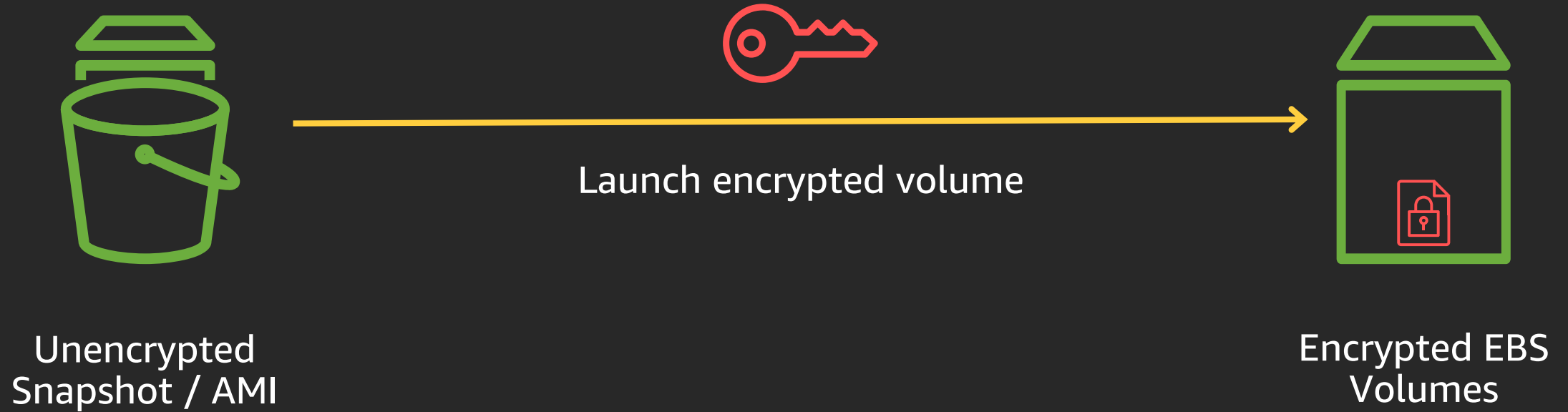
Feature: Encrypted Volumes from Unencrypted Snapshots or AMIs

Previously ...



Similar steps if you need to change encryption on a Snapshot / AMI

Now ...



Similar steps if you need to change encryption on a Snapshot / AMI

How to do this

Create Snapshot Actions

Owned By Me Filter by tags and attributes or search by keyword 1 to 8 of 8

	Name	Snapshot ID	Size	Description	Status	Started	Progress	Encryption
<input checked="" type="checkbox"/>		abc6be...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		c4a9a...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		a0028ff...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		e92b23...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		a7a78a...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-000000000ea2e...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-0dd67735547c...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted
<input type="checkbox"/>		snap-0ea6182c417d...	100 GiB	multi-volume snapshots	completed	June 20, 2019 at 11:09:24 A...	available (100%)	Not Encrypted

- Delete
- Create Volume
- Create Image
- Copy
- Modify Permissions
- Add/Edit Tags

How to do this

[Snapshots](#) > Create Volume

Create Volume

Snapshot ID `snap-041d54e92b23119db`

Volume Type `General Purpose SSD (gp2)` ⓘ

Size (GiB) `100` (Min: 1 GiB, Max: 16384 GiB) ⓘ

IOPS `300 / 3000` (Baseline of 3 IOPS per GiB with a minimum of 100 IOPS, burstable to 3000 IOPS) ⓘ

Availability Zone* `us-west-2a` ⓘ

Throughput (MB/s) Not applicable ⓘ

Encryption ☒ Encrypt this volume

Master Key `(default) aws/ebs` ↻

KMS Key Description Default master key that protects my EBS volumes when no other key is defined

KMS Key Account This account (616031010107)

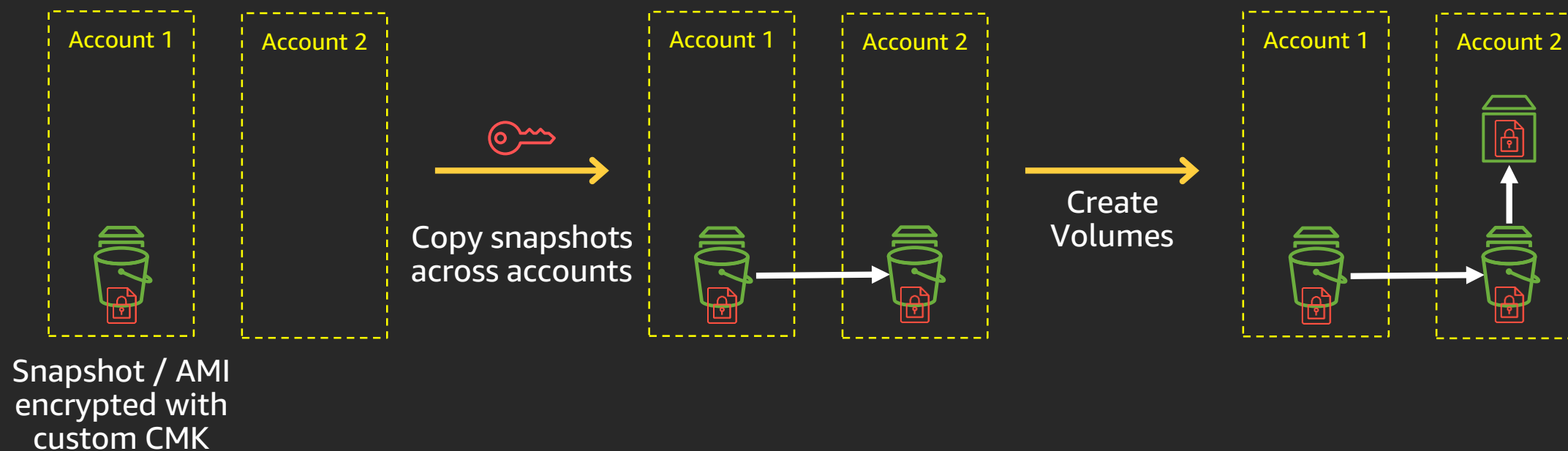
KMS Key ID `arn:aws:kms:us-west-2:616031010107:key/15243824-8b56-4b3a-8b56-4b3a-8b56`

KMS Key ARN `arn:aws:kms:us-west-2:616031010107:key/15243824-8b56-4b3a-8b56-4b3a-8b56`

```
aws ec2 create-volume --snapshot-id snap-010bb9c48a9a4c237 --availability-zone us-west-2a --encrypted --volume-type gp2
```

Feature: Share encrypted Snapshots / AMIs across accounts

Previously ...



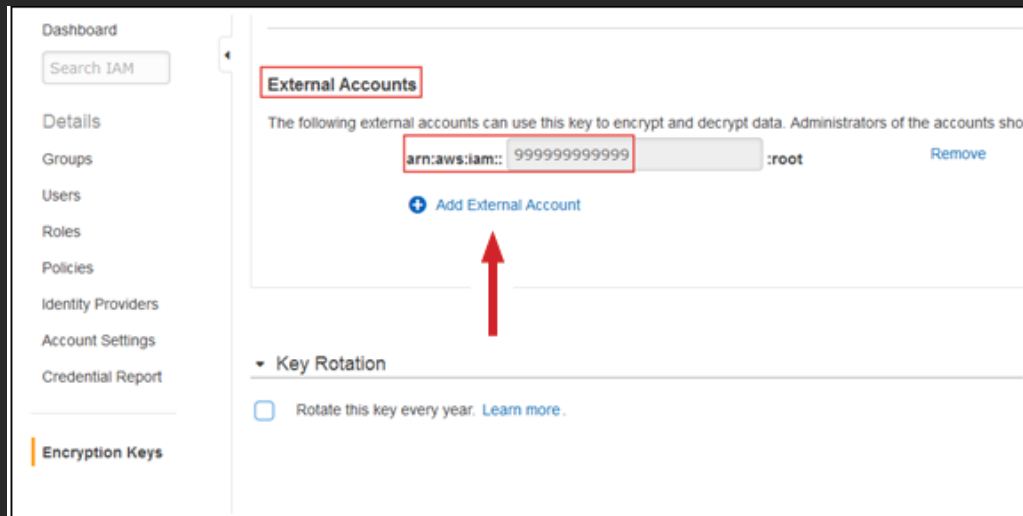
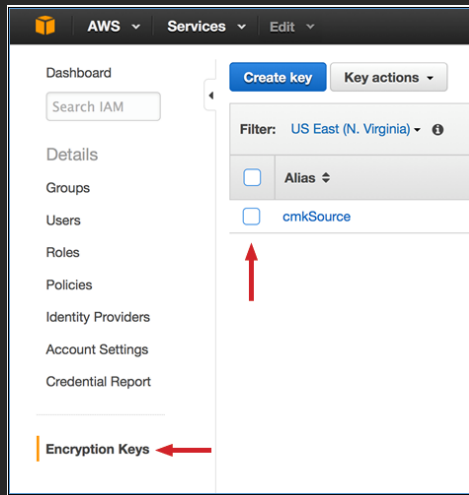
Encrypted snapshots could only be copied across accounts

Now ...



