Storage on AWS

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Agenda

- Introduction
- Storage Primer
- Block Storage
- Shared File Systems
- Object Store
- On-Premises Storage Integration

Introduction: Why choose AWS for storage

Compelling Economics

Pay as you go

No risky capacity planning

No need to provision for redundancy or overhead

Easy to Use

Self service administration

SDKs for simple integration

No Committment

Reduce risk

Durable and Secure

Avoid risks of physical media handling

Speed, Agility, Scale

Reduce time to market

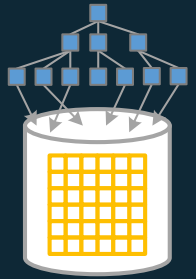
Focus on your business, not your infrastructure

Storage Primer

Block vs File vs Object

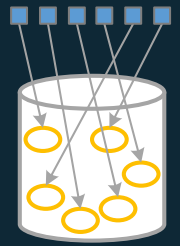
Block Storage

Raw Storage
Data organized as an array of unrelated blocks
Host File System places data on disk
e.g.: Microsoft NTFS, Unix ZFS



File Storage

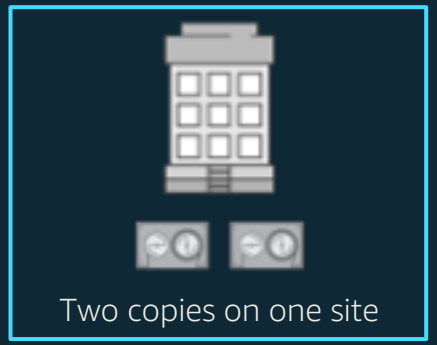
Unrelated data blocks managed by a file (serving) system
Native file system places data on disk



Object Storage

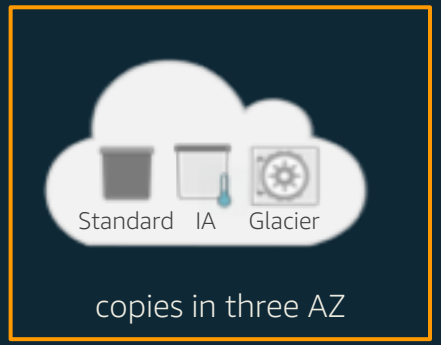
Stores Virtual containers that encapsulate the data, data attributes, metadata and Object IDs
API Access to data
Metadata Driven, Policy-based, etc

Understanding Durability



designed for
99.99%
durability

designed for
99.999%
durability



designed for
99.999999999%
durability

AVAILABILITY VS. DURABILITY

%	Availability	Durability
99.999	5 minutes 15 seconds	1 in 100,000
99.9999	31 seconds	1 in 1,000,000
99.99999	3 seconds	1 in 10,000,000
99.999999999	300 uSeconds	1 in 100,000,000,000

AWS has a variety of storage options

Amazon Elastic Block Store

Amazon Elastic File System

AWS Storage Gateway

AWS Snowball Edge

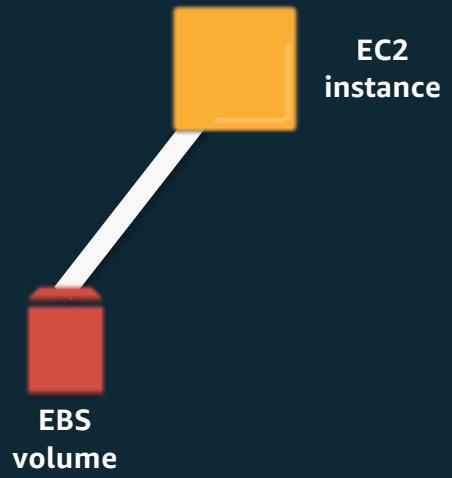
Amazon S3

Amazon Glacier

AWS Snowmobile

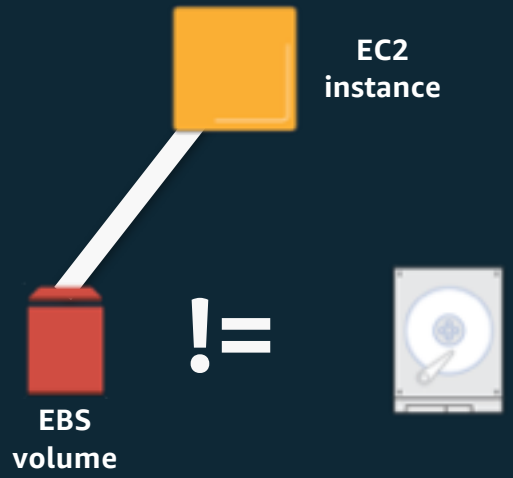
Block Storage

What is Amazon EBS?



- Block storage as a service
- Create, attach volumes through an API
- Service accessed over the network

What is Amazon EBS?



