



SEAGATE

Fifty Shades of S3

Navigating the Gray Areas of API Implementation

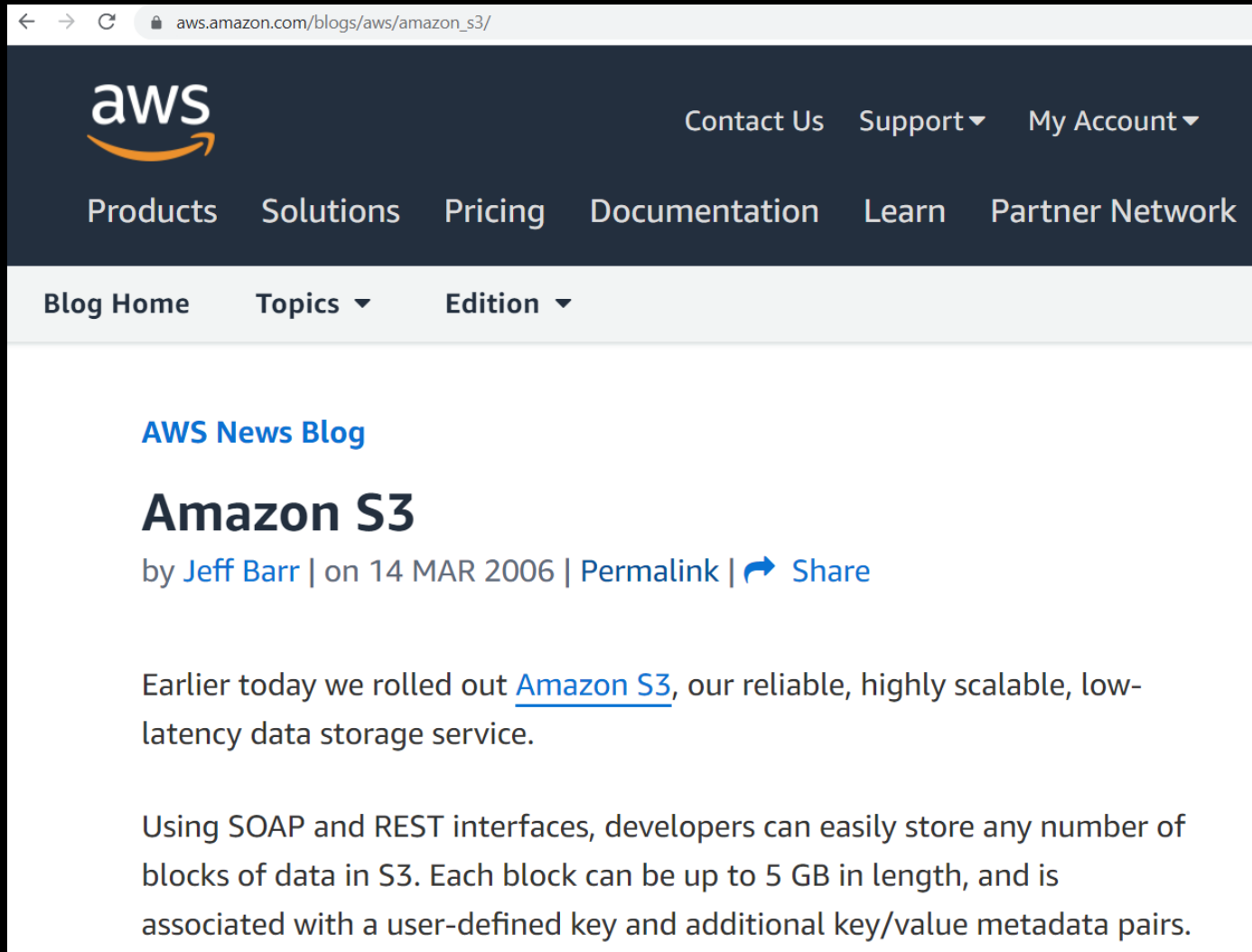
GREGORY TOURETSKY

SENIOR DIRECTOR, LYVE CLOUD

● **Is '100% compatibility' with Amazon S3 just a myth? Let's find out.**

The fine print of S3 compatibility: What vendors won't tell you

Amazon S3



The screenshot shows the AWS website's navigation bar with the AWS logo and links for Contact Us, Support, and My Account. Below the navigation bar are links for Products, Solutions, Pricing, Documentation, Learn, and Partner Network. The main content area features a breadcrumb trail: Blog Home > Topics > Edition. The article title is "Amazon S3" by Jeff Barr, dated March 14, 2006. The text describes the launch of Amazon S3 as a reliable, highly scalable, low-latency data storage service, highlighting its use of SOAP and REST interfaces for storing data blocks up to 5 GB in length with user-defined keys and metadata.