Share Snapshots/AMIs encrypted with custom CMKs across accounts
[NOTE: Snapshots / AMIs encrypted with Default CMKs cannot be shared across accounts]

How to do this



```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "kms:DescribeKey",
        "kms:ReEncrypt*",
        "kms:CreateGrant",
        "kms:Decrypt"
      ],
      "Resource": [
        "arn:aws:kms:us-east-1:<111111111111>:key/<key-id of cmkSource>"
      ]
    }
  ]
}
```

How to do this

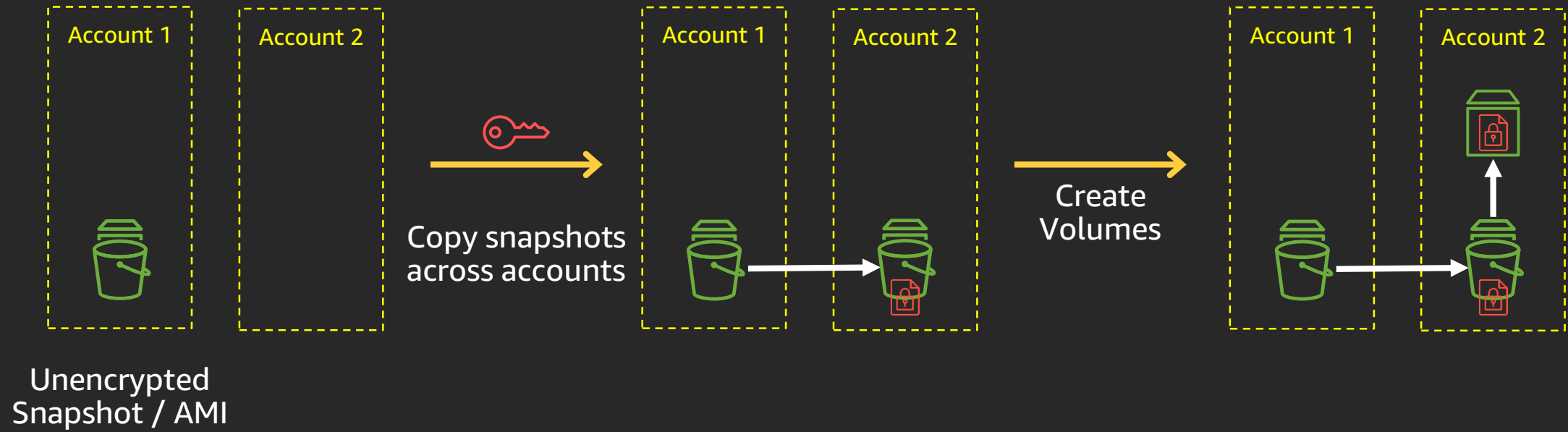
```
$> aws ec2 run-instances
    --image-id ami-XXXXXX
    --count 1
    --instance-type m4.large
    --region us-east-1
    --subnet-id subnet-aec2fc86
    --key-name 2016KeyPair
    --security-group-ids sg-f7dbc78e
    subnet-id subnet-aec2fc86
    --block-device-mappings
    file://mapping.json
```

mapping.json

```
[
  {
    "DeviceName": "/dev/xvda",
    "Ebs": {
      "Encrypted": true,
      "KmsKeyId":
"arn:aws:kms:us-east-
1:<999999999999>:key/<abcd1234-a123-
456a-a12b-a123b4cd56ef>"
    }
  }
]
```


Combining the two features

Previously ...



Now ...



Launch encrypted volumes across accounts from unencrypted Snapshots / AMIs
[NOTE: Snapshots / AMIs encrypted with Default CMKs cannot be shared across accounts]

Feature: Enable EBS account level encryption by default

Previously ...



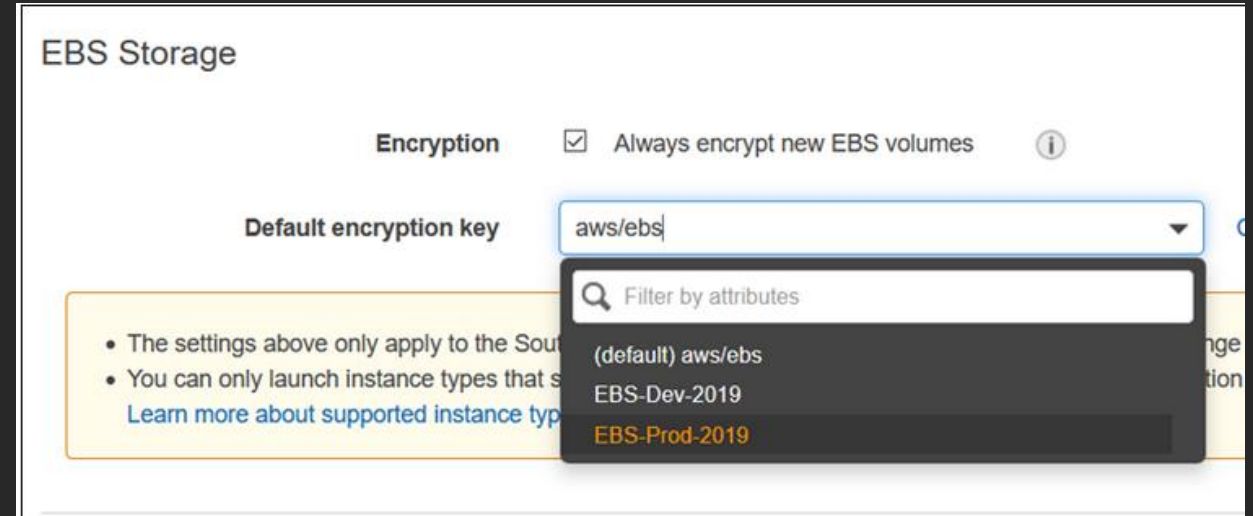
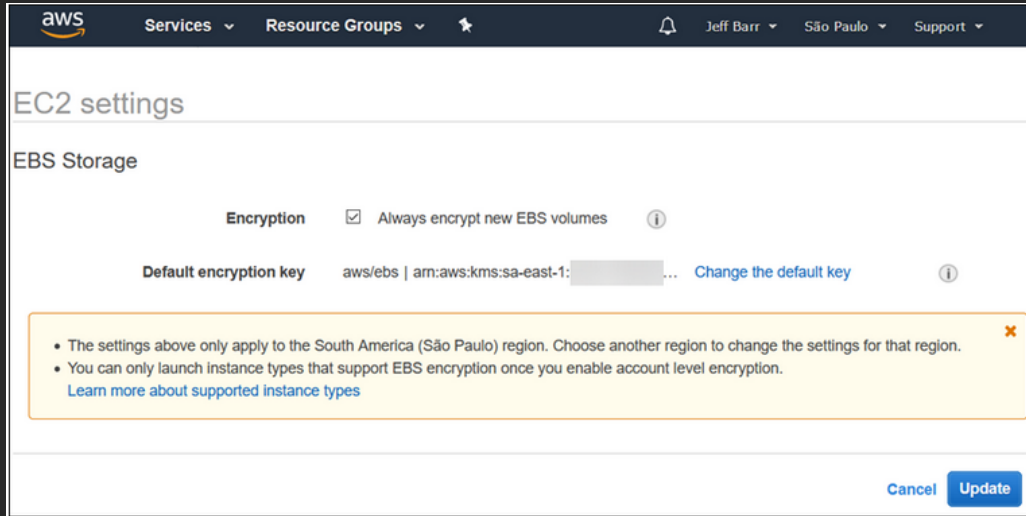
With IAM policies, you can prevent unencrypted volumes from launching

Now ...



Without change to workflows, newly launched volumes + snapshots are encrypted

How to do this



And that's it!

If you remember nothing else ...



Monitor access

Keep tabs on which snapshots
you are sharing and why



Account Level Encryption

Encryption is a check-box –
literally! Use it.

Building your application

Understand your mission



Understand your mission



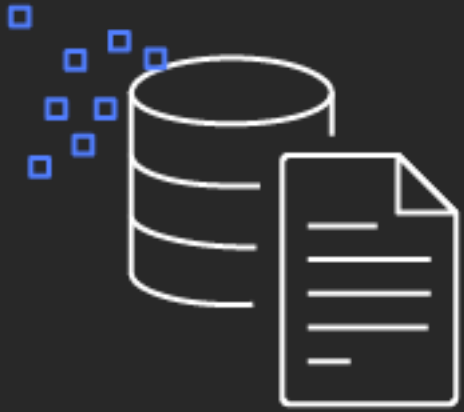
Understand your mission



Gather as much data as possible!



Understand your mission



Databases

PostgreSQL, MySQL
Cassandra, MongoDB



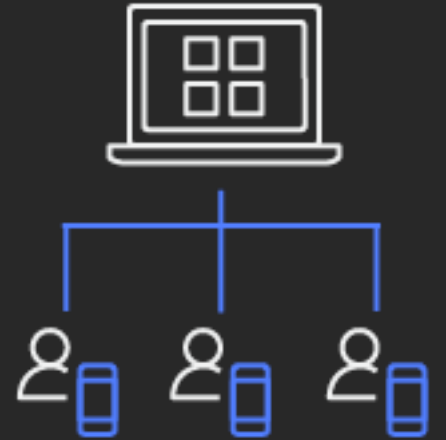
Data & Analytics

Kafka, Splunk, Hadoop,
Data Warehousing



Media

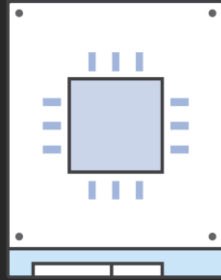
Transcoding, Encoding,
Render Farms



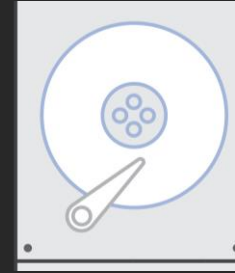
File

CIFS, NFS
Archive

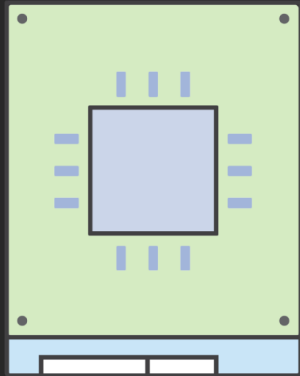
Select the right volume for your workload



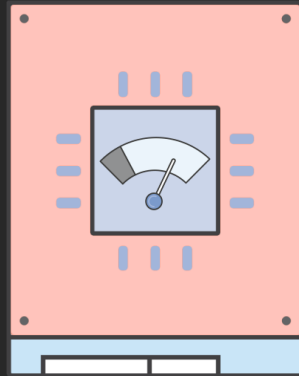
SSD



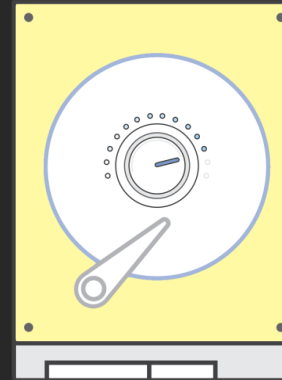
HDD



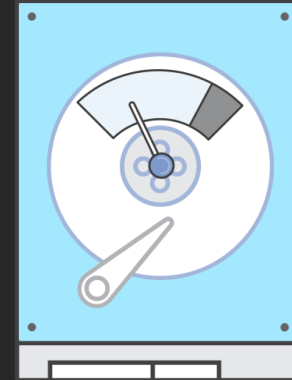
gp2
General
Purpose SSD



io1
Provisioned
IOPS SSD



st1
Throughput
Optimized HDD



sc1
Cold
HDD

Select the right volume



Databases

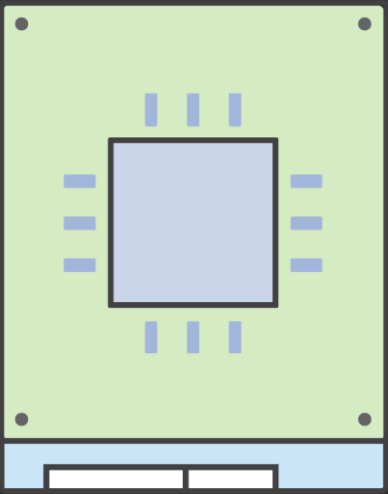
PostgreSQL, MySQL

Cassandra, MongoDB

- Typically high performance requirements
- Mostly random I/O
- Journal is sequential
- Highly workload dependent

Recommendation: SSD (+ HDD?)

