

Amazon S3



Section introduction

- Amazon S3 is one of the main building blocks of AWS
- It's advertised as "infinitely scaling" storage
- Many websites use Amazon S3 as a backbone
- Many AWS services use Amazon S3 as an integration as well
- We'll have a step-by-step approach to S3

Amazon S3 Use cases

- Backup and storage
- Disaster Recovery
- Archive
- Hybrid Cloud storage
- Application hosting
- Media hosting
- Data lakes & big data analytics
- Software delivery
- Static website



Nasdaq stores 7 years of data into S3 Glacier



Sysco runs analytics on its data and gain business insights

Amazon S3 - Buckets

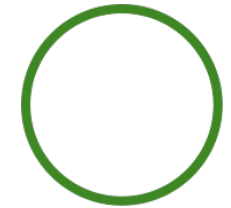
- Amazon S3 allows people to store objects (files) in “buckets” (directories)
- Buckets must have a **globally unique name** (across all regions all accounts)
- Buckets are defined at the region level
- S3 looks like a global service but buckets are created in a region
- Naming convention
 - No uppercase, No underscore
 - 3-63 characters long
 - Not an IP
 - Must start with lowercase letter or number
 - Must NOT start with the prefix **xn--**
 - Must NOT end with the suffix **-s3alias**



S3 Bucket

Amazon S3 - Objects

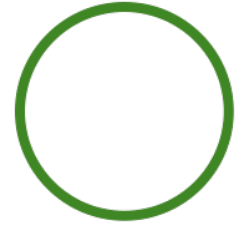
- Objects (files) have a Key
- The **key** is the **FULL** path:
 - s3://my-bucket/**my_file.txt**
 - s3://my-bucket/**my_folder/another_folder/my_file.txt**
- The key is composed of **prefix** + **object name**
 - s3://my-bucket/**my_folder/another_folder/my_file.txt**
- There's no concept of “directories” within buckets (although the UI will trick you to think otherwise)
- Just keys with very long names that contain slashes (“/”)



Object



S3 Bucket
with Objects



Amazon S3 – Objects (cont.)

- Object values are the content of the body:
 - Max. Object Size is 5TB (5000GB)
 - If uploading more than 5GB, must use “multi-part upload”
- Metadata (list of text key / value pairs – system or user metadata)
- Tags (Unicode key / value pair – up to 10) – useful for security / lifecycle
- Version ID (if versioning is enabled)

Amazon S3 – Security

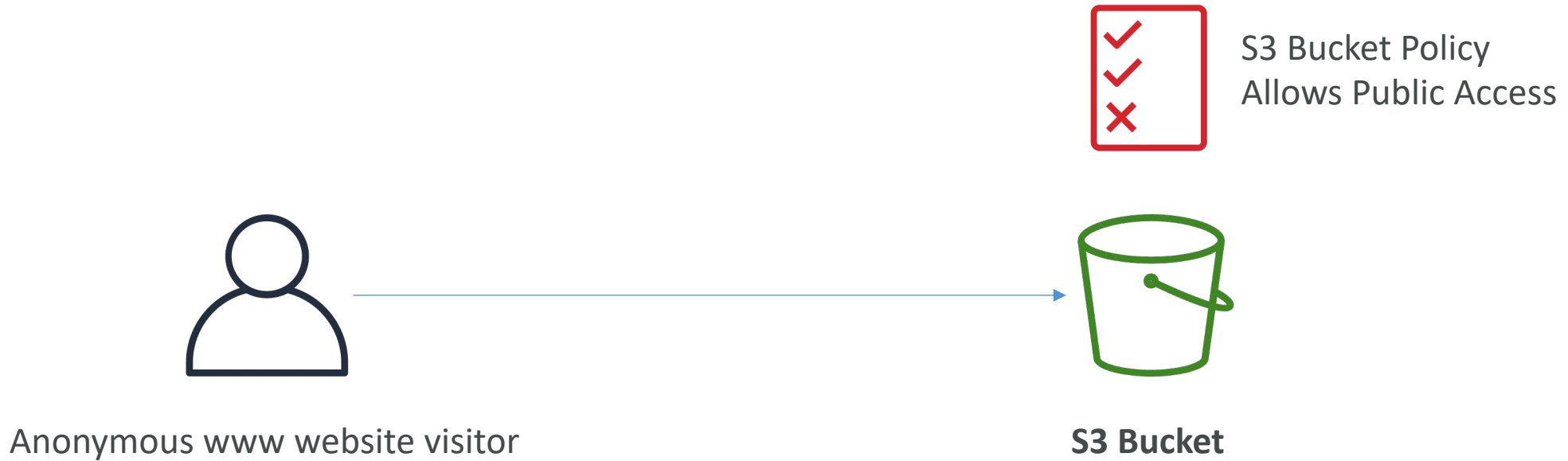
- User-Based
 - IAM Policies – which API calls should be allowed for a specific user from IAM
- Resource-Based
 - Bucket Policies – bucket wide rules from the S3 console - allows cross account
 - Object Access Control List (ACL) – finer grain (can be disabled)
 - Bucket Access Control List (ACL) – less common (can be disabled)
- **Note:** an IAM principal can access an S3 object if
 - The user IAM permissions ALLOW it OR the resource policy ALLOWS it
 - AND there's no explicit DENY
- **Encryption:** encrypt objects in Amazon S3 using encryption keys

