

Navigating the Complexities of Object Storage Compatibility

Live Webinar

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Today's Presenters



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The SNIA Community



200
Corporations,
universities, startups,
and individuals



2,500
Active
contributing
members



50,000
Worldwide
IT end users and
professionals

What We Do



Educate vendors and users on cloud storage, data services and orchestration



Support & promote business models and architectures: OpenStack, Software Defined Storage, Kubernetes, Object Storage



Understand Hyperscaler requirements
Incorporate them into standards and programs



Collaborate with other industry associations

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Agenda

- Object Storage Implementations Landscape
- Incompatibility Examples
- Interoperability Plugfest and Call for Action





Object Storage Implementations Landscape

Gregory Touretsky

Object Storage Protocols and Implementations - Server

- Simple Storage Service (S3)
 - Amazon, Ceph-RGW, Minio, Cloudian, Wasabi, Backblaze, Seagate Lyve, IBM COS, DellEMC, NetApp, Hitachi, Oracle Cloud Storage, Scality, Google Cloud Storage (*), CloudFlare, Akamai, DigitalOcean, ...
- Google Cloud Storage
- Azure Blob Storage
- OpenStack Swift
- SNIA Cloud Data Management Interface (CDMI™)
 - Several open source and commercial (NetApp StorageGrid, Scality Ring, etc) implementations



Object Storage Client Implementations

Not a comprehensive list

SDKs



Go
Python
Java
Ruby
CPP
.Net
Rust
...



Go
Python
Java
CPP
.Net
Rust
...



Acronis



actifio



arcserve



Poll Question #1

- What is your company's role in the object space?
 - A) Customer of one or more object storage platforms
 - B) Developer of one or more object storage platforms
 - C) Service provider offering object storage solutions
 - D) Researcher/Academic in the field of data storage
 - E) Other

Poll Question #2

- If you are a customer of an object storage solution, what is your primary production implementation?
 - A) Open source (ex: Ceph, Minio)
 - B) Commercial on-prem solution (ex: Dell ECS, IBM COS, Cloudian, etc)
 - C) Managed cloud service offering (Amazon S3, Azure Blob, Seagate Lyve, Wasabi, etc)
 - D) Other
 - E) None (not using any object storage solution)

Poll Question #3

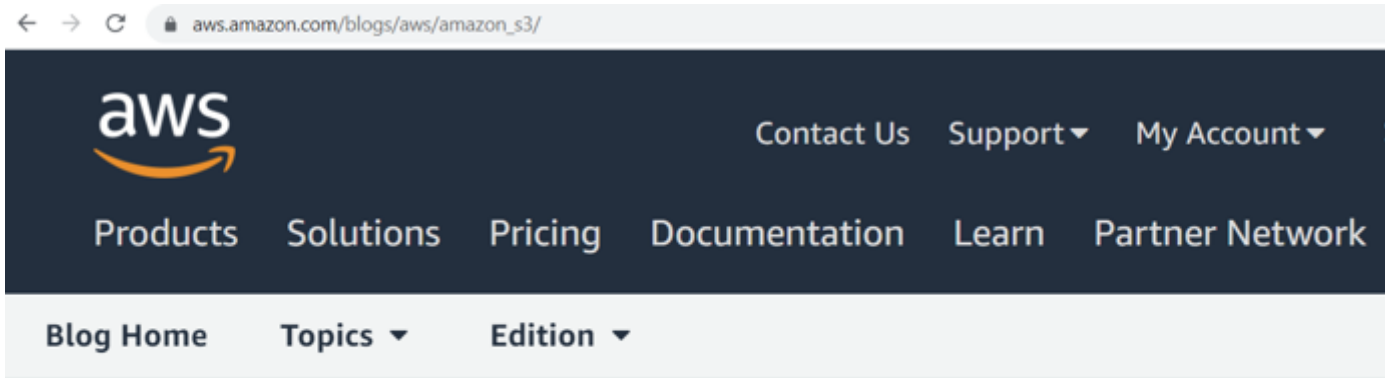
- What is the total object storage capacity used by your business across all locations and implementations?
 - Below 1 TB
 - 1 TB – 1 PB
 - 1 PB – 10 PB
 - Over 10 PB
 - None

Incompatibilities?

What incompatibilities?...