- Block storage as a service
- Create, attach volumes through an API
- Service accessed over the network

AWS EBS Features

Durable

Designed for 99.999 availability

Redundant storage across multiple devices within an AZ

Secure

Identity and Access Policies

Encryption

Scalable

Capacity when you need it

Easily scale up and down

Performance

Low-latency SSD

Consistent I/O Performance

Stripe multiple volumes for higher I/O performance

Backup

Point-in-time Snapshots

Copy snapshots across AZ and Regions

Amazon EBS

Network attached block device

- Independent data lifecycle
- Multiple volumes per EC2 instance
- **Only one EC2 instance at a time per volume**
- Can be detached from an instance and attached to a different one

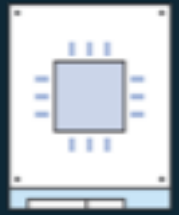
Raw block devices

- Unformatted block devices
- Ideal for databases, filesystems

Multiple Drive Types

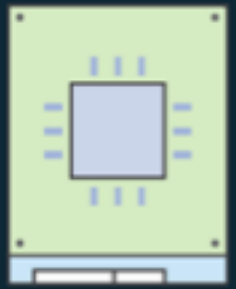
- SSD (iops) and Magnetic (throughput)

Amazon EBS volume types



SSD

HDD



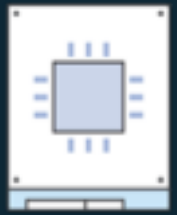
gp2
General Purpose SSD

io1
Provisioned IOPS SSD

st1
Throughput Optimized HDD

sc1
Cold HDD

Amazon EBS use cases



SSD

HDD

Relational Databases

MySQL, SQL Server, PostgreSQL, SAP, Oracle

NoSQL Databases

Cassandra, MongoDB, CouchDB

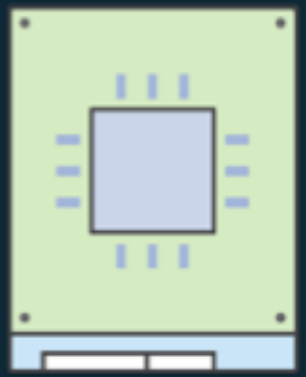
Big Data , Analytics

Kafka, Splunk, Hadoop, Data Warehousing

File / Media

CIFS/NFS, Transcoding, Encoding, Rendering

Amazon EBS volume types: General Purpose SSD



gp2

General Purpose SSD

Baseline: 100 to 16,000 IOPS; 3 IOPS per GiB

Burst: 3,000 IOPS (for volumes up to 1,000 GiB)

Throughput: Up to 250 MiB/s

Latency: Single-digit ms

Capacity: 1 GiB to 16 TiB

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

Amazon EBS volume types: Provisioned IOPS

io1

Provisioned IOPS

Baseline: 100–64,000 IOPS

Throughput: Up to 1,000 MiB/s

Latency: Single-digit ms

Capacity: 4 GiB to 16 TiB

Ideal for critical applications and databases with sustained IOPS

Amazon EBS volume types: Throughput Provisioned

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

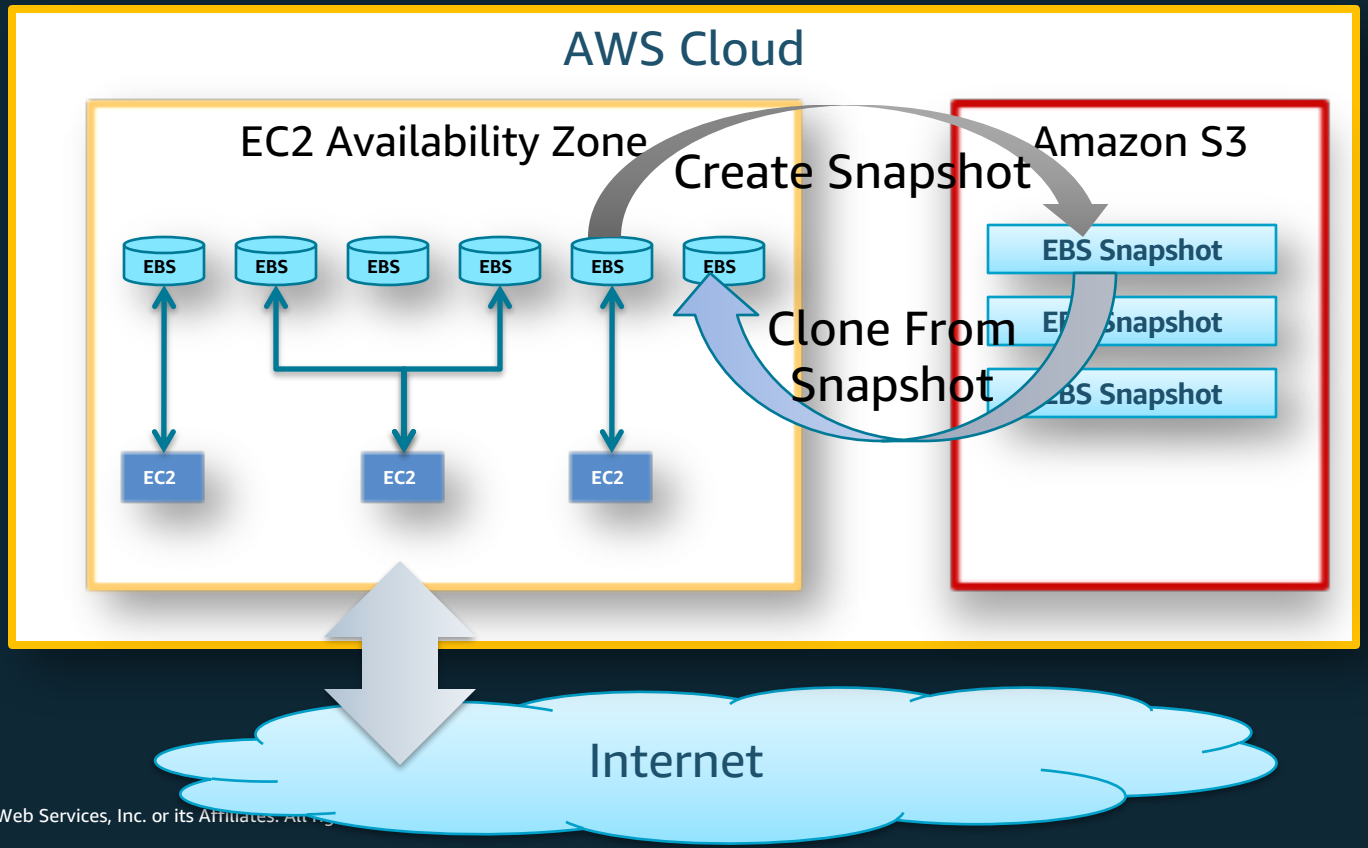
Ideal for large-block, high-throughput sequential workloads

