z/OS 3.2 IBM Education Assistant

Solution Name: Modern API for OAM (S3) - REST API Support

Solution Element(s): DFSMSdfp OAM (Object Access Method)

July 2025

Agenda

- Trademarks
- Objectives
- Overview
- Usage & Invocation
- Interactions & Dependencies
- Upgrade & Coexistence Considerations
- Installation & Configuration
- Cloud Data Access (CDA) Panels
- Summary
- Appendix

Trademarks

- See url http://www.ibm.com/legal/copytrade.shtml for a list of trademarks.
  CLOUD.®, Db2® , IBM® , IBM Z®, WebSphere®
- Additional Trademarks:
  - None

Objectives

- **Why is OAM providing REST (S3) support?**
  - Today, OAM is the access method for storing unstructured object data on z/OS
  - S3 is built for object data
  - Simple authentication methods
  - Maps to our existing OSREQ (Assembler) API
  - Existing S3 applications could work without change

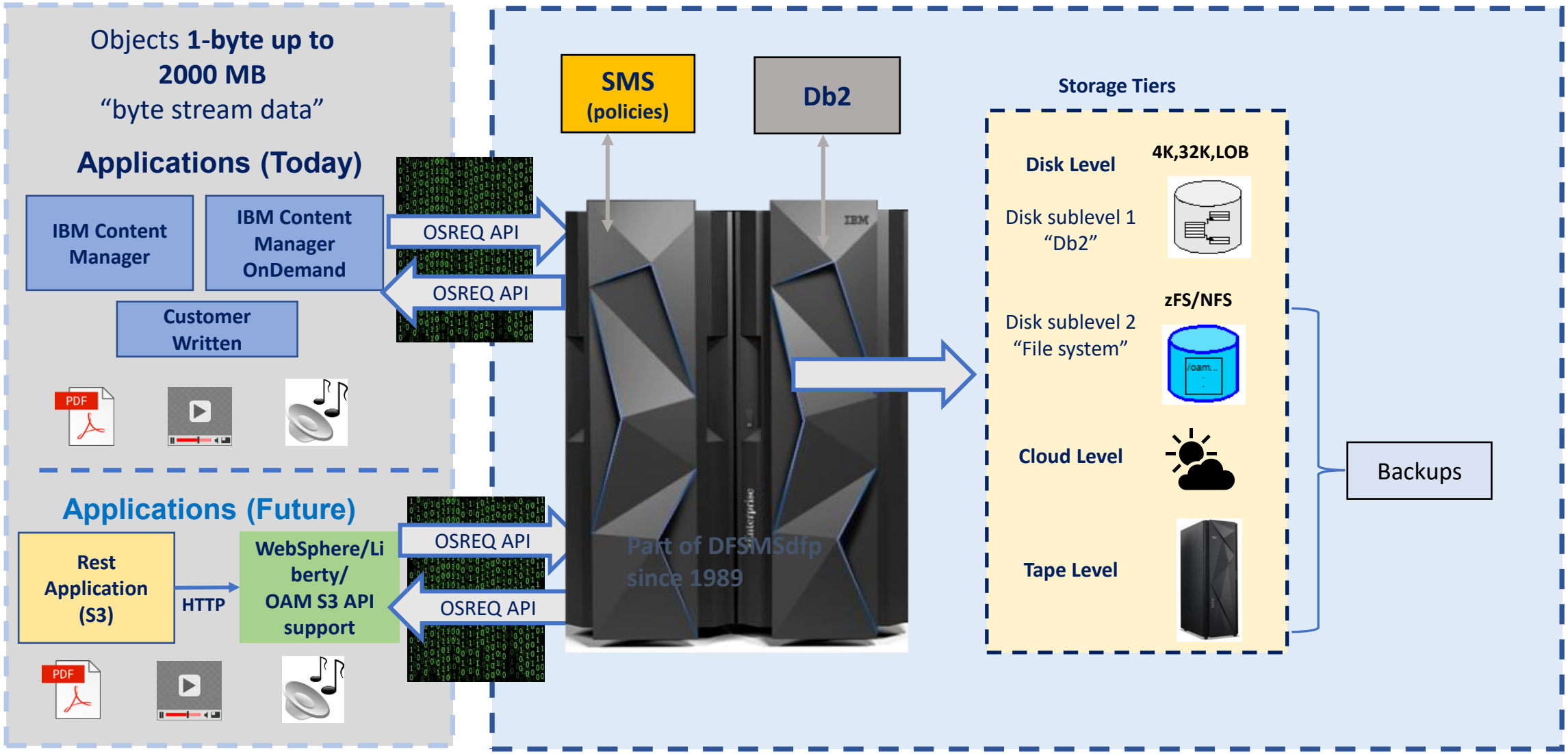
- **Compatibility**
  - Objects stored through OAM REST can be retrieved using OAM OSREQ and vice versa
  - 99.99% of OAM's existing support remains as is
  - New REST front end interfaces with OAM's existing support
  - All existing OAM function continues to work as-is
  - Keeps the data managed by OAM and on z/OS making it easier for application developers