Some real world examples

As an example - Amazon S3



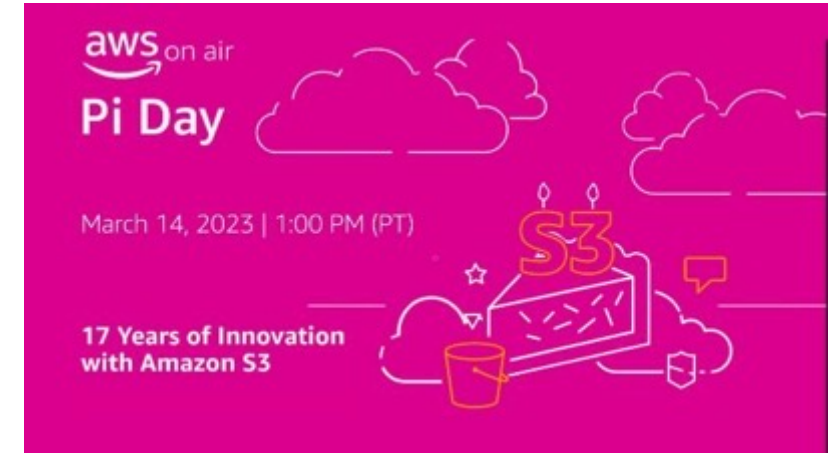
AWS News Blog

Amazon S3

by [Jeff Barr](#) | on 14 MAR 2006 | [Permalink](#) | [Share](#)

Earlier today we rolled out [Amazon S3](#), our reliable, highly scalable, low-latency data storage service.

Using SOAP and REST interfaces, developers can easily store any number of blocks of data in S3. Each block can be up to 5 GB in length, and is associated with a user-defined key and additional key/value metadata pairs.



- >350 Trillion objects
- >100M requests per second
- Traffic peaks at >1PB/sec
- 4B checksum calculations per second
- Millions of hard drives, Exabytes of data

Amazon S3 API

Amazon S3 API Reference

Actions

Amazon S3

- AbortMultipartUpload
- CompleteMultipartUpload
- CopyObject
- CreateBucket
- CreateMultipartUpload
- DeleteBucket
- DeleteBucketAnalyticsConfiguration
- DeleteBucketCors
- DeleteBucketEncryption
- DeleteBucketIntelligentTieringConfiguration
- DeleteBucketInventoryConfiguration
- DeleteBucketLifecycle
- DeleteBucketMetricsConfiguration
- DeleteBucketOwnershipControls
- DeleteBucketPolicy
- DeleteBucketReplication
- DeleteBucketTagging
- DeleteBucketWebsite
- DeleteObject**
- DeleteObjects
- DeleteObjectTagging
- DeletePublicAccessBlock
- GetBucketAccelerateConfiguration
- GetBucketAcl
- GetBucketAnalyticsConfiguration
- GetBucketCors
- GetBucketEncryption
- GetBucketIntelligentTieringConfiguration
- GetBucketInventoryConfiguration

DeleteObject

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Removes the null version (if there is one) of an object. If the object has multiple versions and you do not specify a version, Amazon S3 does not remove the object. If you specify a version and the version does not exist, you must use the version-id header. If the object deleted is a delete marker, Amazon S3 sets the delete marker as the current version.

If the object you want to delete is in a bucket with MFA Delete enabled, you must use the `x-amz-mfa` request header in the DELETE request.

For more information about MFA Delete, see [Using MFA Delete](#).

You can delete objects by explicitly calling DELETE or by using the `s3:DeleteObject` action. If you want to block users or accounts from deleting objects, you can use the `s3:DeleteObjectVersion` action.

The following action is related to DeleteObject:

- PutObject

Request Syntax

```
DELETE /<Key>?versionId=<VersionId> HTTP/1.1
Host: <Bucket>.s3.amazonaws.com
x-amz-mfa: <MFA>
x-amz-request-payer: <RequestPayer>
x-amz-bypass-governance-retention: <BypassGovernanceRetention>
x-amz-expected-bucket-owner: <ExpectedBucketOwner>
```

URI Request Parameters

The request uses the following URI parameters.

Bucket

90+ Amazon S3 Actions

Amazon S3 API Reference

Actions

Amazon S3

Amazon S3 Control

- CreateAccessPoint
- CreateJob
- CreateMultiRegionAccessPoint
- DeleteAccessPoint
- DeleteAccessPointForObjectLambda
- DeleteAccessPointPolicy
- DeleteAccessPointPolicyForObjectLambda
- DeleteBucket
- DeleteBucketLifecycleConfiguration
- DeleteBucketPolicy
- DeleteBucketReplication
- DeleteBucketTagging
- DeleteJobTagging
- DeleteMultiRegionAccessPoint
- DeletePublicAccessBlock
- DeleteStorageLensConfiguration
- DeleteStorageLensConfigurationTagging
- DescribeJob
- DescribeMultiRegionAccessPointOperation
- GetAccessPoint
- GetAccessPointConfigurationForObjectLambda
- GetAccessPointForObjectLambda
- GetAccessPointPolicy
- GetAccessPointPolicyForObjectLambda
- GetAccessPointPolicyStatus

CreateJob

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You can use S3 Batch Operations to create a job that performs one or more actions on objects in a bucket.