S3 Bucket Policies

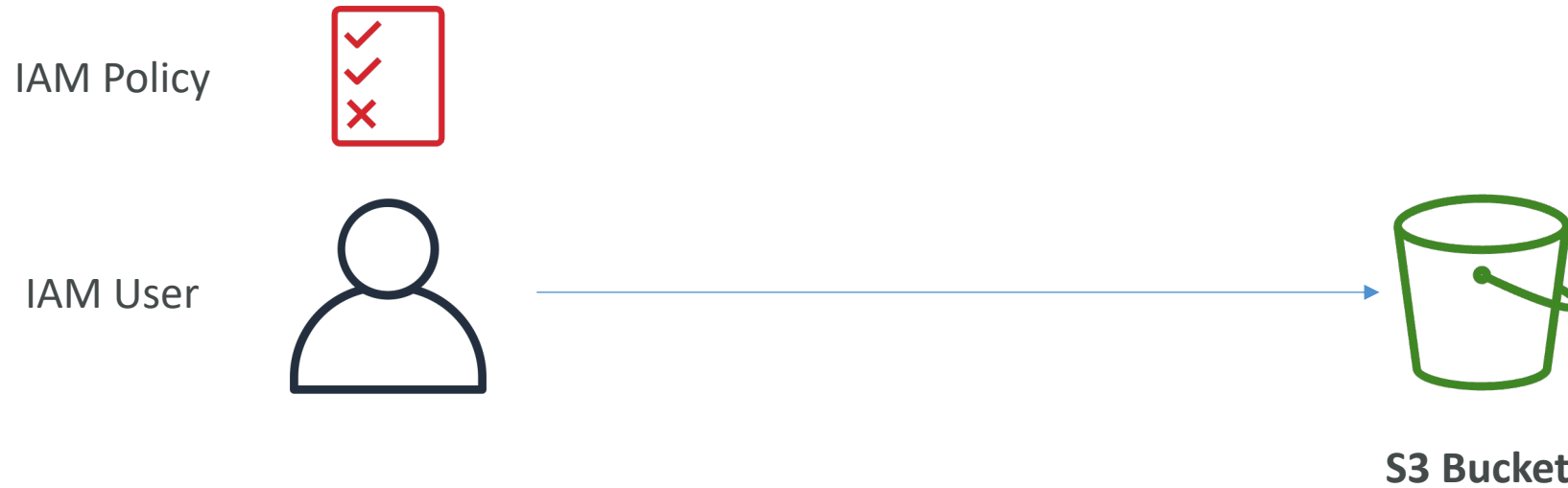
- JSON based policies
 - Resources: buckets and objects
 - Effect: Allow / Deny
 - Actions: Set of API to Allow or Deny
 - Principal: The account or user to apply the policy to
- Use S3 bucket for policy to:
 - Grant public access to the bucket
 - Force objects to be encrypted at upload
 - Grant access to another account (Cross Account)