EBS Volume Types Comparison

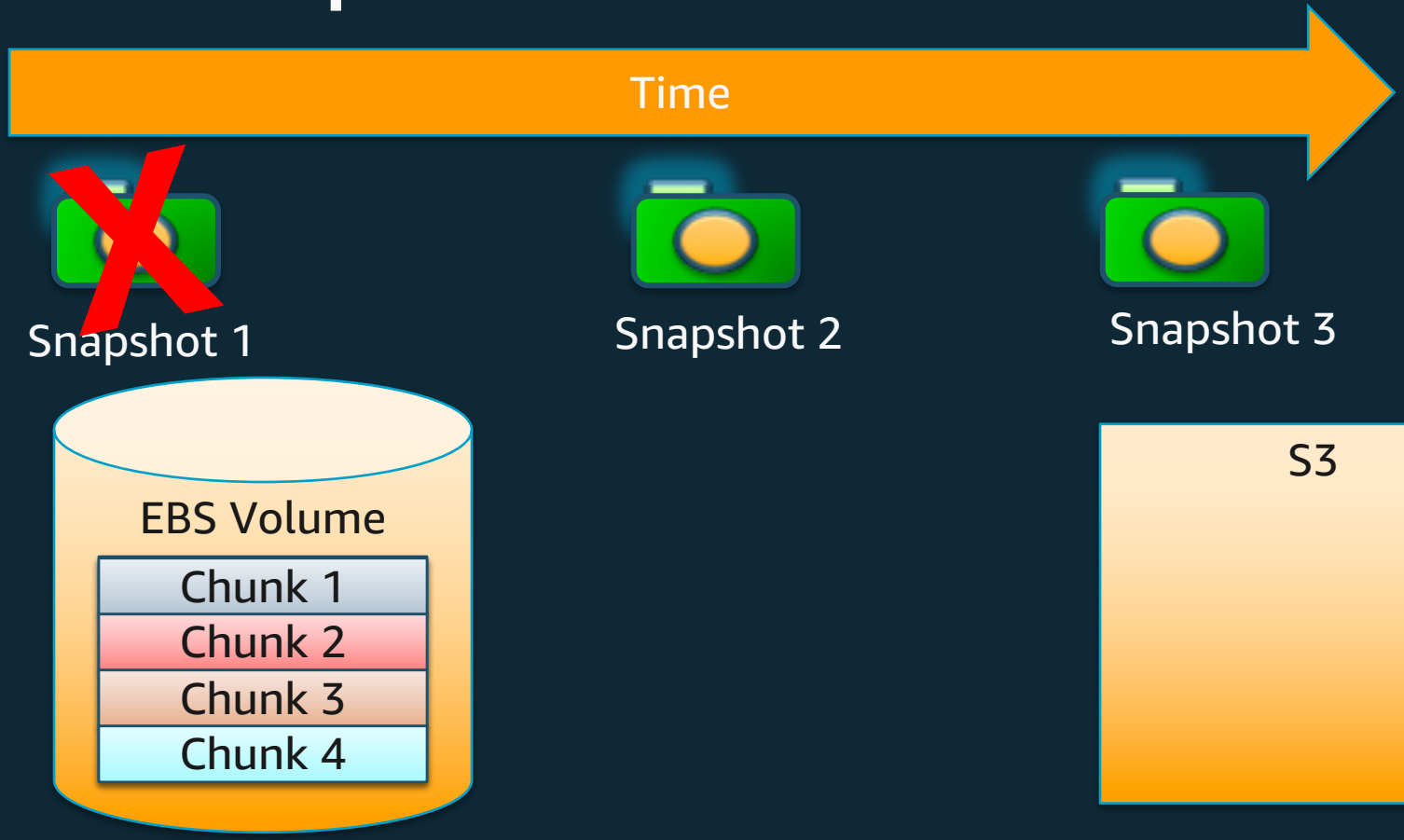
	Magnetic	General Purpose (SSD)	Provisioned IOPS (SSD)
Performance	Lowest Cost	Burstable	Predictable
Use Cases	Infrequent Data Access	Boot volumes Small to Medium DBs Dev & Test	I/O Intensive Relational & NoSQL
Media	Magnetic (HDD)	SSD	SSD
Max IOPS	100 on average with the ability to burst to hundreds of IOPS	Baseline 3 IOPS/GB Burstable to 16,000 IOPS	Consistently performed at provisioned level, up to 64,000 IOPS
Price	$.045/GB (st1) $.025/GB (sc1)	$.10/GB/Month (gp2)	$.125/GB/Month (io1) $.065/provisioned IOPS