Amazon EBS volume: General Purpose SSD



gp2

General Purpose SSD

Baseline: 100 to 16,000 IOPS @ 3 IOPS/GB

Burst: 3,000 IOPS (< 1000 GB)

Throughput: Up to 256 MiB/s

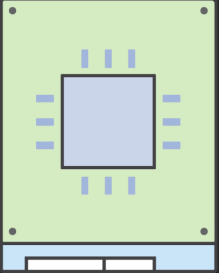
Latency: Single-digit ms

Capacity: 1 GiB to 16 TiB

I/O Size: Up to 256 KiB (logical merge)

Great for boot volumes, low-latency applications, and bursty databases

Burst bucket: gp2



gp2

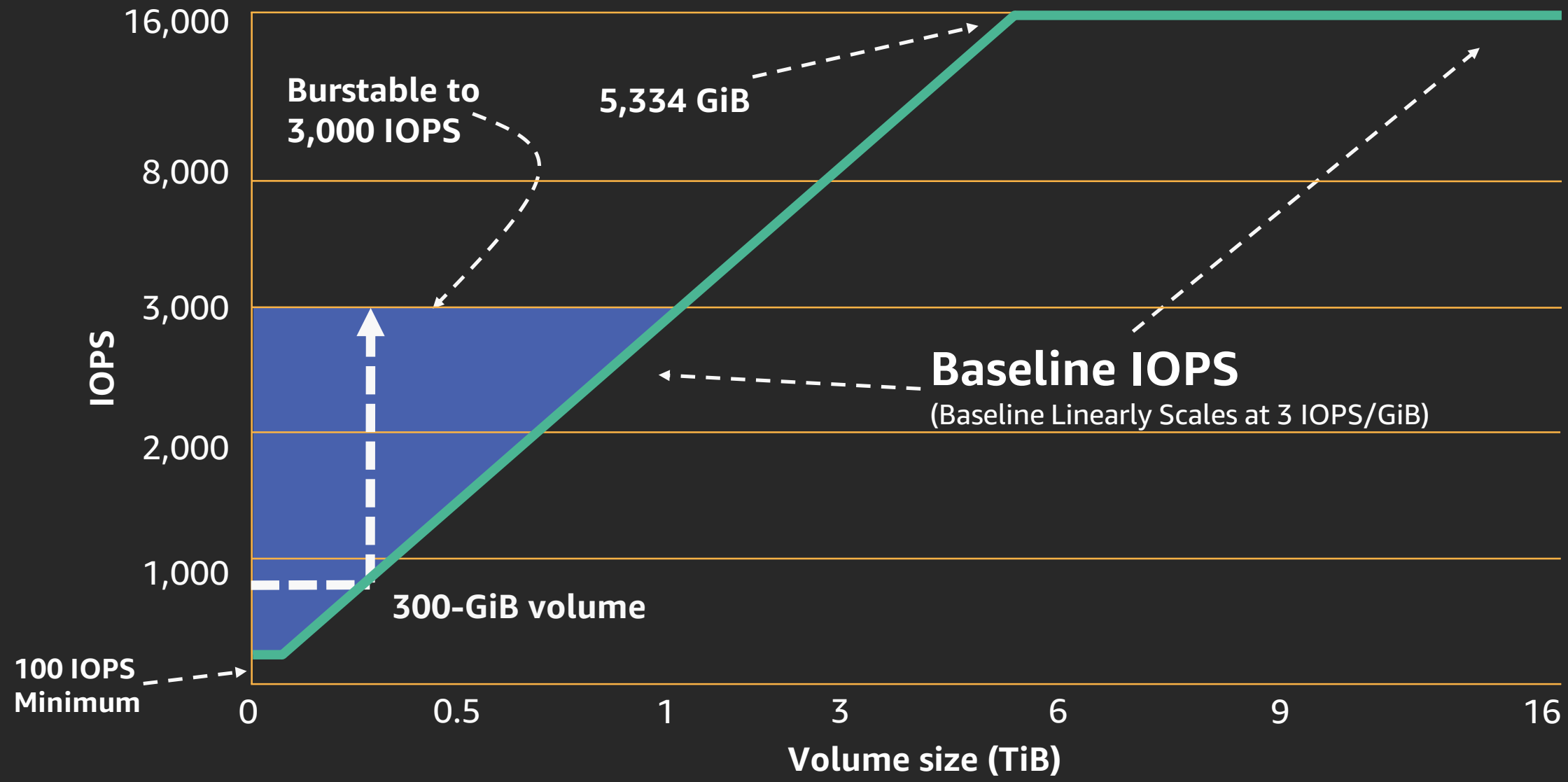


Baseline performance:
Always accumulating
3 IOPS per GiB per second

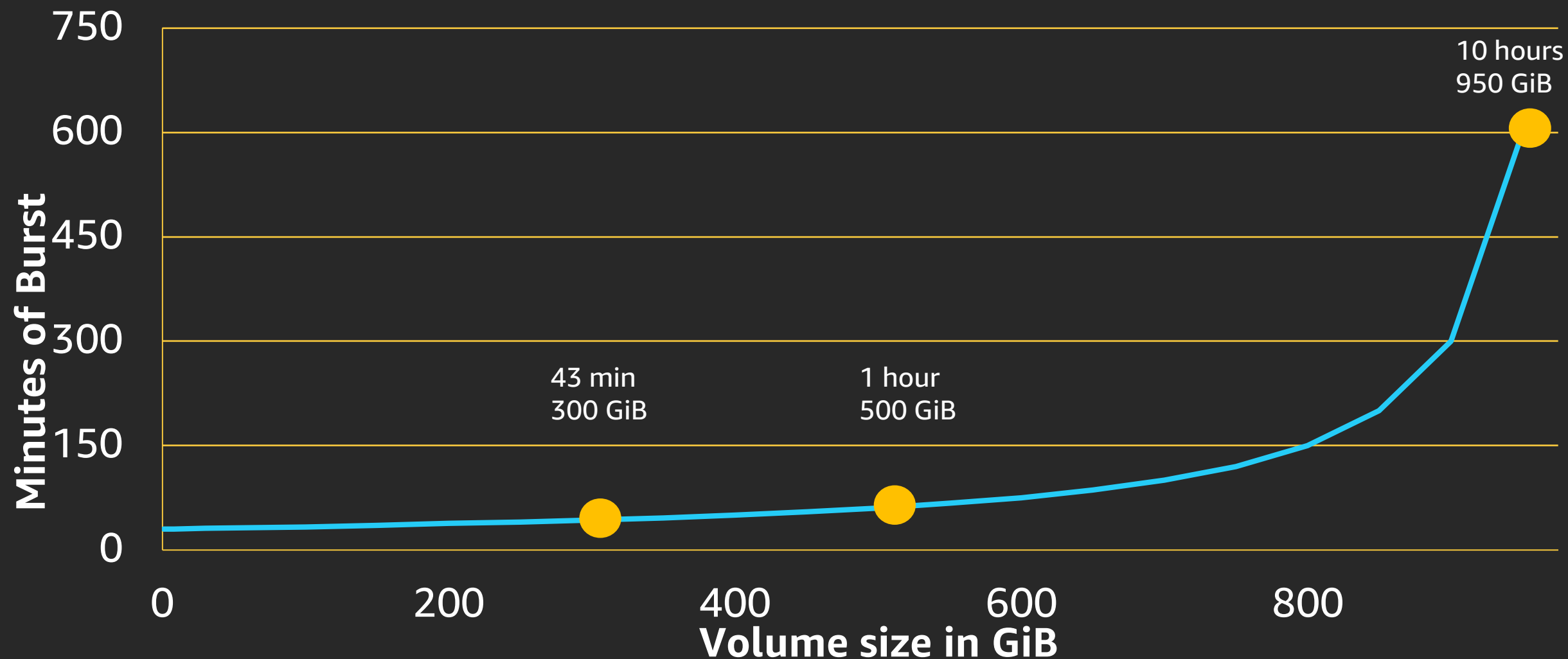
Max I/O credit per bucket is 5.4M

Burst performance:
You can spend up to
3,000 credits per second

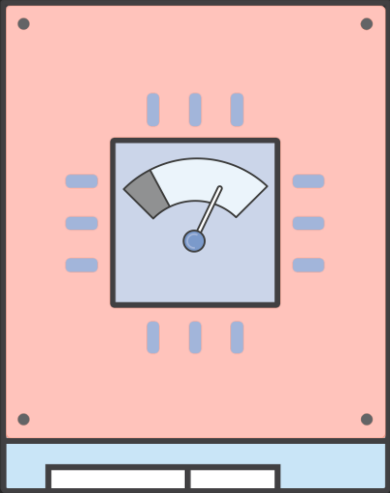
Burst and baseline: gp2



How long can I burst on gp2?