Related actions include:

- DescribeJob
- ListJobs
- UpdateJobPriority
- UpdateJobStatus
- JobOperation

Request Syntax

```
POST /v20180820/jobs HTTP/1.1
Host: s3-control.amazonaws.com
x-amz-account-id: <AccountID>
Content-Type: application/xml
<?xml version="1.0" encoding="UTF-8">
  <CreateJobRequest xmlns="http://s3.amazonaws.com/doc/2018-08-20/">
    <ConfirmationRequired>true</ConfirmationRequired>
    <Operation>
      <LambdaInvoke>
        <FunctionArn><FunctionArn></FunctionArn>
      </LambdaInvoke>
      <S3DeleteObjectTagging>
        <S3DeleteObjectTagging></S3DeleteObjectTagging>
      </S3DeleteObjectTagging>
      <S3InitiateRestore>
        <ExpirationInDays><ExpirationInDays></ExpirationInDays>
        <GlacierJobTier><GlacierJobTier></GlacierJobTier>
      </S3InitiateRestore>
      <S3PutObjectAcl>
        <S3PutObjectAcl></S3PutObjectAcl>
      </S3PutObjectAcl>
    </Operation>
  </CreateJobRequest>
```

60+ Amazon S3 Control Actions

AWS Identity and Access Management

API Reference

CreatePolicy

PDF

Welcome

Actions

- AddClientIDToOpenIDConnectProvider
- AddRoleToInstanceProfile
- AddUserToGroup
- AttachGroupPolicy
- AttachRolePolicy
- AttachUserPolicy
- ChangePassword
- CreateAccessKey
- CreateAccountAlias
- CreateGroup
- CreateInstanceProfile
- CreateLoginProfile
- CreateOpenIDConnectProvider
- CreatePolicy**
- CreatePolicyVersion
- CreateRole
- CreateSAMLProvider
- CreateServiceLinkedRole
- CreateServiceSpecificCredential
- CreateUser
- CreateVirtualMFADevice
- DeactivateMFADevice
- DeleteAccessKey
- DeleteAccountAlias

As a best practice, you can validate your policy by using the `aws iam validate-policy` command. For more information about managed policies, see [Versioning for managed policies](#) in the [AWS IAM User Guide](#).

Request Parameters

For information about the parameters for this action, see [Request Parameters](#) in the [AWS IAM User Guide](#).

Description

A friendly description of the policy.

Typically used to store information about the policy.

The policy description is immutable.

Type: String

Length Constraints: Maximum length is 1024 characters.

Required: No

Path

The path for the policy.

For more information about paths, see [Request Parameters](#) in the [AWS IAM User Guide](#).

This parameter is optional. If it is not specified, the policy is created with the default path, `/`.

This parameter allows (through its `regex` attribute) the path to contain forward slashes (`/`). In addition, the path can contain alphanumeric characters, spaces, and punctuation characters, digits, and underscores.

IAM, STS Actions

Documented Incompatibilities

IBM Documentation

Search in IBM Cloud Object Storage System 3.10.2

IBM Cloud Object Storage System

IBM

System Cloud Storage Object API

List Parts (GET)

Returns a list of parts that are associated with the specified object.

The following operations are not supported in the IBM COS implementation of the S3 API:

– DELETE Bucket analytics

– DELETE Bucket inventory

– DELETE Bucket lifecycle

– DELETE Bucket metrics

– DELETE Bucket policy

– DELETE Bucket replication

– DELETE Bucket website

– GET Bucket accelerate

github.com/scality/cloudserver/blob/development/8.7/constants.js#L98

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unsupportedQueries: [

'accelerate',

'analytics',

'inventory',

'logging',

'metrics',

'policyStatus',

'publicAccessBlock',

'requestPayment',

'torrent',

],

// Headers supported by AWS that we do not currently support.

unsupportedHeaders: [

'x-amz-server-side-encryption-customer-algorithm',

'x-amz-server-side-encryption-context',

'x-amz-server-side-encryption-customer-key',

'x-amz-server-side-encryption-customer-key-md5',

],

Unsupported S3 APIs

Table 3. Unsupported S3 APIs

| FEATURE | NOTES |
|-----------------------|--|
| DELETE Bucket tagging | - |
| DELETE Bucket website | - |
| GET Bucket location | ECS is only aware of a single Virtual Data Center (VDC). |

Use metadata search queries

The metadata search feature provides a rich query language that enables objects that have indexed metadata to be searched.