	Solid State Drives (SSD)		Hard Disk Drives (HDD)	
Volume Type	EBS Provisioned IOPS SSD (io1)	EBS General Purpose SSD (gp2)*	Throughput Optimized HDD (st1)	Cold HDD (sc1)
Short Description	Highest performance SSD volume designed for latency-sensitive transactional workloads	General Purpose SSD volume that balances price performance for a wide variety of transactional workloads	Low cost HDD volume designed for frequently accessed, throughput intensive workloads	Lowest cost HDD volume designed for less frequently accessed workloads
Use Cases	I/O-intensive NoSQL and relational databases	Boot volumes, low-latency interactive apps, dev & test	Big data, data warehouses, log processing	Colder data requiring fewer scans per day
API Name	io1	gp2	st1	sc1
Volume Size	4 GB - 16 TB	1 GB - 16 TB	500 GB - 16 TB	500 GB - 16 TB
Max IOPS**/Volume	64,000	16,000	500	250
Max Throughput***/Volume	1,000 MB/s	250 MB/s	500 MB/s	250 MB/s
Max IOPS/Instance	80,000	80,000	80,000	80,000
Max Throughput/Instance	1,750 MB/s	1,750 MB/s	1,750 MB/s	1,750 MB/s
Price	$0.125/GB-month $0.065/provisioned IOPS	$0.10/GB-month	$0.045/GB-month	$0.025/GB-month
Dominant Performance Attribute	IOPS	IOPS	MB/s	MB/s

EBS Snapshots



How Do Snapshots Work?



What is Amazon EC2 instance store?

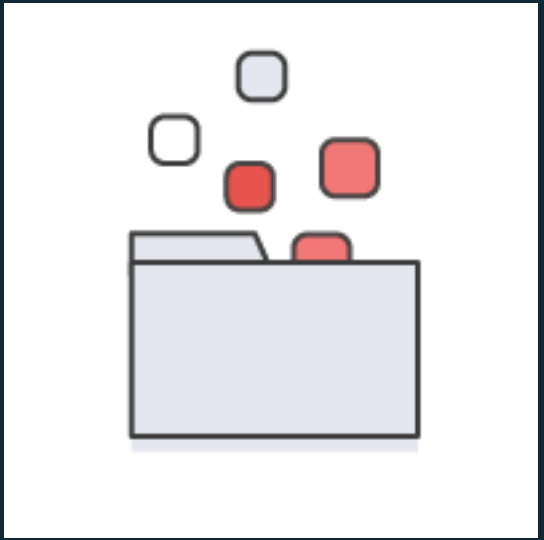
- Local to instance
- Non-persistent data store
- Data not replicated (by default)
- No snapshot support
- SSD or HDD
- >80,000 iops
- >1,750 MB/S

Shared file system

Elastic File System (EFS)

- Fully managed file system for EC2 instances
- Provides standard file system semantics
- Works with standard operating system APIs
- Sharable across thousands of instances
- Elastically grows to petabyte scale
- Delivers performance for a wide variety of workloads
- Highly available and durable
- NFS v4–based
- Accessible from on-premise servers

1 Amazon EFS is Simple



Fully managed

- No hardware, network, file layer
- Create a scalable file system in seconds!