← → ↻ 🔒 aws.amazon.com/blogs/aws/amazon_s3/

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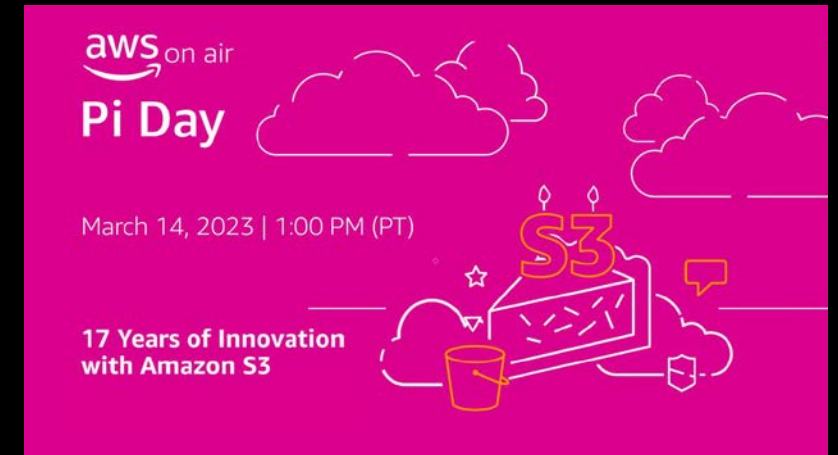
AWS News Blog

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.



- >280 Trillion objects
- >100M requests per second
- 4B checksum calculations per second

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

PDF

Removes the null version (if there is one) of an object. If there is a non-null version, Amazon S3 does not remove the object. To delete an object, you must use the version ID of the object. 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. Alternatively, you can delete objects by using the `s3:DeleteObject` or `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
 - CreateMultiRegionAccessPoint
 - DeleteAccessPoint
 - DeleteAccessPointForObjectLambda
 - DeleteAccessPointPolicy
 - DeleteAccessPointPolicyForObjectLambda
 - DeleteBucket
 - DeleteBucketLifecycleConfiguration
 - DeleteBucketPolicy
 - DeleteBucketReplication
 - DeleteBucketTagging
 - DeleteJobTagging
 - DeleteMultiRegionAccessPoint
 - DeletePublicAccessBlock
 - DeleteStorageLensConfiguration
 - DeleteStorageLensConfigurationTagging
 - DescribeJob
 - DescribeMultiRegionAccessPointOperation
 - GetAccessPoint
 - GetAccessPointConfigurationForObjectLambda
 - GetAccessPointForObjectLambda
 - GetAccessPointPolicy
 - GetAccessPointPolicyForObjectLambda
 - GetAccessPointPolicyStatus

CreateJob

PDF

You can use S3 Batch Operations to create a job.