Amazon EBS volume: Provisioned IOPS



io1

Provisioned IOPS

Baseline: 100 – 64,000 IOPS

Throughput: Up to 1000 MiB/s

Latency: Single-digit ms

Capacity: 4GiB – 16 TiB

I/O Size: Up to 256 KiB (logical merge)

Ideal for critical applications and databases with sustained IOPS

Would my customers or my business be impacted by degradation or an outage?

Understand your mission

Tier 1 (critical)

Everything Else

Select the right volume



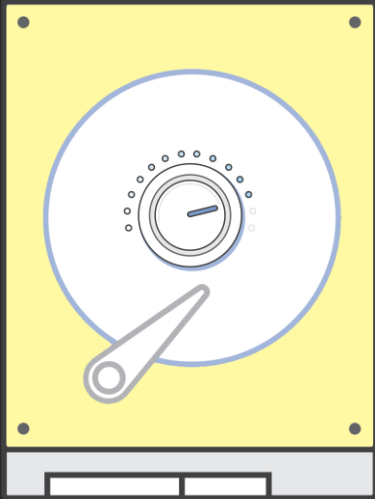
Media

Transcoding, Encoding,
Render Farms

- Typically high throughput requirements
- Mostly sequential I/O
- Sustained I/O

**Recommendation: Throughput Optimized HDD
(st1)**

Amazon EBS volume: Throughput Optimized



st1

Throughput
Optimized HDD

Baseline: 40 MiB/s per TiB, up to 500 MiB/s

Burst: 250 MiB/s per TiB, up to 500 MiB/s

Capacity: 500 GiB to 16 TiB

I/O Size: Up to 1 MiB (logical merge)

Ideal for large-block, high-throughput sequential workloads

Select the right volume



Data & Analytics

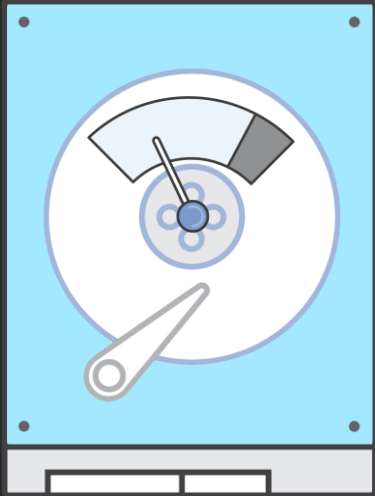
Kafka, Splunk, Hadoop,

Data Warehousing

- Typically high throughput requirements
- Mostly sequential I/O
- Daily periodicity

Recommendation: HDD

Amazon EBS volume: Cold HDD



sc1

Cold HDD

Baseline: 12 MiB/s per TiB, up to 192 MiB/s

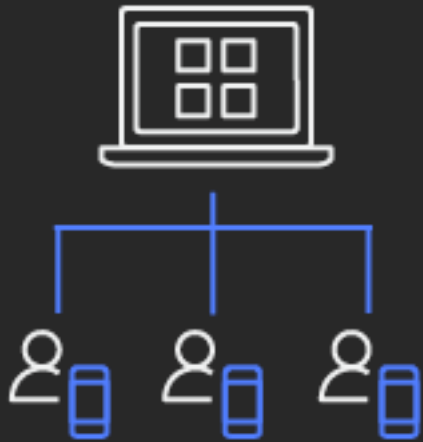
Burst: 80 MiB/s per TiB, up to 250 MiB/s

Capacity: 500 GiB to 16 TiB

I/O Size: Up to 1 MiB (logical merge)

Ideal for sequential throughput workloads, such as logging and backup

Select the right volume



File

CIFS, NFS

Archive

- Typically low throughput requirements
- Bursty workloads
- Cost sensitive

Recommendation: Cold HDD (sc1)

Understand your mission

Need more detail?

```
$ iostat -xdm /dev/nvme2n1 5
```

```
Device:      rrqm/s  wrqm/s  r/s  w/s  rMB/s  wMB/s  avgrq-sz  avgqu-sz  ...  
nvme2n1      0.00   0.00 24649.80 1564.80 995.53   6.11   78.25    40.31   ...
```

995.53 MB/s / 24650 reads/s \approx 40KiB / request

6.11 MB/s / 1565 writes/s \approx 4KiB / request

78 sectors / 512 B/sector \approx 39 KiB / request

Understand your mission

Going deeper with blktrace

```
$ sudo blktrace -w 300 /dev/nvme2n1  
  
:  
  
$ blkparse -d nvme2n1.bin -i nvme2n1 -O  
  
$ btt -i nvme2n1.bin -B blk_offsets  
  
$ ./bt_analyze.py blk_offsets_259,4_r.dat blk_offsets_259,4_w.dat
```

Blktrace analysis

```
with open(tracefile) as f:
    for line in f:
        start, end = line.split()[1:]

        start = int(start)
        end = int(end)

        num_ios += 1

        # keep track of sequential segments
        if start != prev_segment:
            num_segments += 1
            prev_segment = end

        # convert sectors to bytes
        sz = (end - start) / 2
        iosize[sz] += 1
        total_size += sz
```

Understanding your mission

Going deeper with blktrace

Read

```
Sequential: 0.0006%  
I/O by Size:  
 0 - 4 KiB: 48  
 4 - 8 KiB: 2  
 8 - 16 KiB: 259776  
16 - 32 KiB: 65996  
32 - 64 KiB: 320934  
128 - 256 KiB: 2
```

Write

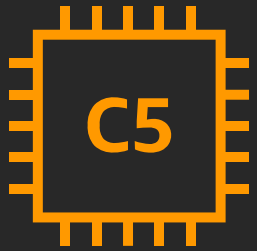
```
Sequential: 99.9879%  
I/O by Size:  
 0 - 4 KiB: 32973
```

Select the right volumes

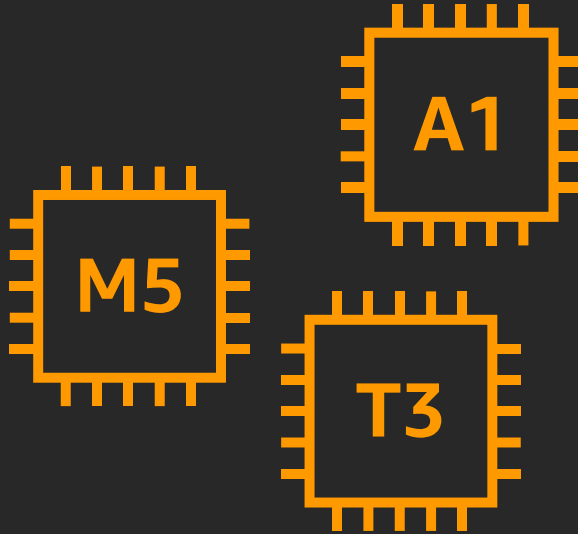
Multiple EBS volumes can be attached to an instance

Mix and match volume types for optimum performance

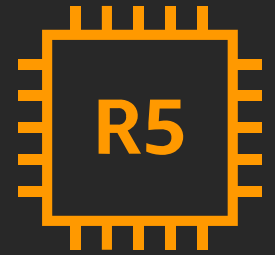
EC2 instance selection



Compute
Optimized



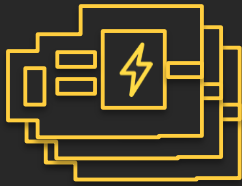
General
Purpose



Memory
Optimized

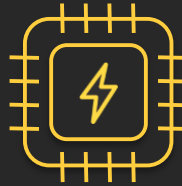
Nitro in three parts

Nitro Cards



VPC Networking
Amazon Elastic Block Store
(Amazon EBS)
Instance Storage
System Controller

Nitro Security Chip



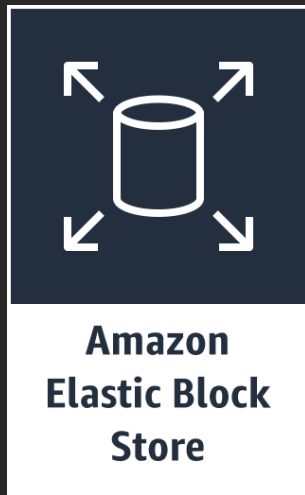
Integrated into motherboard
Protects hardware resources
Hardware Root of Trust