Seamless integration with existing tools and apps

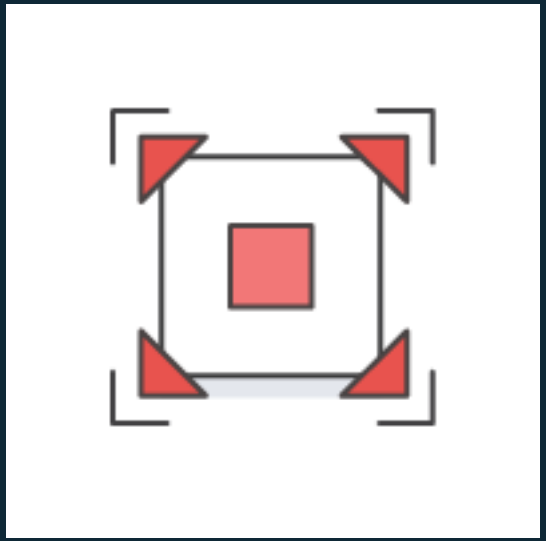
- NFS v4.1—widespread, open
- Standard file system access semantics
- Works with standard OS file system APIs

Simple pricing = simple forecasting

2 Amazon EFS is Elastic

- File systems grow and shrink automatically as you add and remove files
- No need to provision storage capacity or performance
- You pay only for the storage space you use, with no minimum fee

3 Amazon EFS is Scalable



- File systems can grow to petabyte scale
- Throughput and IOPS scale automatically as file systems grow
- Consistent low latencies regardless of file system size
- Support for thousands of concurrent NFS connections

Example use cases

Big Data Analytics

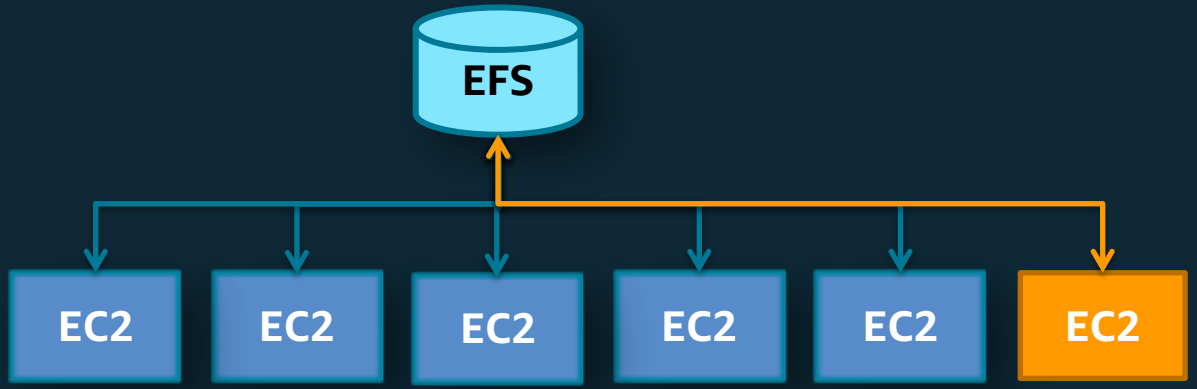
Media Workflow Processing

Web Serving

Content Management

Home Directories

EFS – Mounting



EFS DNS Name

availability-zone.file-system-id.efs.*aws-region*.amazonaws.com

Mount on machine

sudo mount -t nfs4 mount-target-DNS:/ ~/efs-mount-point

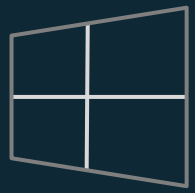
FSx for Windows

Fully managed Windows file systems …

… built on Windows Server

Integrated with AWS

Native Windows compatibility and features



Native Windows compatibility

NTFS

SMB

Native SMB 2.0 to 3.1.1

AD

Integrates with Microsoft AD and supports Windows ACLs

DFS Namespaces and DFS Replication

Windows Server

Object Stores

Amazon S3 (Simple Storage Service)

- Web accessible object store (through API or HTTPS)
- Highly durable (99.999999999% design)
- Limitlessly scalable
- Multiple Tiers to match your workload
- Data Lifecycle Rules
- Static Website Hosting

Amazon Simple Storage Service (S3)

Collect

Move Data via API, HTTPS, SDK

Multiple Encryption Options

Automated cost reduction tools

Store

Designed for 99.999999999% durability

Parallel I/O for Max Speed

Replication options across regions

Analyze

On-demand analytics

Built-in support for SQL expressions with S3 Select

Detailed data on usage patterns and access

Object storage classes

Standard

Active data
Millisecond access
Min 3 AZs
$0.023

Infrequent Access

30 day min duration
Millisecond access
Min 3 AZs
$0.0125

1 Zone - IA

30 day min duration
Millisecond access
Min 1 AZ
$0.01

Intelligent

ML to optimize
Storage costs
Min 3 AZs
*scan cost

Glacier

Archive data
Minutes to Hours
$0.001 - $0.004
Min 3 AZs

Pricing is per GB per month in the US East (N. Virginia) region

Amazon Glacier

Secure

Regulatory compliance certifications

Vault Lock

Locking, encryption, audit and alerting tools

Archive

Designed for 99.999999999% durability

Replication options across regions

Cost-effective

Query-in-place analytics

Expedited and bulk retrievals

Deep Archive

Object Storage Use Cases

Standard

- Cloud Applications
- Big Data Analytics
- Content Distribution
- Primary Data
- Temporary & Small Objects