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>string</FunctionArn>
    </LambdaInvoke>
    <S3DeleteObjectTagging>
      </S3DeleteObjectTagging>
    </S3DeleteObjectTagging>
    <S3InitiateRestoreObject>
      <ExpirationInDays>integer</ExpirationInDays>
      <GlacierJobTier>string</GlacierJobTier>
    </S3InitiateRestoreObject>
    <S3PutObjectAcl>
      <AccessControlPolicy>string</AccessControlPolicy>
    </S3PutObjectAcl>
  </Operation>
</CreateJobRequest>
```

60+ Amazon S3 Control Actions

AWS Identity and Access Management API Reference

CreatePolicy

PDF

Welcome to the AWS Identity and Access Management (IAM) console. You can use the console to create a policy for your IAM user or group. For more information about managed policies, see [Managed Policies](#).

As a best practice, you can validate your policy. For more information about managed policies, see [Versioning for managed policies](#) in the IAM User Guide.

Request Parameters

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

This parameter is optional. If it is not specified, the policy is created in the root path.

This parameter allows (through its regex pattern) to be any alphanumeric character, an underscore, or a forward slash. In addition, it can contain hyphens, but it must not end with forward slashes. In addition, it can contain all lowercase characters, digits, and underscores.

IAM, STS Actions

S3-Compatible Storage

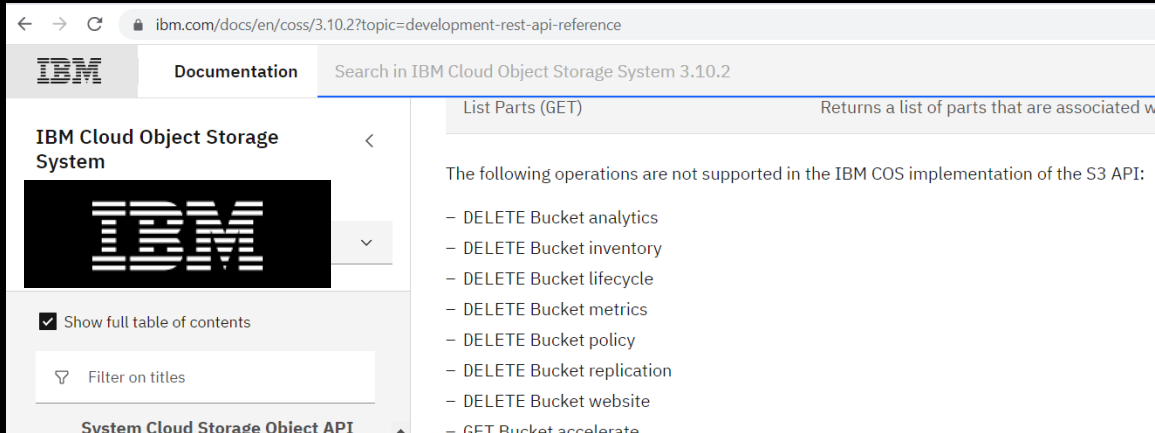
Cloud services



Systems and Software



Official Incompatibilities



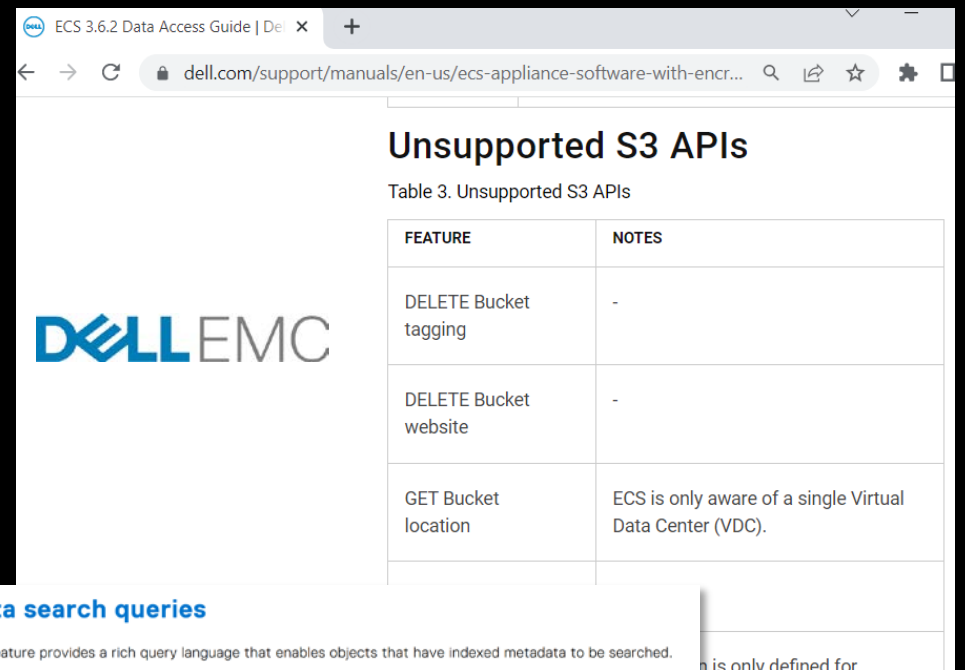
IBM Cloud Object Storage System 3.10.2

Search in IBM Cloud Object Storage System 3.10.2

List Parts (GET) Returns a list of parts that are associated with the 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



ECS 3.6.2 Data Access Guide | Dell EMC

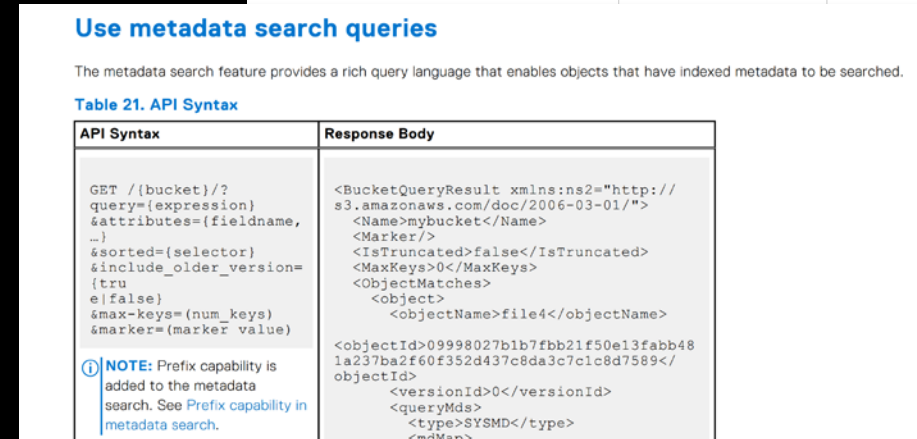
Unsupported S3 APIs

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).