Nitro Hypervisor



Lightweight hypervisor
Memory and CPU allocation
Bare Metal-like performance

Nitro Card for EBS



NVMe Controller

Standard drivers broadly available

EBS Data Plane

Encryption support

NVM to remote storage protocol

EBS Optimized by default

EBS Optimized



Dedicated EBS bandwidth

Up to 14 Gbps (1,750 MiB/s) per instance

Burst available for smaller instances

Tip: Ensure EBS optimized bandwidth can support your volumes

NEW EBS Optimized



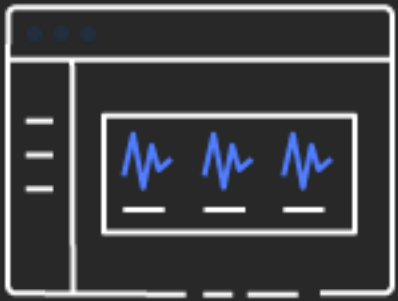
Dedicated EBS bandwidth

Up to **19** Gbps (**2,375** MiB/s) per instance

Burst available for smaller instances

Tip: Ensure EBS optimized bandwidth can support your volumes

Experiment and measure

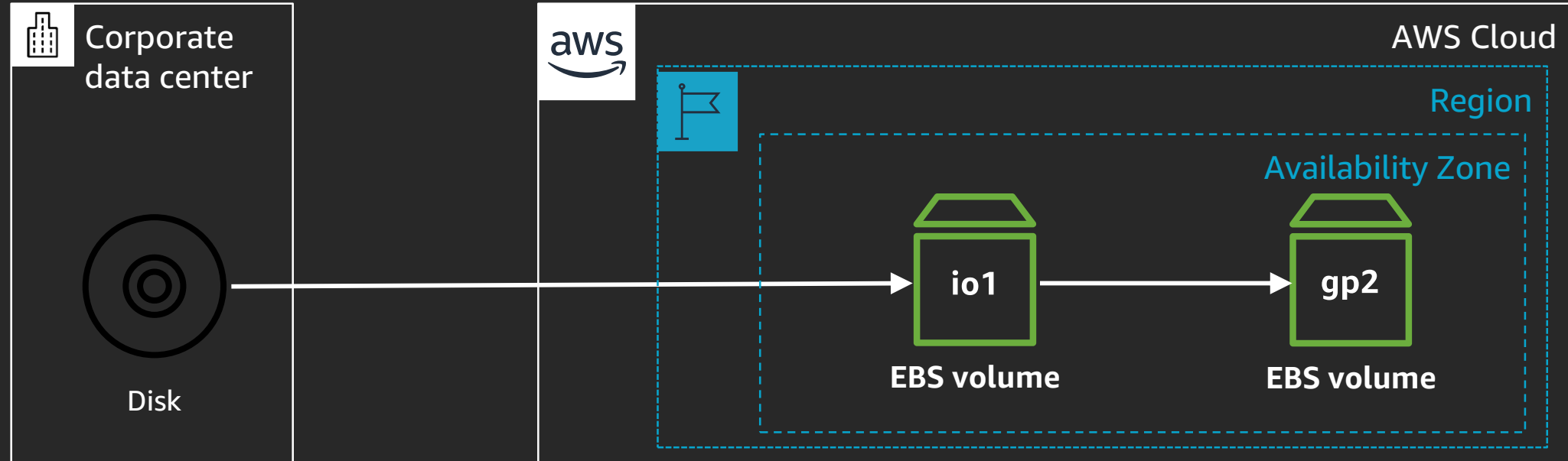


Use the scientific method!

Benchmarks give you a good baseline, but perform differently than real world data!

Monitor with CloudWatch and other tools

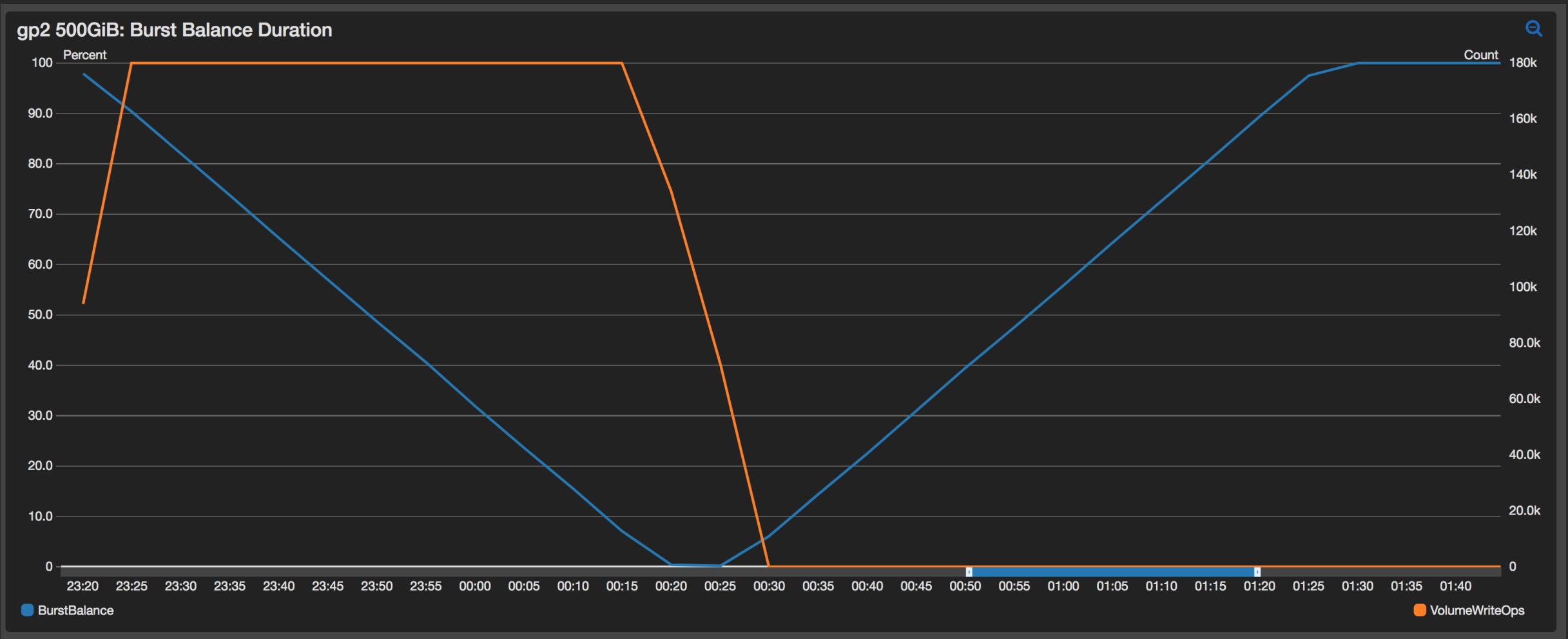
Elastic Volumes: Get to the right volume type



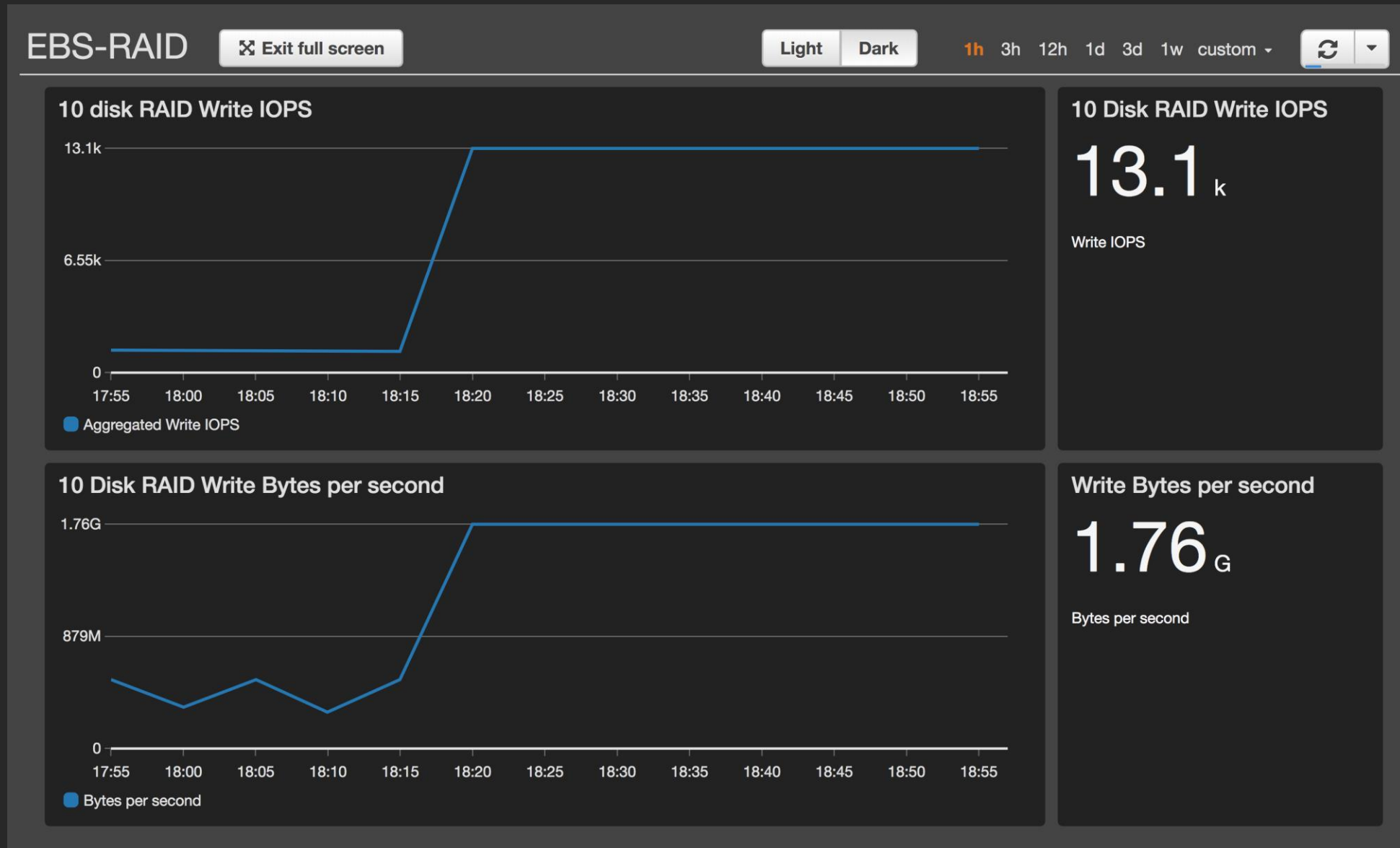
```
aws ec2 modify-volume --volume-id vol-00d820abc6be8d639 --volume-type gp2 --size 10000
```

Ensure that you have enough IOPS on gp2

CloudWatch monitoring



CloudWatch metric math



Availability and Durability

EBS is designed for...