IA

- File Sync & Share
- Active Archive
- Enterprise Backup
- Media Transcoding
- Disaster Recovery / Geo Redundancy

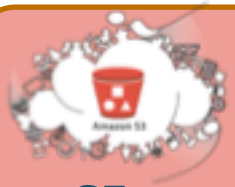
1Zone-IA

- Secondary Backups
- Easily Re-Creatable Data
- S3 Cross-Region Replication Target

Glacier

- Deep / Offline Archives
- Tape Vaulting Replacement
- WORM Compliant Data

Storage Tiered To Your Requirements



S3

"Hot" Data
Active and/or
Temporary Data

Starts at $0.023 / GB per month | > 0K | ≥ 0 Days

S3-IA

"Warm" Data
Infrequently
Accessed Data

$0.0125 / GB per month | ≥ 128K | ≥ 30 Days

$0.01/GB retrieval

Glacier

"Cold" Data
Archive and
Compliance Data

$0.001 / GB per month
$0.004 / GB per month

> 0K | ≥ 90 Days

1-5 mins	3–5 hrs	5–12 hrs
Expedited $0.03 / GB	**Standard** $0.01 / GB	**Bulk** $0.0025 / GB

Lifecycle

Durable
99.999999999%

Available
S3: 99.99%
S3-IA: 99.9%

Performant
Low Latency
High Throughput

Scalable
Elastic capacity
No preset limits

aws

S3 Storage Management Features

S3 Object Tagging

manage and control access for Amazon S3 objects.

S3 Analytics, Storage Class Analysis

Analyze storage access patterns and transition the right data to the right storage class.

S3 Inventory

Simplify and speed up business workflows and big data jobs

S3 CloudWatch Metrics

Understand and improve the performance of your applications that use S3

Amazon CloudFront

Easy-to-use Content Delivery Network (CDN)
Pay-as-you-go pricing
Multiple origins: S3, EC2, on-premise

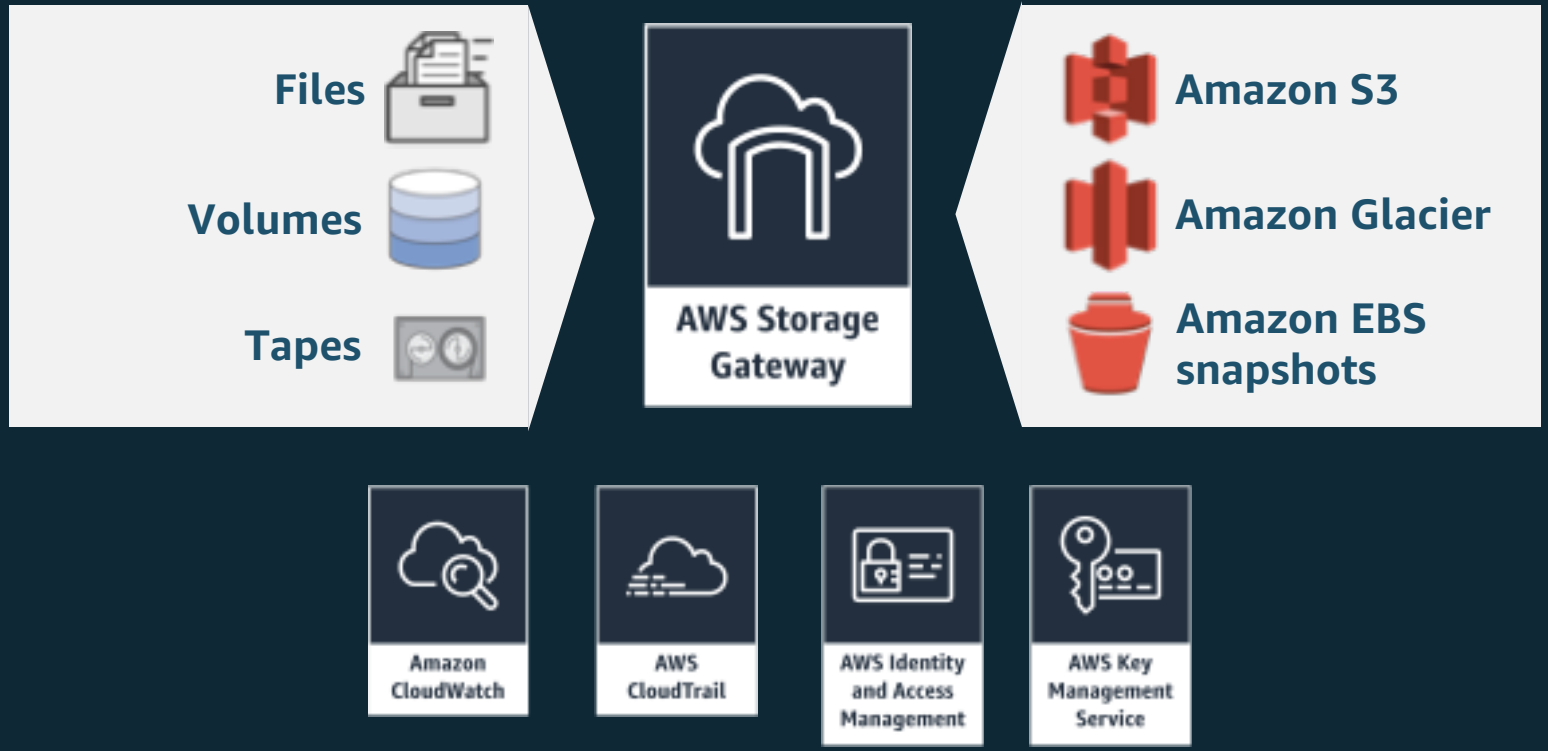
Worldwide network of 125+ edge locations and growing