```
98 unsupportedQueries: [  
99   'accelerate',  
100   'analytics',  
101   'inventory',  
102   'logging',  
103   'metrics',  
104   'policyStatus',  
105   'publicAccessBlock',  
106   'requestPayment',  
107   'torrent',  
108 ],  
109  
110 // Headers supported by AWS that we do not currently support.  
111 unsupportedHeaders: [  
112   'x-amz-server-side-encryption-customer-algorithm',  
113   'x-amz-server-side-encryption-context',  
114   'x-amz-server-side-encryption-customer-key',  
115   'x-amz-server-side-encryption-customer-key-md5',  
116 ],  
117
```



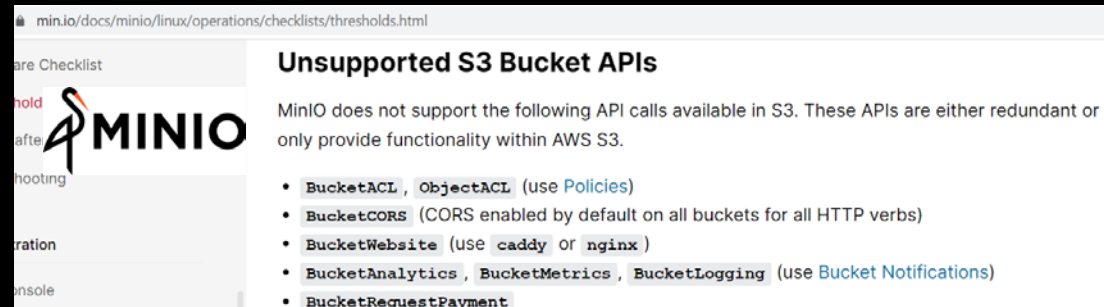
Use metadata search queries

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>09998027b1b7fbb21f50e13fab48 1a237ba2f60f352d437c8da3c7c1c8d7589</ objectId> <versionId>0</versionId> <queryMds> <type>SYSMD</type> </queryMds> </object> </ObjectMatches> </BucketQueryResult></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**

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>

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

Is Minio more S3-compatible than Amazon S3? 😊

What Is Behind the Endpoint?

