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# How to enable cross functionality testing for multiple cloud storage APIs such as CDMI, OpenStack Swift and Amazon S3

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# Focal Points of Discussion

01 Object Storage: Overview

02 Major Object Storage APIs

03 Products supporting multiple Object APIs

04 Why Interoperability is critical??

05 Testing - Challenges and Best Practices

06 Object APIs Cross Functionality Testing - Test Cases

# Object Storage: Overview

**Unstructured Data Growth**

- IDG: Unstructured data is growing at the rate of 62% per year.
- IDG: By 2022, 93% of all data in the digital universe was unstructured.
- Gartner: Data volume is set to grow 800% over the next 5 years and 80% of it will reside as unstructured data.

**Object Storage**

- A proven option for effectively managing unstructured data.
- Storage architecture that manages data as objects
- A data container capable of storing files and metadata about the files, which consists of the attributes for the actual data being stored.

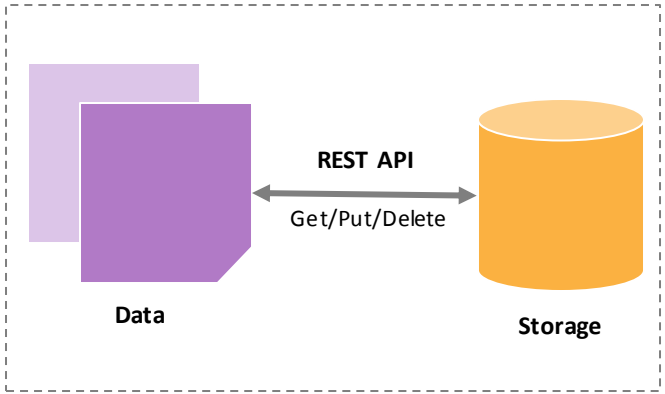
# Object Storage: Overview

**Characteristics**

- Manage data in form of Container & Data Object
- Flat address space
- Unique ObjectID
- HTTP/REST/SOAP
- CRUD

**Advantages**

- Security and reliability
- Platform independence
- Scalability
- Manageability
- suitable for cloud environment



# Major Object Storage APIs



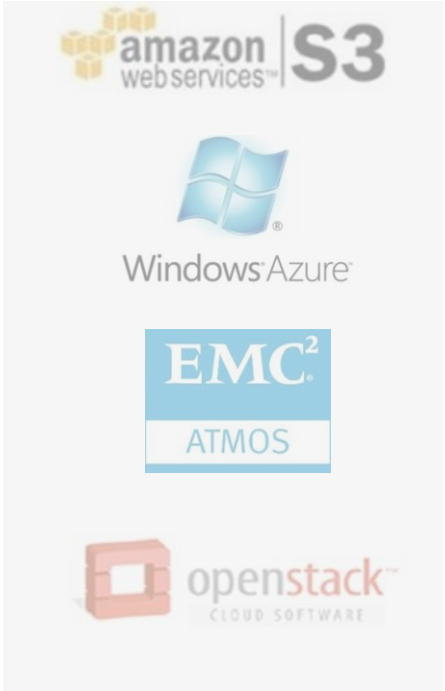
- First publicly available web service
- Introduced and originally offered by Amazon Web Services
- Abbreviation for **S**imple **S**torage **S**ervice.
- Supports **REST**, **SOAP**, and **BitTorrent** web services interfaces
- **Bucket** - fundamental container for data storage
- **Object**
  - upto 5 TB in size, upto 2 KB of Metadata
  - **Key**
    - used to identify object
    - Unique within each bucket
    - user-assigned
    - Unicode characters (UTF-8 encoding length 1024 bytes)
  - **version ID**
    - Used for Object Versioning
    - S3 generates a unique version ID and assigns it to the object
- Requests are authorized using an **access control list** associated with each bucket and object.

# Major Object Storage APIs


**OpenStack Swift:**

- OpenStack Object Store project
- OpenSource, Highly Scalable, Highly Available & Production ready project
- Supports **REST** web services interfaces
- Containers - Provide name space where object stored
- Object
  - fundamental unit for data storage
  - Support sixe upto 5Gb
- Pseudo-Hierarchical Directories
  - Doesn't support nested Containers
  - To manage huge number of object pseudo- hierarchical directories can be created.
- **Object Versioning**
  - Each PUT request to an object will result in the existing object being archived to a special "versions" container.
- **Authentication**
  - OpenStack Keystone
  - Flexible enough to integrate with other authentication mechanism