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "PublicRead",
      "Effect": "Allow",
      "Principal": "*",
      "Action": [
        "s3:GetObject"
      ],
      "Resource": [
        "arn:aws:s3:::examplebucket/*"
      ]
    }
  ]
}
```

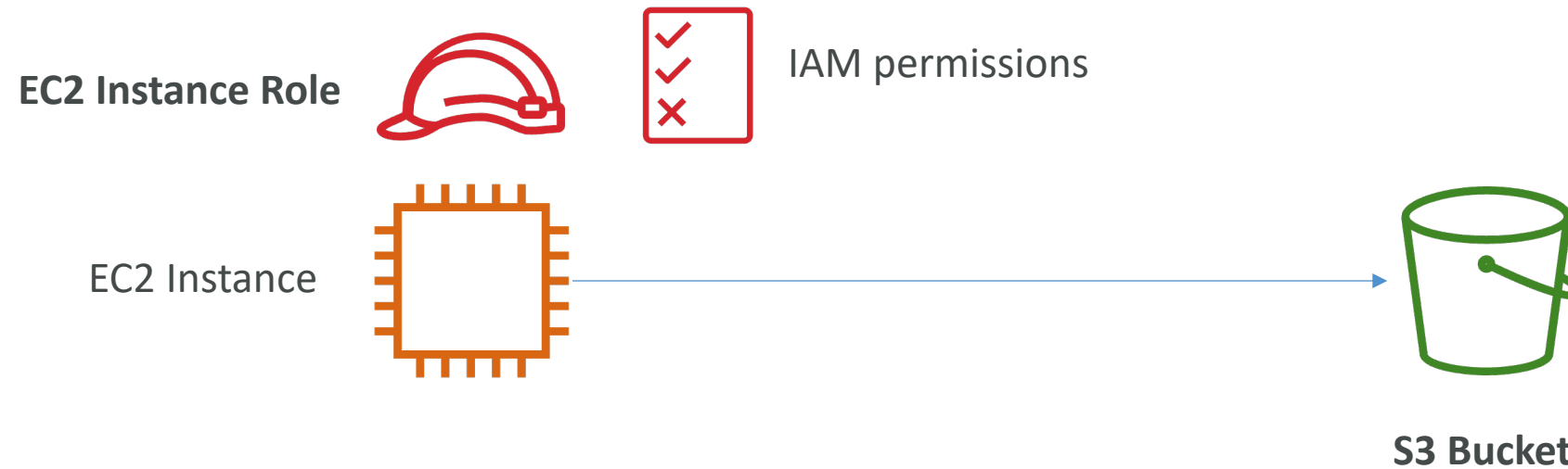

Example: Public Access - Use Bucket Policy



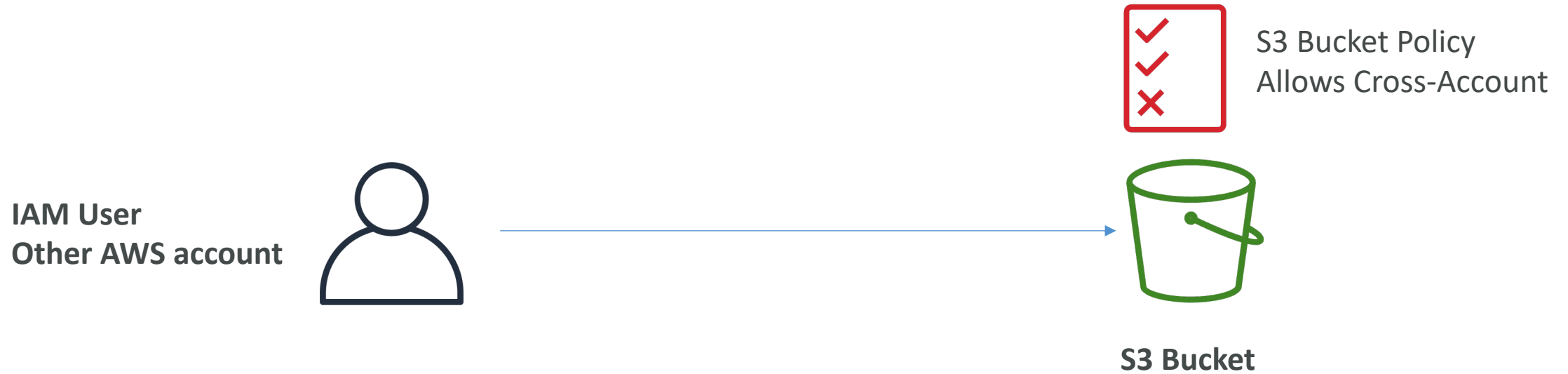
Example: User Access to S3 – IAM permissions



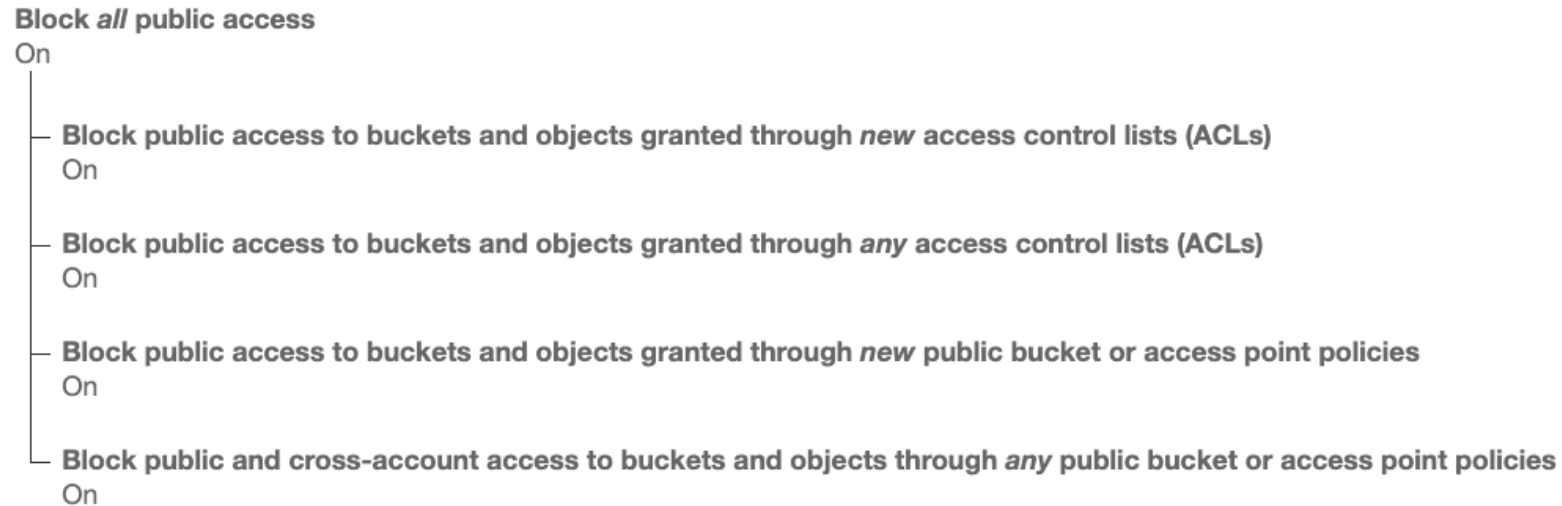
Example: EC2 instance access - Use IAM Roles



Advanced: Cross-Account Access – Use Bucket Policy



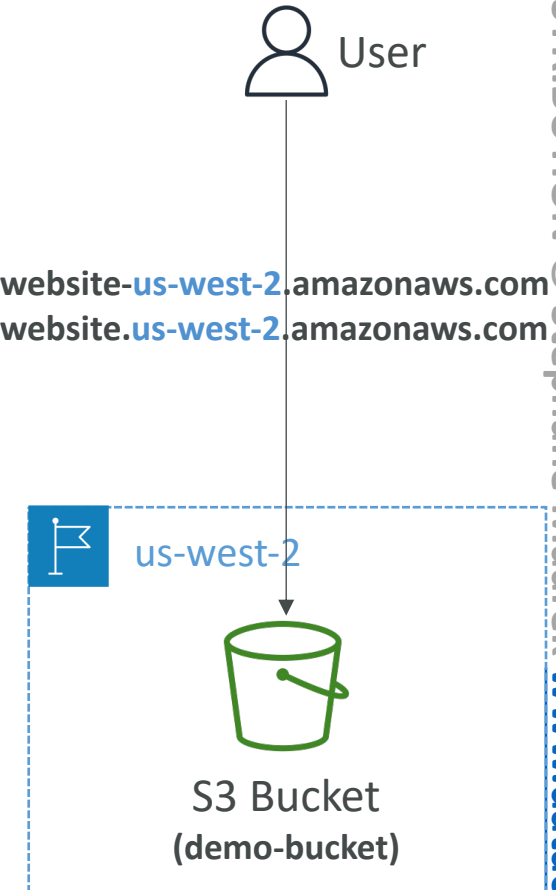
Bucket settings for Block Public Access



- These settings were created to prevent company data leaks
- If you know your bucket should never be public, leave these on
- Can be set at the account level

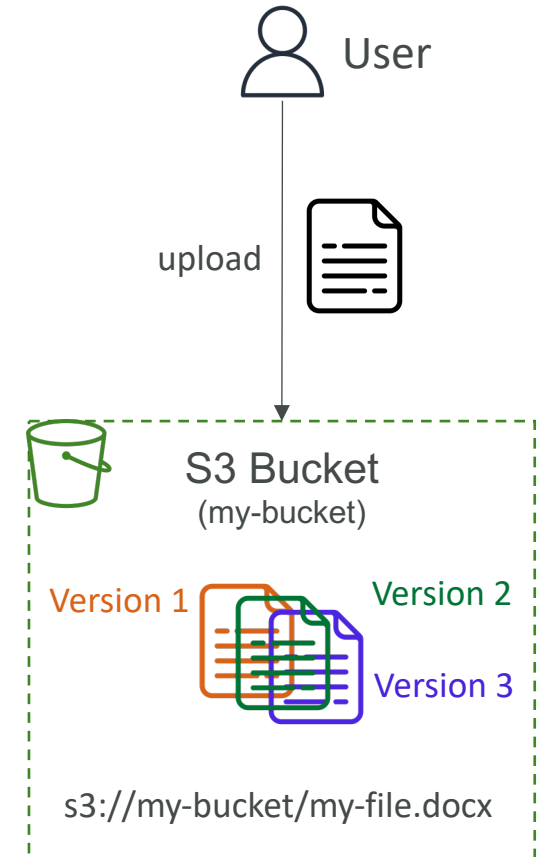
Amazon S3 – Static Website Hosting

- S3 can host static websites and have them accessible on the Internet
- The website URL will be (depending on the region)
 - <http://demo-bucket.s3-website-us-west-2.amazonaws.com>
<http://demo-bucket.s3-website.us-west-2.amazonaws.com>
 - <http://bucket-name.s3-website-aws-region.amazonaws.com>
OR
<http://bucket-name.s3-website.aws-region.amazonaws.com>
- If you get a **403 Forbidden** error, make sure the bucket policy allows public reads!



Amazon S3 - Versioning

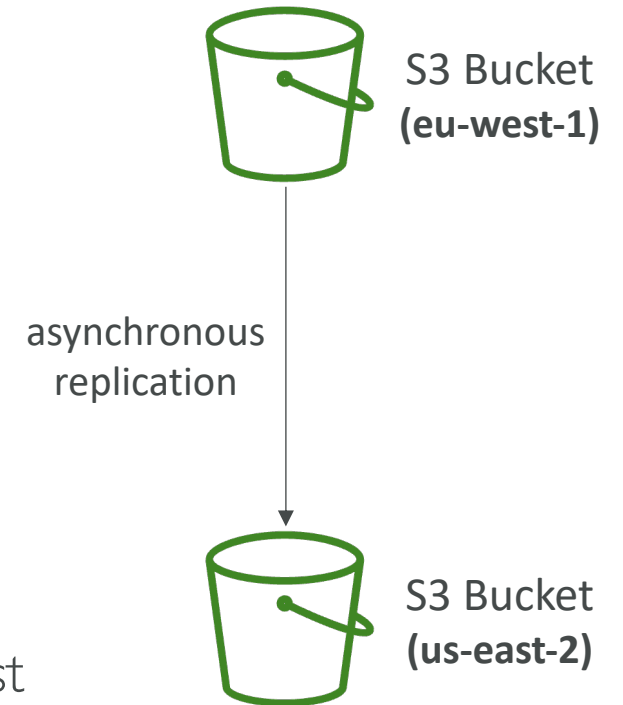
- You can version your files in Amazon S3
- It is enabled at the **bucket level**
- Same key overwrite will change the “version”: 1, 2, 3....