Table 21. API Syntax

| API Syntax | Response Body |
|---|--|
| <pre>GET /{bucket}/? query={expression} &attributes={fieldname, ...} &sorted={selector} &include_older_version={true false} &max-keys={num_keys} &marker={marker_value}</pre> | <pre><BucketQueryResult xmlns:ns2="http:// s3.amazonaws.com/doc/2006-03-01/"> <Name>mybucket</Name> <Marker/> <IsTruncated>false</IsTruncated> <MaxKeys>0</MaxKeys> <ObjectMatches> <object> <objectName>file4</objectName> <objectId>09998027b1b7fbb21f50e13fabb48 1a237ba2f60f352d437c8da3c7c1c8d7589</ objectId> <versionId>0</versionId> <queryMds> <type>SYSMD</type> <mdMap></pre> |

NOTE: Prefix capability is added to the metadata search. See [Prefix capability in metadata search](#).

Unsupported S3 Bucket APIs

MinIO does not support the following API calls available in S3. These APIs are either redundant or only provide functionality within AWS S3.

- `BucketACL`, `ObjectACL` (use `Policies`)
- `BucketCORS` (CORS enabled by default on all buckets for all HTTP verbs)
- `BucketWebsite` (use `caddy` or `nginx`)
- `BucketAnalytics`, `BucketMetrics`, `BucketLogging` (use `Bucket Notifications`)
- `BucketRequestPayment`

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TECHNOLOGIES

Protocol Compliance Tools

- Home-grown
- 3rd party applications
- <https://github.com/ceph/s3-tests>
- <https://github.com/splunk/s3-tests>
- <https://github.com/open-io/ceph-s3-tests>
- <https://github.com/minio/mint>

Example: Running a particular test suite against different implementations

| Solution | Failed Mint tests |
|---------------------------|-------------------|
| Minio | 0 |
| Backblaze B2 | 14 |
| Google Cloud Storage – S3 | 15 |
| AWS S3 | 12 |

Object Key (Path)

- Up to 1,024 bytes long
- The following objects can coexist in a bucket:
 - mybucket/myfolder/obj
 - mybucket/myfolder/obj/
 - mybucket/myfolder/obj//
 - mybucket/myfolder/./obj/
 - mybucket/myfolder/

- Up to 1,024 bytes long
- “/” is interpreted as a directory
- Directory segments are limited to 255 bytes
- “//”, “.”, “..” are not allowed
- mybucket/myfolder and mybucket/myfolder/obj objects can’t co-exist

Solution 1

Solution 2

```
$ aws --profile minio s3api put-object --bucket  
bucket1 --key NameWith//Inside --body ~/empty
```

An error occurred (XMinioInvalidObjectName) when calling the PutObject operation: Object name contains unsupported characters

Complete-Multipart-Upload Response Caching



[AWS CLI Command Reference](#)[Home](#)[User Guide](#)[Forum](#)[GitHub](#)

- [Examples](#)
- [Output](#)

complete-multipart-upload ¶

Quick search

Search box

Description ¶

Complete Multipart Upload is an **idempotent** operation. After your first successful complete multipart upload, if you call the operation again within a short period, the operation will succeed.

```
$ aws s3api complete-multipart-upload --bucket A
--key B --uploadId XX --multipart-upload file
POST 200 None
$ aws s3api complete-multipart-upload --bucket A
--key B --uploadId XX --multipart-upload file
POST 200 None
```

Solution 1

```
$ aws s3api complete-multipart-upload --bucket A
--key B --uploadId XX --multipart-upload file
POST 200 325
$ aws s3api complete-multipart-upload --bucket A
--key B --uploadId XX --multipart-upload file
POST 404 449
```


CompleteMultipartUpload: Undocumented Implementation

■ Amazon S3 API documentation:

Request Syntax

```
POST /Key?uploadId=UploadId HTTP/1.1
Host: Bucket.s3.amazonaws.com

* * *
<CompleteMultipartUpload xmlns="http://s3.amazonaws.com/doc/2006-03-01/">
  <Part>
    <ChecksumCRC32>string</ChecksumCRC32>
    <ChecksumCRC32C>string</ChecksumCRC32C>
    <ChecksumSHA1>string</ChecksumSHA1>
    <ChecksumSHA256>string</ChecksumSHA256>
    <ETag>string</ETag>
    <PartNumber>integer</PartNumber>
  </Part>
  ...
</CompleteMultipartUpload>
```