# Major Object Storage APIs




**SNIA CDMI:**

- Introduced by SNIA (**S**torage **N**etworking **I**ndustry **A**ssociation)
- Abbreviation for **C**loud **D**ata **M**anagement **I**nterface
- CDMI Specification defines functional interface for object storage that application can use to create, retrieve, update and delete data elements from the Cloud
- Foster **Interoperability** to avoid Vendor Lock-in
- An open international (ISO) standard
- Provide support for **REST** APIs
- **Data Management**:
  - Data is stored and managed using **Containers** and **Data Objects**.
  - **Data Objects** are identified by user assigned name and system assigned Object ID.
  - Object IDs are **globally unique** and native format of an object ID is a variable length byte sequence and shall be a maximum length of 40 bytes
  - Supports **Capability** object that used to discover cloud storage offerings and functionalities.
- **Authentication:**
  - relies on an authentication service (local or external) to validate client credentials.
  - Supports following authentication methods
    - Anonymous/Basic/Digest/Kerberos
    - Certificate-based authentication via TLS
    - **S3** API signed header authentication
    - **OpenStack** Identity API header authentication

# Why Interoperability is critical??

01 Data Lock-in

02 Seamless Adoptability

03 Focus on enterprise level feature

04 Market Pace

05 Agility and flexibility

# Testing - Challenges and Best Practices

| | Challenge | Best Practice |
|---|---|---|
| **Interoperability Support** | ▪ Does product support interoperability among different object APIs | ▪ Check for any other alternative or work around in which Object APIs can be interoperable.<br>▪ Otherwise, This solution is not applicable for such products. |
| **Object API - Authentication Method** | ▪ Different Object API supports different authentication method. | ▪ Prepare reusable components/methods for each object API authentication scheme<br>▪ Check for any common authentication supported by Product |
| **Large object support** | ▪ Different Object API supports different size for large objects e.g. 5TB for S3 and 5GB for OpenStack Swift | ▪ Check for any alternative option/support for larger object size e.g. in OpenStack Swift larger object than 5 GB are supported using Segment/Manifest object.<br>▪ Check for these alternatives support in Product, to be tested. |

# Testing - Challenges and Best Practices (Contd..)

| | Challenge | Best Practice |
|---|---|---|
| **Same feature but Different implementation : Object Versioning** | ▪ In OpenStack Swift, older copies of Objects are kept in a particular container, while in S3 all versions are kept in same bucket only, with new versionID created on each update. | ▪ Needs to be tested very carefully, to check if request is being diverted properly to correct container/bucket url in order to access particular version. |
| **Unique Feature- Nested Containers** | ▪ CDMI allows nested containers to be created, but S3/Swift doesn't. | ▪ Nested Containers to be mapped with Pseudo-Hierarchical directory |

# Object APIs Cross Functionality Testing - Test Cases

**Test Case Classification (Based on complexity)**

- **Simple Test Cases**
  - Covers CRUD operations only
- **Medium Test Cases**
  - Covers medium level features such as CRUD with Metadata, Object Versioning etc.
- **Complex Test Cases**
  - Covers complex features such as Retention policies, large object etc.