```
aws s3 ls --debug |& grep "Response headers" | awk -F 'Server' '{print $2}'
```

Solution	Server Header
Amazon S3	AmazonS3
Google Cloud Storage (S3 compatible)	UploadServer
Ceph	-
Minio	MinIO
Wasabi	WasabiS3/7.12.1004-2023-02-17-7ff2f5bdd9 (head07)
Seagate Lyve Cloud	Seagate-LyveCloudS3
Backblaze B2	-

What Is in the Request?

Example: UploadPart

Component	Example
Method	PUT
Bucket	mybucket
Host	us-east-1.lyvecloud.seagate.com
Key	myprefix/myobject
partNumber	12
uploadId	2e1c42be-fc1d-4055-bbce-d10a55a0a662
authorization	AWS4-HMAC-SHA256 Credential=REDUCTED/20230418/us-east-1/s3/aws4_request, SignedHeaders=content-length;host;user-agent;x-amz-content-sha256;x-amz-date, Signature=61b9391bc68984f634db8437779e76a8f609a5823b3ea0ac00a3df48e431d59c
user-agent	APN/1.0 Qumulo/1.0 S3Replication/6.0.2
...	

What Is in the Response?

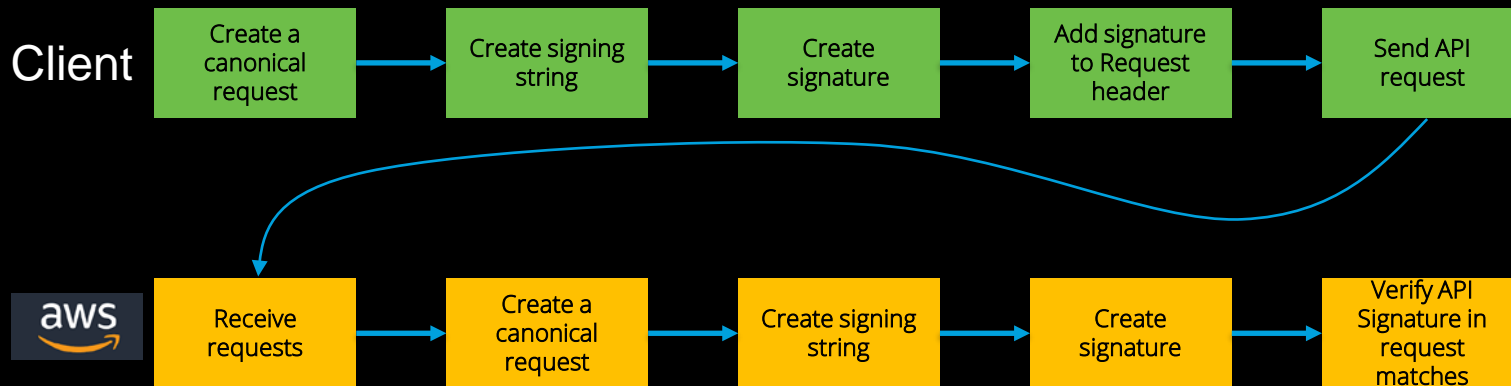
Example: UploadPart

Component	Example
Response code	HTTP/1.1 200
Date	Tue, 18 Apr 2023 04:25:17 GMT
Etag	"3ae3ac4887f98ddefde4eeb82e37280b"
Server	Seagate-LyveCloudS3
X-Amz-Request-Id	1756ECD65A5EE9C2
...	

Authentication / Signature



- Sig V2 – old, discontinued in 2020
 - **But many client apps still use it!**
- Sig V4 – current, in use since 2012:



```
#Create a Canonical Request
CanonicalRequest =
  HTTPRequestMethod + '\n' +
  CanonicalURI + '\n' +
  CanonicalQueryString + '\n' +
  CanonicalHeaders + '\n' +
  SignedHeaders + '\n' +
  HexEncode(Hash(RequestPayload))
```

Header names, sorted by **lowercase character code**, delimited by semi-colon

- Customer's app fails CopyObject requests: **SignatureDoesNotMatch**
- Root cause:
 - Server returns a mix of lower case and mixed-case header names, Ex: X-Amz-Server-Side-Encryption
 - Customer's app sorts headers case-sensitive → Signed headers string is not properly sorted

```
Authorization: AWS4-HMAC-SHA256
Credential=REDACTED/20230205/us-east-1/s3/aws4_request,SignedHeaders=content-type;host;user-agent;x-amz-server-side-encryption;x-amz-acl;x-amz-content-sha256;x-amz-copy-source;x-amz-date;x-amz-metadata-directive,
Signature=246998b7b32681af8d6dbfdf8754da20c4633509d20fc6391bfe291d0d4caba1
```

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

```
$ 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
```



```
$ 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
```

Don't Be Fooled by "Success"

Complete-Multipart-Upload

Processing of a Complete Multipart Upload request could take several minutes to complete. After Amazon S3 begins processing the request, it sends an HTTP response header that specifies a 200 OK response. While processing is in progress, Amazon S3 periodically sends white space characters to keep the connection from timing out. **A request could fail after the initial 200 OK response has been sent.** This means that a 200 OK response can contain either a success or an error.