<https://aws.amazon.com/sdk-for-javascript/> (prior to v 3.35.0):

```
<CompletedMultipartUpload xmlns="http://s3.amazonaws.com/doc/2006-03-01/">
  <Part>
    <ChecksumCRC32>string</ChecksumCRC32>
    <ChecksumCRC32C>string</ChecksumCRC32C>
    <ChecksumSHA1>string</ChecksumSHA1>
    <ChecksumSHA256>string</ChecksumSHA256>
    <ETag>string</ETag>
    <PartNumber>integer</PartNumber>
  </Part>
  ...
</CompletedMultipartUpload>
```

- Worked with Amazon S3
- Failed with some other implementations
- Fixed <https://github.com/aws/aws-sdk-js-v3/issues/1814>

Get-object-attributes



```
$ aws s3api get-object-attributes --bucket gt-test-006 --key awscliv2.zip --object-attributes "ETag"
```

```
{
  "LastModified": "2023-04-20T01:01:27+00:00",
  "VersionId": "2m1EHmC6ALD_FVJ6HZBJ9znvBEbi6pNa",
  "ETag": "75c77163c337dfd5bb5a5f9f7a6473dd-1"
}
```

```
$ aws s3api get-object-attributes --bucket gt-test-006 --key awscliv2.zip --object-attributes "ETag"
```

Solution 1

Solution 3

Unable to parse response (not well-formed (invalid token): line 1, column 2), invalid XML received. Further retries may succeed:

```
b'PK\x03\x04\x14\x00\x00\x00\x00\x00F\x8f\xf4T\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x04\x00\x00\x00aws/PK\x03\x04\x14\x00\x00\x00\x00\x00E\x8f\xf4T\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\t\x00\x00\x00aws/dist/PK\x03\x04\x14\x00\x00\x00\x08\x00\x1a\x8e\xf4TW\x92\xbe\n<\x02\x00\x00\x0b'
```


Head-bucket



```
$ aws s3api head-bucket --bucket gt-test-006 --expected-bucket-owner wronguser --debug  
& grep HEAD  
urllib3.connectionpool - DEBUG - https://gt-test-006.s3.us-east-1.amazonaws.com:443  
"HEAD / HTTP/1.1" 400 0
```

Solution 1

Solution 4

```
$ aws s3api head-bucket --bucket gt-test-006 --expected-bucket-owner wronguser --debug  
& grep HEAD  
urllib3.connectionpool - DEBUG - http://10.0.0.83:9000 "HEAD /gt-test-006 HTTP/1.1" 200  
0
```


Summary



Complexity + nuance



Incompatibilities



Deep understanding of the API



Thorough testing



Compatibility = customer adoption

Poll Question #4

- Have you encountered compatibility issues between various object storage implementations?
 - Yes
 - No



Cloud Object Storage Plugfest

Arnold Jones

SNIA Cloud Object Storage Plugfest

The purpose of the Plugfest is for vendors to bring their Object Storage implementations to test, identify, and fix bugs in a collaborative setting with the goal of providing a forum in which companies can develop interoperable products.



Plugfest Operational Overview

- Similar format to the SMB3 Interoperability Lab held at the Storage Developer Conference (SDC) every year.
 - <https://www.snia.org/SMB3IOlab>
- SNIA provides and supports the network and infrastructure for the Plugfest, creating a collaborative framework for testing.
- The participants of the Plugfest work together to define the testing process, assuring that objectives are accomplished.
 - Planning calls held prior to the event to work out the details
- There is a fee to participate which includes a full SDC conference pass for each participating engineer
- All Plugfest participants are under an NDA to protect disclosure of issues found

Plugfest Plan

- Participation from Protocol Support experts onsite
 - Working on getting an Object Storage Protocol Support experts from Amazon, Google, and Microsoft onsite during the Plugfest
- Availability of protocol test suites
 - Working on getting companies with protocol test suites and equipment involved
 - Participants are encouraged to bring and share test software

Poll Question #5

- Would you be interested to learn more about the Plugfest and/or participate in it?
 - Yes
 - No



Call for Participation

Driving Compatibility and Collaboration in Cloud Object Storage

- Foster Ecosystem Collaboration

- Facilitate collaboration and knowledge sharing among Object Storage developers by establishing a platform for discussions, forums, and workshops

- Host an Object Storage Interoperability Plugfest

- Facilitated by SNIA and co-located at Storage Developer Conference (SDC) 2024
- September 16-18, 2024, Santa Clara, CA

- Interested in more details?

- Email us @ cloudtwgchair@snia.org
- Fill out Plugfest survey at <https://www.surveymonkey.com/r/objectplugfest>



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