99.999% service availability



0.1% to 0.2% annual failure rate (AFR)

EBS Snapshots



Point in time backup of modified volume data

Changed blocks stored in S3

Incremental and crash consistent

Can take consistent snapshot of all volumes
attached to an instance

Amazon Data Lifecycle Manager



Automate snapshot lifecycle

Integrates with CloudFormation

EBS volume or instance level policies

EBS Fast Snapshot Restore

6x lower Recovery Time Objective



New on
11/20

Predictability

Manage RTO based on size and credits

Speed

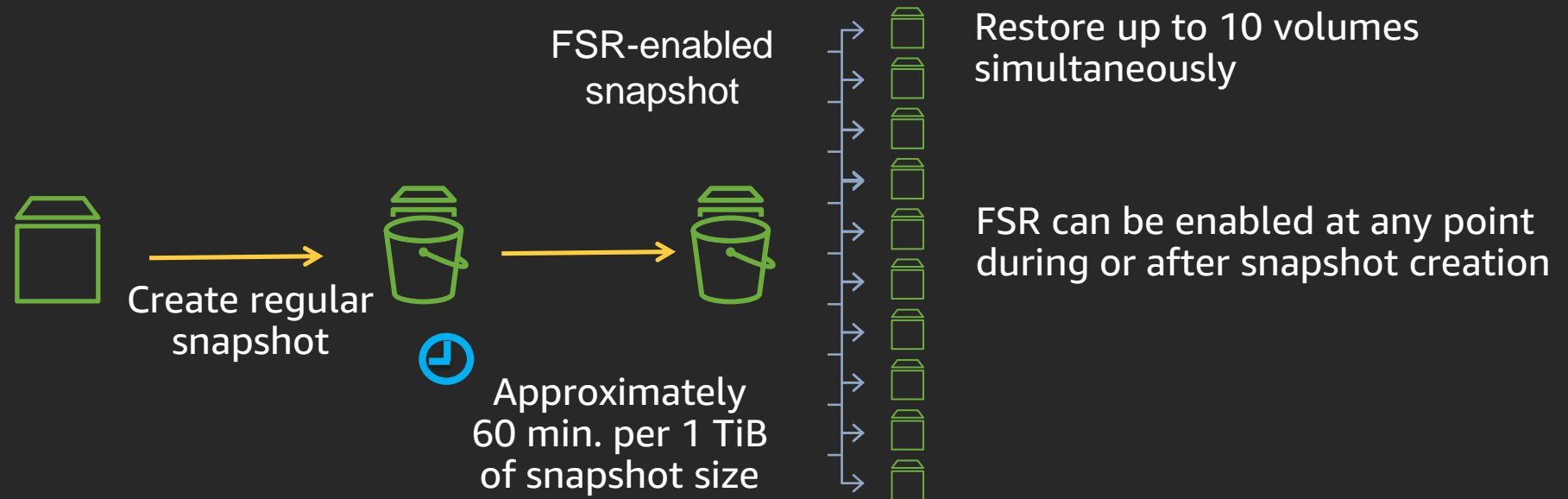
Instant access on volume from snapshots

Scale

Up to 10 volume restores instantly

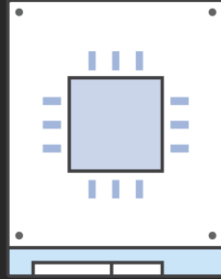
Cost

No need for additional EC2 instances

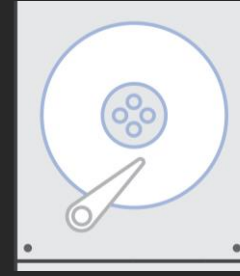


So you want to save cost on EBS

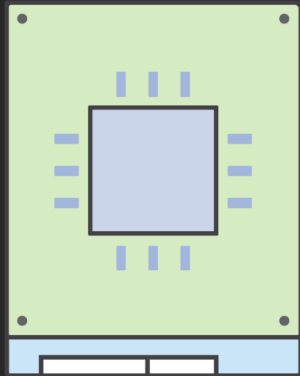
Select the right volume for your workload



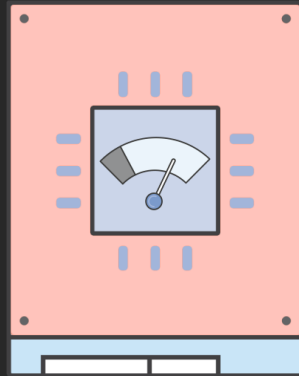
SSD



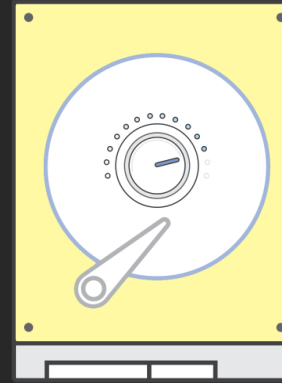
HDD



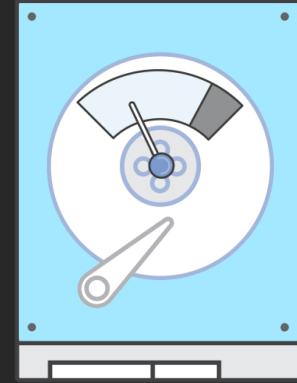
gp2
General
Purpose SSD



io1
Provisioned
IOPS SSD

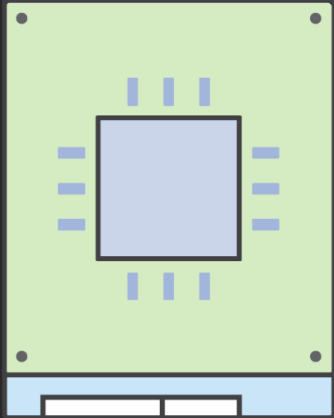


st1
Throughput
Optimized HDD



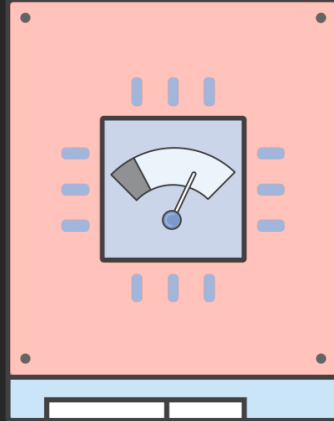
sc1
Cold
HDD

I/O Provisioned Volumes



gp2

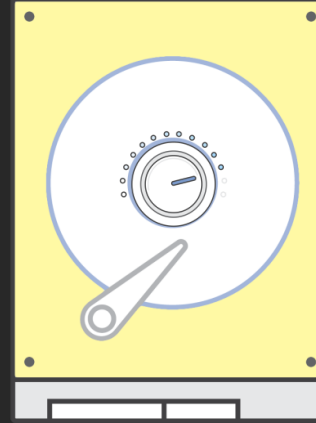
\$0.10 per GiB



io1

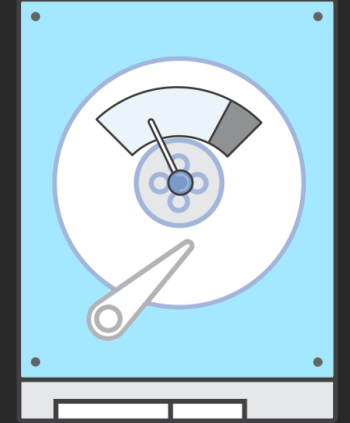
\$0.125 per GiB
\$0.065 per PIOPS

Throughput Provisioned Volumes



st1

\$0.045 per GiB



sc1

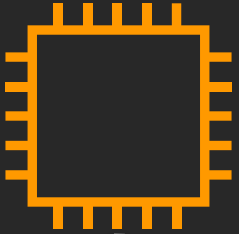
\$0.025 per GiB

Snapshot storage for all volume types is \$0.05 per GiB per month

* All prices are per month, prorated to the second, and from the us-west-2 Region as of Nov 2019

Elastic Volumes: Size your volumes correctly!

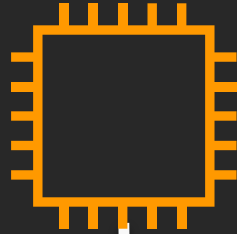
EC2 instance



EBS volume



EC2 instance



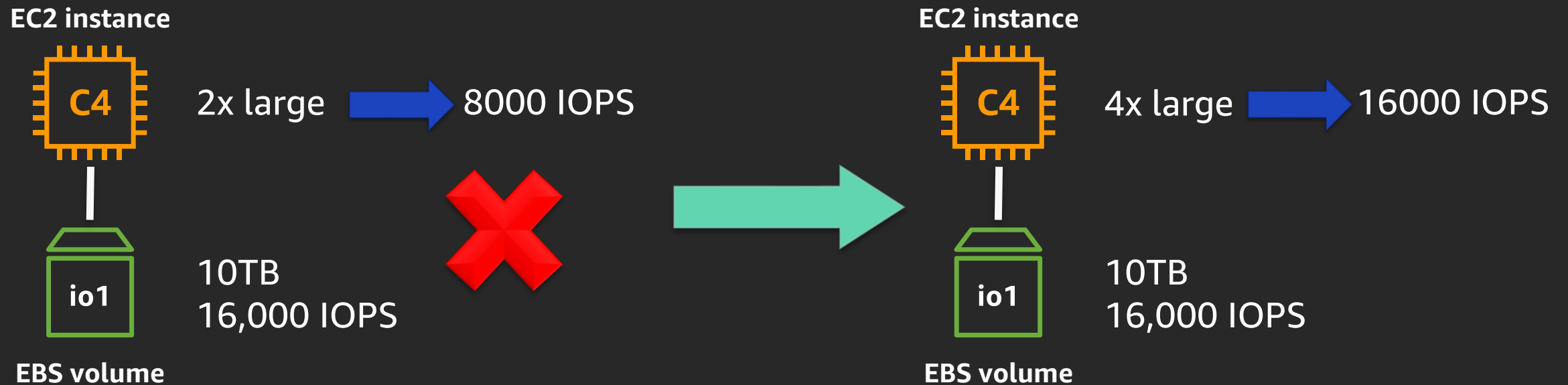
EBS volume

Increase the size of volumes and IOPS as you need it – rather than all up-front

```
aws ec2 modify-volume --volume-id vol-00d820abc6be8d639 --size 10000 --iops 32000
```

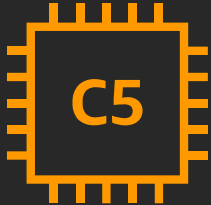
Remember to expand the file-system to take advantage of the increased capacity

Select the right instance size to match needs



Nitro: EBS Optimized Burst

- Nitro instances (*5*, i3n, t3, z1d) sizes < 4x large support EBS Optimized burst
- Burst IOPS and throughput run for up to 30 mins every 24h
- For workloads that need burst max < 30 mins, you could use a smaller size