- It is best practice to version your buckets
 - Protect against unintended deletes (ability to restore a version)
 - Easy roll back to previous version
- Notes:
 - Any file that is not versioned prior to enabling versioning will have version “null”
 - Suspending versioning does not delete the previous versions



Amazon S3 – Replication (CRR & SRR)



- Must enable Versioning in source and destination buckets
- Cross-Region Replication (CRR)
- Same-Region Replication (SRR)
- Buckets can be in different AWS accounts
- Copying is asynchronous
- Must give proper IAM permissions to S3
- Use cases:
 - **CRR** – compliance, lower latency access, replication across accounts
 - **SRR** – log aggregation, live replication between production and test accounts



Amazon S3 – Replication (Notes)

- After you enable Replication, only new objects are replicated
- Optionally, you can replicate existing objects using **S3 Batch Replication**
 - Replicates existing objects and objects that failed replication
- For DELETE operations
 - **Can replicate delete markers** from source to target (optional setting)
 - Deletions with a version ID are not replicated (to avoid malicious deletes)
- There is no “chaining” of replication
 - If bucket 1 has replication into bucket 2, which has replication into bucket 3
 - Then objects created in bucket 1 are not replicated to bucket 3

S3 Storage Classes

- Amazon S3 Standard - General Purpose
 - Amazon S3 Standard-Infrequent Access (IA)
 - Amazon S3 One Zone-Infrequent Access
 - Amazon S3 Glacier Instant Retrieval
 - Amazon S3 Glacier Flexible Retrieval