```
2023-03-15 21:40:29,089 - MainThread - urllib3.connectionpool - DEBUG - https://gt-test-006.s3.us-east-1.amazonaws.com:443 "POST /largeobjecttest?uploadId=szRCQ4o6dw8qjRjUjOe9WD2z2JbE5bHFuZvL27zUciZJW3um8GelqYcPILNu_GzUzuYCheYCYpAaWdLZF3x3l8rAdVF_7U109PBm3nd_ATIntjyYqHOcVdbS6X8vmxNI HTTP/1.1" 200 None
```

```
21:40:29,096 - MainThread - botocore.parsers - DEBUG - Response body:b'<?xml version="1.0" encoding="UTF-8"?>\n<Error><Code>EntityTooLarge</Code><Message>Your proposed upload exceeds the maximum allowed size</Message><ProposedSize>5513664266240</ProposedSize><MaxSizeAllowed>5497558138880</MaxSizeAllowed><RequestId>A1B9N8GCJ9368Z0N</RequestId><HostId>nXky785ol/qBz4qo1PO3M00bNF/SJSXiw6tLSEESNF1hVT2kEU2cKWKxbfG5iTw4KIVBNOK5GoY=</HostId></Error>'
```

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"
```

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\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\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
```

```
$ 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
```



Put-object – Unsupported CRC32C

```
$ ./warp get --access-key=REDACTED --secret-key= REDACTED --bucket=gt-test-001 --  
concurrent=60 --host=ENDPOINT --obj.size=16MiB --tls --duration 300s --objects=2500 --  
analyze.v
```

```
warp: <ERROR> upload error: The X-Amz-Checksum-Crc32c you specified did not match what  
we received.
```

```
$ aws s3api put-object --bucket gt-test-001 --key myobject --body myobject.zip --  
checksum-crc32-c 8KygCQ==
```

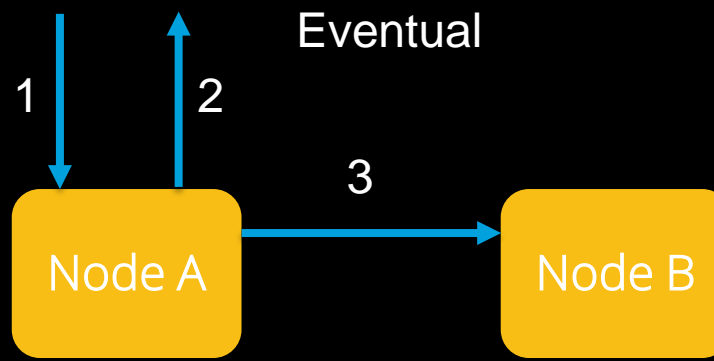
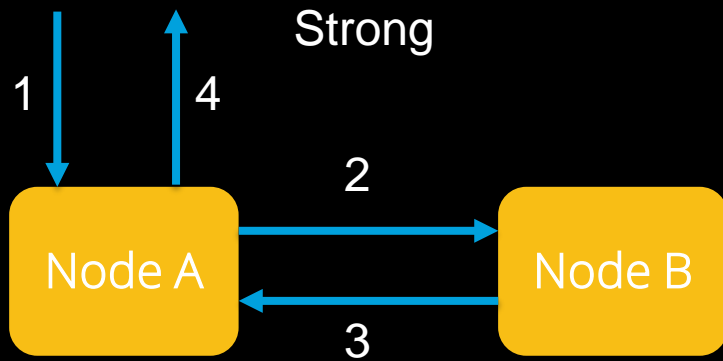
```
An error occurred (InvalidRequest) when calling the PutObject operation: Value for x-  
amz-checksum-crc32c header is invalid.
```

Performance



	aws	Azure	Google Cloud Storage	wasabi
Requests/ sec	<ul style="list-style-type: none"> 3,500 PUTs / 5,500 GETs per sec per partitioned prefix Request rates are allocated proportionally 	<ul style="list-style-type: none"> Up to 500 requests/sec for a single blob (object) Default max request rate per storage account: 20,000 requests / sec 	<ul style="list-style-type: none"> Initial ~1,000 writes/sec, 5,000 reads/sec Gradually autoscaling above limits, based on prefixes. Double rate every 20 min Bucket <ul style="list-style-type: none"> Create/delete: 0.5/sec Update: 1/sec 	<ul style="list-style-type: none"> S3 API: "fair use", depends on storage volume Account Control API: GET 1000/min, PUT 100/min, DELETE 10/min
Throughput	<ul style="list-style-type: none"> single-instance ... up to 100 Gb/s aggregate ... multiple Tbps 	<ul style="list-style-type: none"> Default max ingress per storage account: 10/25/60 Gbps (varies per region) Default max egress per storage account : 50/120 Gbps 	<ul style="list-style-type: none"> Default egress quota: 200Gbps per region 	<ul style="list-style-type: none"> No details

Consistency Model^(*)



Before Dec'2020



(*) Data path. Access control, etc may vary


Summary

 Complexity + nuance

 Incompatibilities

 Deep understanding of the S3 API

 Thorough testing

 S3 compatibility = customer adoption