	Baseline		Burst	
65.525 MB/s	4000 IOPS	large	20000 IOPS	437.5 MB.s
100 MB/s	6000 IOPS	xlarge	20000 IOPS	437.5 MB/s
218.75 MB/s	10000 IOPS	2xlarge	20000 IOPS	437.5 MB/s

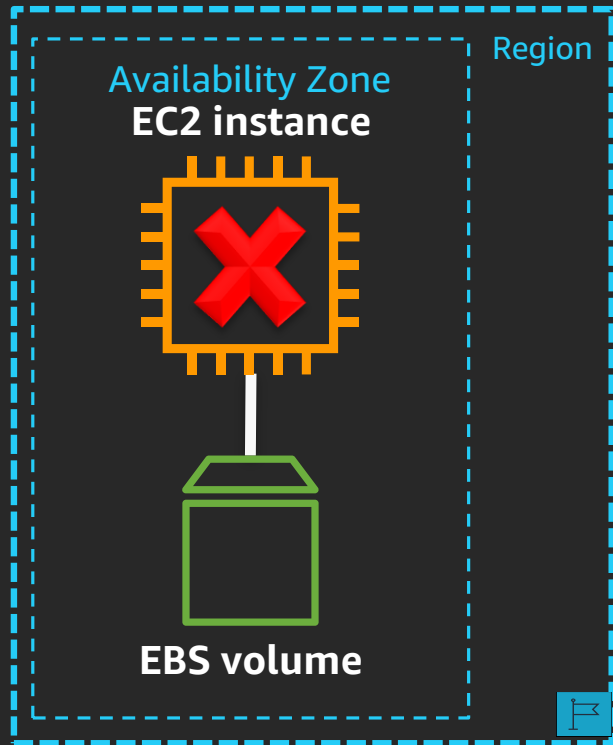
Tag Volumes and Snapshots on Create

- Tag volumes and snapshots at create time
- Delete volumes when instances and applications are terminated
- Use tags to keep track of resources and how they are created / allocated

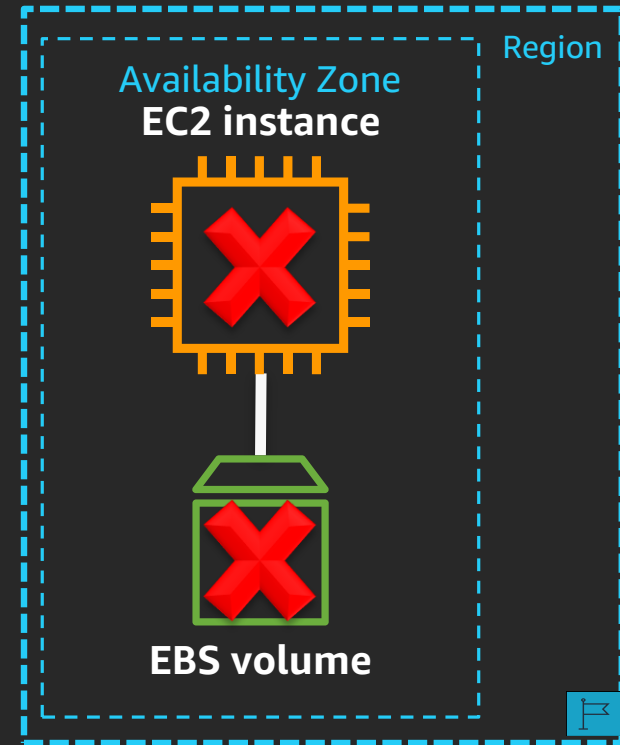
```
aws ec2 create-volume --snapshot-id snap-00d820abc6be8d639 --tag-specification  
'ResourceType=volume Tags=[{Key=CostCenter,Value=115},{Key=IsProd,Value=Yes}]'
```

```
aws ec2 create-snapshot --volume-id vol-03f3c34ded2e3398f --tag-specification  
'ResourceType=snapshot Tags=[{Key=CostCenter,Value=115},{Key=IsProd,Value=Yes}]'
```

Set DeleteOnTermination = TRUE if storage lifecycle = instance lifecycle



DeleteOnTermination = FALSE



DeleteOnTermination = TRUE

USE WITH CARE – You might delete volumes you need

Manage Snapshot costs with Data Lifecycle Manager

- Set policies on when snapshots are taken and how many snapshots to keep in a lineage
- Use cost allocation tags to track snapshot costs

Create Snapshot Lifecycle Policy

Data Lifecycle Manager for EBS Snapshots will help you automate the creation and deletion of EBS snapshots based on a schedule. Volumes are targeted by tags.

Description* ⓘ

Select resource type ☒ Volume ☐ Instance

Target with these tags This policy will be applied to volumes with **any** of the following tags. ⓘ
You cannot use tags that are in use by another enabled or disabled lifecycle policy.

* ⓘ (+1) ↻

Policy Schedule

Schedule name* ⓘ

Run policy every ⓘ

Starting at UTC

Snapshots start being created within one hour of the specified start time.

Retention rule Number of snapshots that will be retained. ⓘ

* ⓘ

NEW Snapshot Time-Based Data Lifecycle Manager Policies

- NEW: Create retention policies that are based on Snapshot Age
- Snapshot retention now possible based on # of days, weeks, months
- Meet your business compliance and DR needs

aws Services Resource Groups

This resource currently has no tags

Add Tag 50 remaining (Up to 50 tags maximum)

Policy Schedule

Schedule name* Default Schedule ⓘ

Run policy every 24 Hours ⓘ

Starting at 09 : 00 UTC

Snapshots start being created within one hour of the specified start time.

Retention type* Age

Retain* Filter by attributes

IntervalUnit Weeks

Fast snapshot restore (optional)

Feedback English (US)

aws Services Resource Groups

Run policy every 24 Hours ⓘ

Starting at 09 : 00 UTC

Snapshots start being created within one hour of the specified start time.

Retention type* Age

Retain* 5 ⓘ

IntervalUnit Weeks After Creation

Fast snapshot restore (optional)

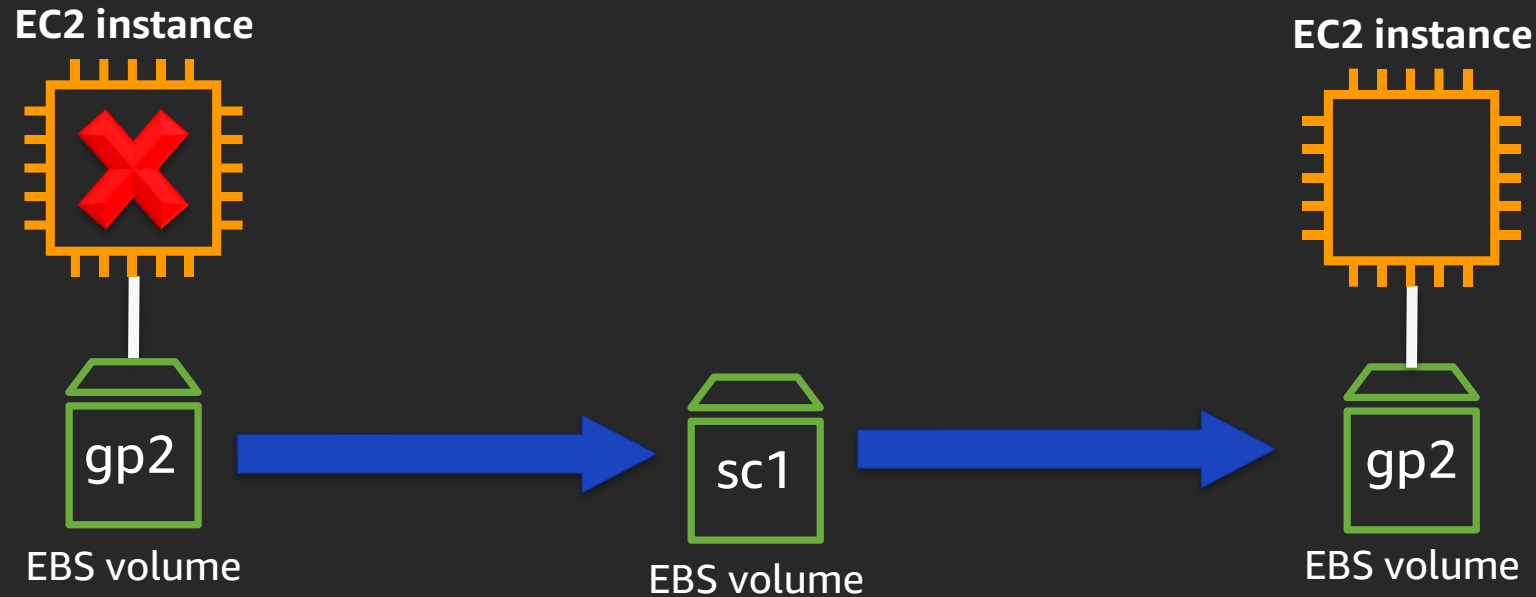
Fast snapshot restore

Maximum enabled snapshots* ⓘ

Availability Zone us-east-1a us-east-1e

Feedback English (US)

Tier to lower cost volume type if volume is not in use



- Move to lower cost tier if detached longer than
 - 6h (EV time limit) or
 - time to modify-volume
- Especially helpful for predictable schedules e.g. weekends, month ends

Use with care: Delete volumes you don't need

- Figure out volumes that have been detached
- Using CloudWatch events (or tags), figure out how long these have been detached
- Set an explicit org policy for how long volumes can stay detached
- **STRONGLY ADVISE:** Take snapshots of these volumes
- Delete volumes