- Video streaming
- Geo Restriction
- Custom SSL Certificates
- Dynamic Content
- Supports POST/PUT

On-Premises Storage Integration

Storage Gateway hybrid storage solutions

Enables using standard storage protocols to access AWS storage services



Storage Gateway – Files, volumes, and tapes

File gateway NFS (v3 and v4.1) interface

On-premises file storage backed by Amazon S3 objects

Volume gateway iSCSI block interface

On-premises block storage backed by S3 with EBS snapshots

Tape gateway iSCSI virtual tape library interface

Virtual tape storage in Amazon S3 and Glacier with VTL management

Storage Gateway – Common capabilities

Standard storage protocols integrate with on-premises applications

Local caching for low-latency access to frequently used data

Efficient data transfer with buffering and bandwidth management

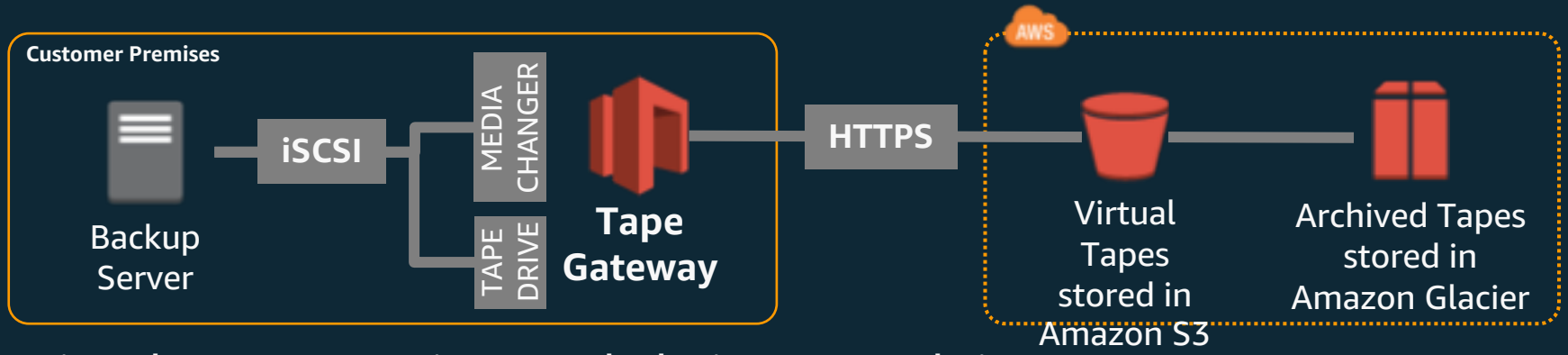
Native data storage in AWS

Stateless virtual appliance for resiliency

Integrated with AWS management and security

Tape gateway

Virtual tape storage in Amazon S3 and Glacier with VTL management



Virtual tape storage in S3 and Glacier accessed via tape gateway

Data compressed in-transit and at-rest

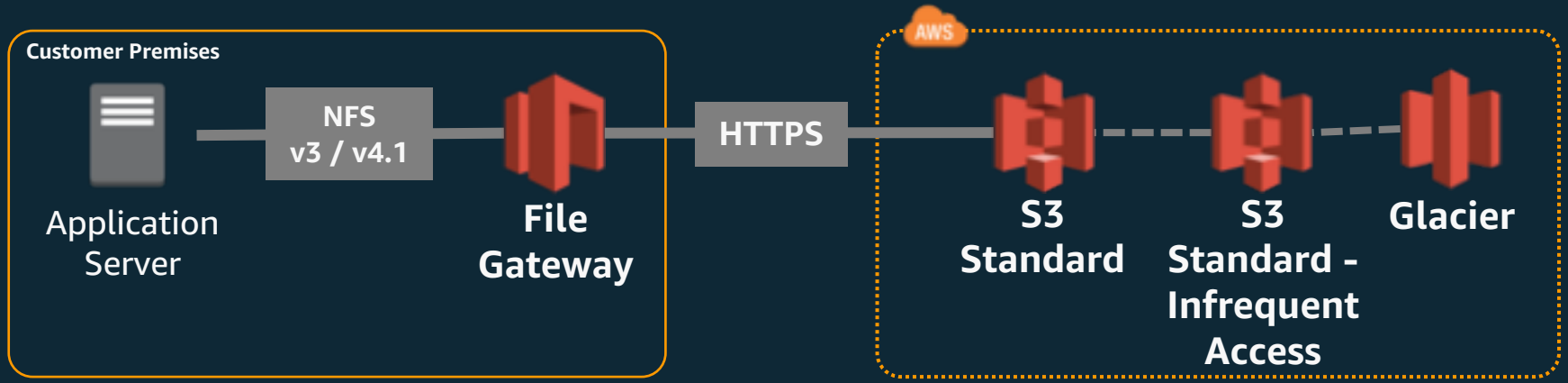
Unlimited virtual tape storage, with up to 1PB of tapes active in library