 - Amazon S3 Glacier Deep Archive
 - Amazon S3 Intelligent Tiering
-
- Can move between classes manually or using S3 Lifecycle configurations

S3 Durability and Availability

- Durability:
 - High durability (99.9999999999%, 11 9's) of objects across multiple AZ
 - If you store 10,000,000 objects with Amazon S3, you can on average expect to incur a loss of a single object once every 10,000 years
 - Same for all storage classes
- Availability:
 - Measures how readily available a service is
 - Varies depending on storage class
 - Example: S3 standard has 99.99% availability = not available 53 minutes a year



S3 Standard – General Purpose

- 99.99% Availability
 - Used for frequently accessed data
 - Low latency and high throughput
 - Sustain 2 concurrent facility failures
-
- Use Cases: Big Data analytics, mobile & gaming applications, content distribution...

S3 Storage Classes – Infrequent Access

- For data that is less frequently accessed, but requires rapid access when needed
- Lower cost than S3 Standard
- Amazon S3 Standard-Infrequent Access (S3 Standard-IA)
 - 99.9% Availability
 - Use cases: Disaster Recovery, backups
- Amazon S3 One Zone-Infrequent Access (S3 One Zone-IA)
 - High durability (99.999999999%) in a single AZ; data lost when AZ is destroyed
 - 99.5% Availability
 - Use Cases: Storing secondary backup copies of on-premises data, or data you can recreate



Amazon S3 Glacier Storage Classes

- Low-cost object storage meant for archiving / backup
- Pricing: price for storage + object retrieval cost