How Teradata uses EBS

Vinod Raman
Product Manager
Teradata

Mahesh Subramanian
Senior Director, Engineering
Teradata

Teradata is Cloud-First with Enterprise Scalability

 ticketmaster[®] SIEMENS PHILIPS MONSANTO[®] AVIVA

Joint Customers with AWS

\$2.2B
Revenue

Consecutive
leadership positions
in analyst evals for
17+ years

9K
Employees

Worldwide Presence

157 certifications

5,400 accreditations

9 Well-Architected reviews



Teradata Serves Industry-Leading Customers



18 of the top 20

Global Banks use Teradata to grow revenue across channels



19 of the top 20

Communication Providers use Teradata to optimize operations



15 of the top 20

Global Retailers use Teradata to improve customer experience



All of the top 6

Airlines use Teradata to maximize customer experience



11 of the top 20

Healthcare companies use us to drive better medical outcomes

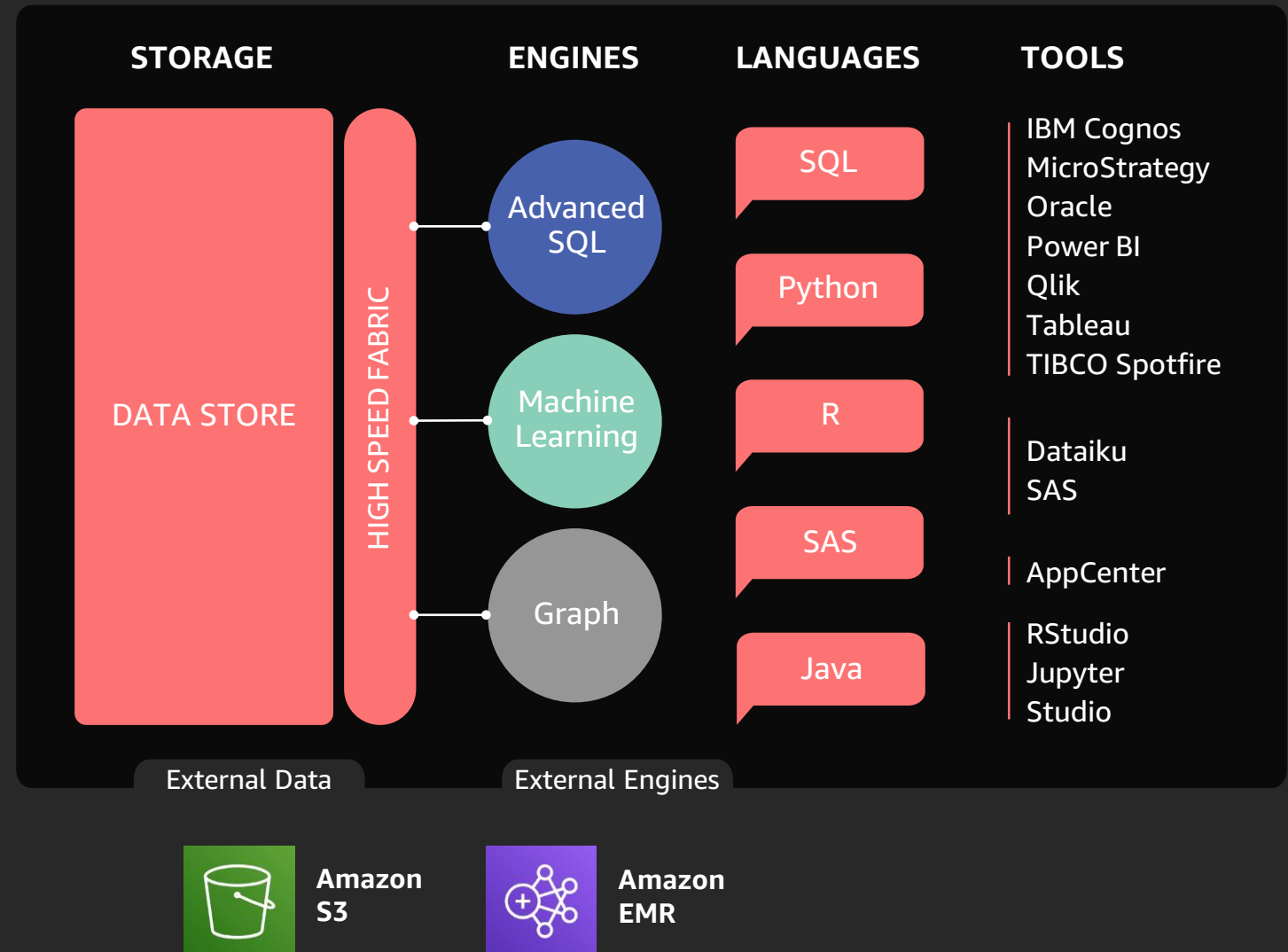


13 of the top 20

Global manufacturing firms use Teradata to increase throughput

Teradata Vantage: Analytics Platform Software

- **Any** tool
- **Any** language
- **100%** of the data



Customer Use Cases for Vantage on AWS

Millions of queries. Thousands of users. Hundreds of applications.

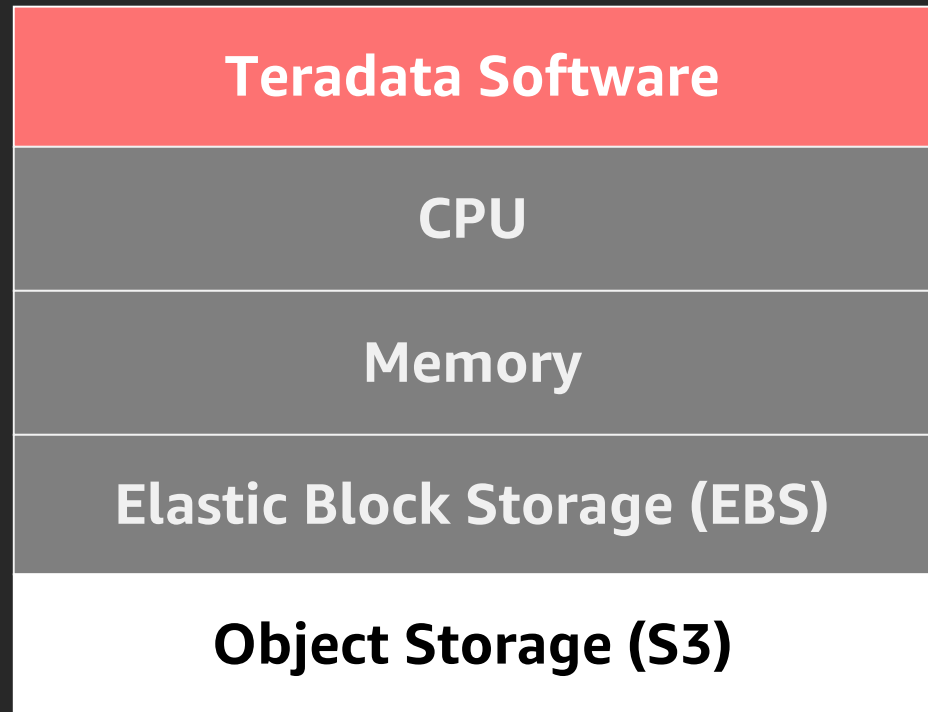
**Production
Analytics**

**Development
& Test**

**Discovery
Analytics**

**Disaster
Recovery**

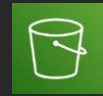
Vantage Leverages Multiple Storage Types



Amazon
EC2



Amazon
EBS



Amazon
S3

- **Memory:** For the small small amounts of data that are frequently queried.
- **EBS:** For persistent data that needs to be accessed or updated often and needs performance SLAs
- **S3:** Large volumes of unstructured data in data lakes



Overall Workload Characteristics

Teradata Vantage is typically the “source of truth” for the enterprise

- **Enterprise Data Warehouse**

Advanced SQL Engine: Well-curated business-critical data used for reporting

Machine Learning and Graph Engines: Data science, model training and inference

- **Leverages both EBS and S3**

To ensure availability against isolated local failures and zonal events

- **Vantage can be CPU or Memory or Throughput-to-Storage intensive**

CPU-intensive: IOT sensor and time series analytics

Memory-intensive: Machine learning and model training

Throughput-intensive: Complex SQL queries

- **Vantage workload profile is 90% Read and 10% Write**

A balance of High Throughput and IOPS

Why GP2 SSD for Vantage

- Teradata Vantage leverages **General Purpose SSD (gp2)** EBS volumes to deliver optimal price and performance for our customers
- **Teradata Vantage primarily uses a 96KB IO**
 - Relatively small IO sizes ranging from 4KB to 512 KB
- Throughput Optimized HDD (st1) does not meet the performance needs of Vantage given the small IO size and the random nature of IO
- The price and consistency offered by Provisioned IOPS SSD (io1) is not needed to meet the needs of Vantage

Partnership with EBS

- **Expansion of EBS volumes using Elastic Volumes:**
 - Teradata was an early adopter of EBS APIs to expand volumes
 - This allows Teradata Vantage to expand EBS storage based on customer needs
 - No need to re-deploy clusters to expand storage
- **Crash-consistent EC2-wide snapshot:**
 - Teradata is an early partner to adopt this new feature
 - This allows Teradata Vantage to offer faster and smoother backups
 - Early tests show promising results that can speed up backups and let us offer lower RPOs
 - Teradata Vantage also leverages this capability to offer Disaster Recovery (DR) for customers with specific RTO/RPO SLAs

teradata.

ANALYTICS

DATA LAKES

DATA WAREHOUSES

UNIFIED IN THE
CLOUD



Visit Our Booth

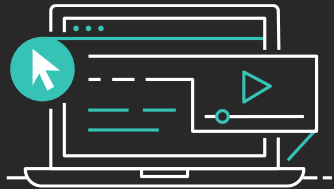
#405

teradata.com/AWS

#AnswersInTheCloud

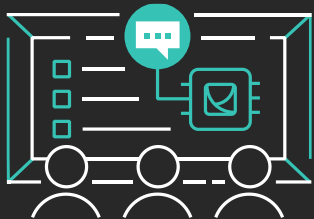
Learn storage with AWS Training and Certification

Resources created by the experts at AWS to help you build cloud storage skills



45+ free digital courses cover topics related to cloud storage, including:

- Amazon S3
- AWS Storage Gateway
- Amazon S3 Glacier
- Amazon Elastic File System (Amazon EFS)
- Amazon Elastic Block Store (Amazon EBS)



Classroom offerings, like Architecting on AWS, feature AWS expert instructors and hands-on activities

Visit aws.amazon.com/training/path-storage/

Thank you!



Please complete the session
survey in the mobile app.