# Object APIs Cross Functionality Testing - Test Cases

## Simple Test Cases

*CDMI and OpenStack Swift APIs Cross Functionality testing*

### Container Object

**Figure:1**

**Test Case#1:**
Create a container using Swift APIs and Retrieve through CDMI

**Test Case#2:**
Create a container using Swift APIs and Delete through CDMI

**Test Case#3:**
Create a container using Swift APIs and Update through CDMI

**Figure:2**

**Test Case#4:**
Create a container using CDMI APIs and Retrieve through Swift

**Test Case#5:**
Create a container using CDMI APIs and Update through Swift

**Test Case#6:**
Create a container using CDMI APIs and Delete through Swift

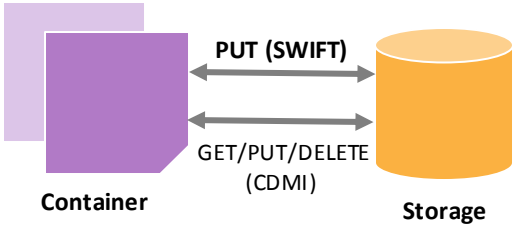



**Figure: 1**

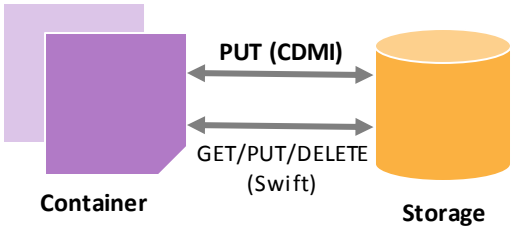



**Figure: 2**

# Object APIs Cross Functionality Testing - Test Cases

## Simple Test Cases

*CDMI and OpenStack Swift APIs Cross Functionality testing*

**Data Object**

**Figure:3**

**Test Case#7:**
Create a Container/Data Object using Swift APIs and Retrieve through CDMI

**Test Case#8:**
Create a Container/Data Object using Swift APIs and Update through CDMI

**Test Case#9:**
Create a Container/Data Object using Swift APIs and Delete through CDMI

**Figure:4**

**Test Case#10:**
Create a Container/Data Object using CDMI APIs and Retrieve through Swift

**Test Case#11:**
Create a Container/Data Object using CDMI APIs and Update through Swift

**Test Case#12:**
Create a Container/Data Object using CDMI APIs and Delete through Swift

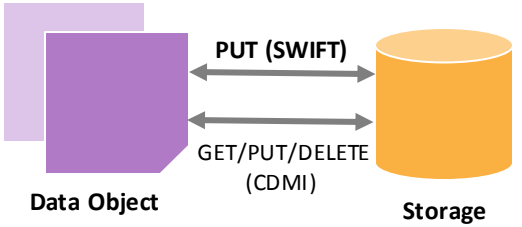



**Figure: 3**

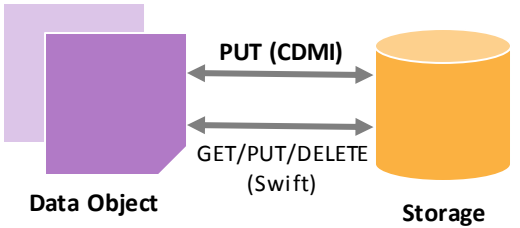



**Figure: 4**

# Object APIs Cross Functionality Testing - Test Cases

## Simple Test Cases

*CDMI and OpenStack Swift APIs Cross Functionality testing*

### Data Object

**Test Case#13:**
Create a Container using CDMI APIs and create Data object within CDMI Container through Swift

**Test Case#14:**
Create a Container using Swift APIs and create Data object within Swift Container through CDMI

**Test Case#15:**
Create a Container (Swift API)/Data Object (CDMI) and read Data object through Swift API

# Sample Test Cases

**Test Case Name**

TestCase#1

**Test Case Description**

Create a Container using Swift API and Retrieve the same through CDMI

**Pre-Test Dependencies**

- Product must support interoperability between OpenStack Swift and CDMI APIs
- Swift Service End-Point (SWIFT_URL)
- CDMI Service End-Point (CDMI_URL)

**Description**

<Test Case : Start>

- Generate and save authentication token "SWIFT_AUTH_TOKEN" for Swift using OpenStack Keystone or supported authentication service.
  *curl –X POST –H "Content-Type: application/json" –d '{"auth" : {"tenantName": "XXX", "passwordCredentials" : {"username": "XXX", "password": "XXX"}}}' **AUTH_URL***
- Create a container named "TestContainer1" using swift API
  *curl –X PUT –H "Content-Length: 0" –H "X-Auth-Token: **$SWIFT_AUTH_TOKEN**" **$SWIFT_URL/TestContainer1***
- Verify if container created successfully using swift API:
  *curl –X GET –H "X-Auth-Token: **$SWIFT_AUTH_TOKEN**" **$SWIFT_URL/TestContainer1***
  Check for HTTP status code: ***200 OK*** returned
- Set valid login credentials for CDMI request.
- Retrieve Container created in above step using CDMI API:
  GET <CDMI_URL>/TestContainer1/ HTTP/1.1
  Host: cloud.example.com

  Accept: application/cdmi-container
  X-CDMI-Specification-Version: 1.0.2
- Verify response code:
  Check for HTTP status code: ***200 OK*** returned.
- Expected Result: Container "TestContainer1" should be created and retrieved successfully.
- Cleanup created container

<Test Case : End>

# Sample Test Cases

**Test Case Name**

TestCase#2

**Test Case Description**

Create a Container using Swift API and Delete the same through CDMI

**Pre-Test Dependencies**

- Product must support interoperability between OpenStack Swift and CDMI APIs
- Swift Service End-Point (SWIFT_URL)
- CDMI Service End-Point (CDMI_URL)

**Description**

<Test Case : Start>

- Generate and save authentication token “SWIFT_AUTH_TOKEN” for Swift using OpenStack Keystone or supported authentication service.
  *curl –X POST –H “Content-Type: application/json” –d ‘{“auth” : {“tenantName”: “XXX”, “passwordCredentials” : {“username”: “XXX”, “password”: “XXX”}}}’* ***AUTH_URL***
- Create a container named "TestContainer1“ using swift API
  *curl –X PUT –H “Content-Length: 0” –H “X-Auth-Token:* ***$SWIFT_AUTH_TOKEN”***
  ***$SWIFT_URL/TestContainer1***
- Verify if container created successfully using swift API:
  *curl –X GET –H “X-Auth-Token:* ***$SWIFT_AUTH_TOKEN”*** ***$SWIFT_URL/TestContainer1***
  Check for HTTP status code: ***200 OK*** returned
- Set valid login credentials for CDMI request.
- Delete Container, created in above step, using CDMI API:
  *DELETE <CDMI_URL>/TestContainer1/ HTTP/1.1*
  *Host: cloud.example.com*

  *X-CDMI-Specification-Version: 1.0.2*
- Verify response code:
  Check for HTTP status code: ***204 No Content*** returned.
- Expected Result: Container "TestContainer1" should be created and deleted successfully.

<Test Case : End>

# References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