- **Amazon S3 Glacier Instant Retrieval**
 - Millisecond retrieval, great for data accessed once a quarter
 - Minimum storage duration of 90 days
- **Amazon S3 Glacier Flexible Retrieval** (formerly Amazon S3 Glacier):
 - Expedited (1 to 5 minutes), Standard (3 to 5 hours), Bulk (5 to 12 hours) – free
 - Minimum storage duration of 90 days
- **Amazon S3 Glacier Deep Archive** – for long term storage:
 - Standard (12 hours), Bulk (48 hours)
 - Minimum storage duration of 180 days





S3 Intelligent-Tiering

- Small monthly monitoring and auto-tiering fee
- Moves objects automatically between Access Tiers based on usage
- There are no retrieval charges in S3 Intelligent-Tiering
- *Frequent Access tier (automatic)*: default tier
- *Infrequent Access tier (automatic)*: objects not accessed for 30 days
- *Archive Instant Access tier (automatic)*: objects not accessed for 90 days
- *Archive Access tier (optional)*: configurable from 90 days to 700+ days
- *Deep Archive Access tier (optional)*: config. from 180 days to 700+ days

S3 Storage Classes Comparison

	Standard	Intelligent-Tiering	Standard-IA	One Zone-IA	Glacier Instant Retrieval	Glacier Flexible Retrieval	Glacier Deep Archive
Durability	99.999999999% == (11 9's)						
Availability	99.99%	99.9%	99.9%	99.5%	99.9%	99.99%	99.99%
Availability SLA	99.9%	99%	99%	99%	99%	99.9%	99.9%
Availability Zones	>= 3	>= 3	>= 3	1	>= 3	>= 3	>= 3
Min. Storage Duration Charge	None	None	30 Days	30 Days	90 Days	90 Days	180 Days
Min. Billable Object Size	None	None	128 KB	128 KB	128 KB	40 KB	40 KB