Supports leading backup applications:

VERITAS DELL EMC veeam Hewlett Packard Enterprise System Center Data Protection Manager 2012 arcserve

File gateway

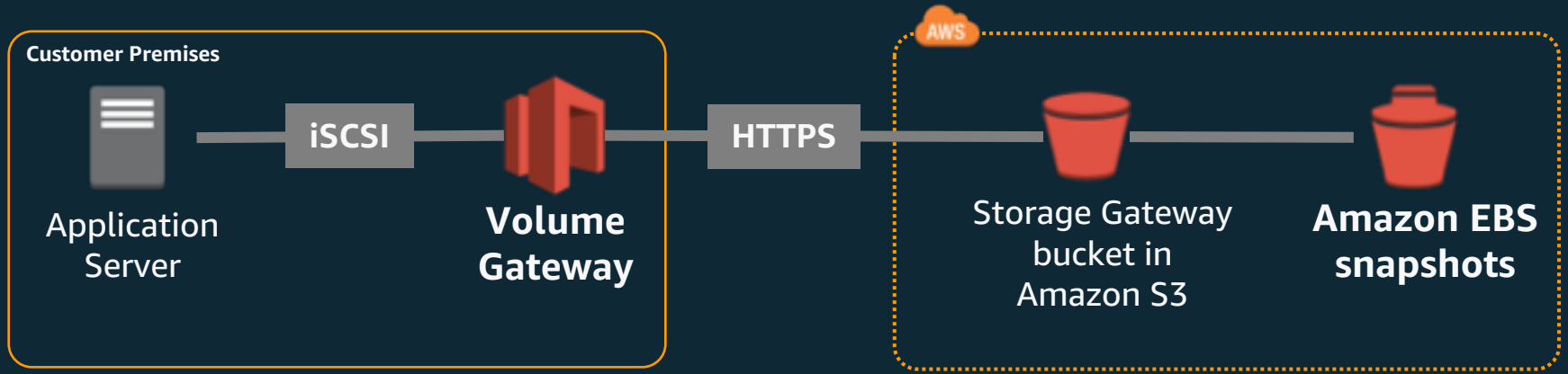
On-premises file storage maintained as objects in Amazon S3



- Data stored and retrieved from your S3 buckets
- One-to-one mapping from files-to-objects
- File metadata stored in object metadata
- Bucket access managed by IAM role you own and manage
- Use S3 Lifecycle Policies, versioning, or CRR to manage data

Volume gateway

On-premises volume storage backed by Amazon S3 with EBS snapshots



Block storage in S3 accessed via the volume gateway

Data compressed in-transit and at-rest

Backup on-premises volumes to EBS snapshots

Create on-premises volumes from EBS snapshots

Up to 1PB of total volume storage per gateway

Hybrid storage use cases with Storage Gateway

Enabling cloud workloads

Move data to AWS storage for Big Data, cloud bursting, or migration

Backup, archive, and disaster recovery

Cost effective storage in AWS with local or cloud restore

Tiered cloud storage

Easily add AWS storage to your on-premises environment

Amazon Snowball & Snowball Edge

- Terabyte scale data transport
- Uses secure appliances
- Faster than Internet for significant data sets
- Import into S3
- HIPAA Compliant

What is Snowball?

Terabyte scale data transport

Ruggedized
case
“8.5G Impact”

E-ink shipping
label

80 TB
10G network

Rain & dust
resistant

Tamper-resistant
case & electronics

All data encrypted
end-to-end

How fast is Snowball?

- Less than 1 day to transfer 250TB via 5x10G connections with 5 Snowballs, less than 1 week including shipping
- Number of days to transfer 250TB via the Internet at typical utilizations

	Internet Connection Speed			
Utilization	1Gbps	500Mbps	300Mbps	150Mbps
25%	95	190	316	632
50%	47	95	158	316
75%	32	63	105	211

Quiz

1. What is the difference between object storage and block storage?
2. Can a single EBS volumes be shared with multiple EC2 instances?
3. What is the best way to transfer 100 TB of data into AWS?
4. What are the differences between S3 Standard and Glacier?
5. What is the right storage type for hosting a database?