Retrieval Fee	None	None	Per GB retrieved	Per GB retrieved	Per GB retrieved	Per GB retrieved	Per GB retrieved

<https://aws.amazon.com/s3/storage-classes/>

S3 Storage Classes – Price Comparison

Example: us-east-1

	Standard	Intelligent-Tiering	Standard-IA	One Zone-IA	Glacier Instant Retrieval	Glacier Flexible Retrieval	Glacier Deep Archive
Storage Cost (per GB per month)	\$0.023	\$0.0025 - \$0.023	\$0.0125	\$0.01	\$0.004	\$0.0036	\$0.00099
Retrieval Cost (per 1000 request)	GET: \$0.0004 POST: \$0.005	GET: \$0.0004 POST: \$0.005	GET: \$0.001 POST: \$0.01	GET: \$0.001 POST: \$0.01	GET: \$0.01 POST: \$0.02	GET: \$0.0004 POST: \$0.03 Expedited: \$10 Standard: \$0.05 Bulk: free	GET: \$0.0004 POST: \$0.05 Standard: \$0.10 Bulk: \$0.025
Retrieval Time	Instantaneous					Expedited (1 – 5 mins) Standard (3 – 5 hours) Bulk (5 – 12 hours)	Standard (12 hours) Bulk (48 hours)
Monitoring Cost (per 1000 objects)		\$0.0025					

<https://aws.amazon.com/s3/pricing/>

S3 Express One Zone

- High performance, **single Availability Zone** storage class
- Objects stored in a **Directory Bucket** (bucket in a single AZ)
- Handle 100,000s requests per second with **single-digit millisecond** latency
- Up to 10x better performance than S3 Standard (50% lower costs)
- High Durability (99.999999999%) and Availability (99.95%)
- Co-locate your storage and compute resources in the same AZ (reduces latency)
- Use cases: latency-sensitive apps, data-intensive apps, AI & ML training, financial modeling, media processing, HPC...
- Best integrated with SageMaker Model Training, Athena, EMR, Glue...