Overview

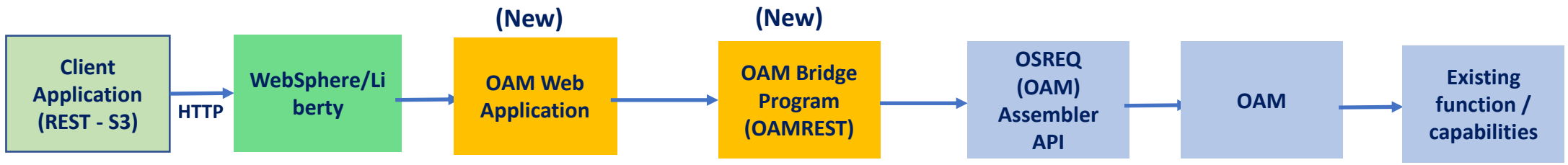
- **Who (Audience)**
  - As an application developer, I want to easily store and manage my unstructured (object) data on z/OS.
- **What (Solution)**
  - I want to be able to write an application that interfaces with OAM using industry standard (REST) interfaces.
- **Wow (Benefit / Value, Need Addressed)**
  - My team can more easily maintain, enhance, and develop applications using more readily available industry standard skills.

OAM Object Overview

Objects can be stored and can transition to any layer in the hierarchy based on SMS policies



OAM REST Overview



GetObject
PutObject
DeleteObject
HeadObject
GetObjectTagging
PutObjectTagging

1. Validate and authorize S3 requests
2. Build and send request to Bridge Program
3. Build and send HTTP response

1. Waits for a request
2. Determines request type
3. Invokes OSREQ API
4. Sends response

Store
Retrieve
Delete
Query
Change (Policies)

https://OAM_Liberty_Server_Web_URL/group01/group01.s001.s001

S3 Bucket Name / OAM Collection Name

S3 Key Name / Object Name

Overview cont.

- OAM is supporting AWS (S3) Signature Version 4.
- Signature passed in the HTTP authorization headers, or in a pre-signed request using the HTTP query parameters.
- Where the standard AWS S3 interface does not support all the parameters allowed through OSREQ, this is handled through OAM custom headers.
- If an AWS S3 supported parameter is specified that is not supported by OAM, the parameter will be ignored.
- Delivered via **APAR OA64282** (z/OS 3.1 and above)
- z/OS DFSMS Cloud Data Access (CDA) used to enter S3 credentials

For information on the existing OSREQ parameters and API, refer to the OAM Application Programmer's Reference and for additional information on the AWS S3 interface refer to https://docs.aws.amazon.com/AmazonS3/latest/API/Welcome.html.

Usage & Invocation (1)

S3 Operation	Function	Supported Parameters	Requirements
PutObject	Stores an object (OSREQ STORE) Does not currently support object locking, object versioning or multi-part puts (stores).	• Bucket (required) • Key (required) • Content-Length (required) • Content-MD5 (optional)	• Bucket (OAM Collection Name) • Key (OAM Object Name) (Both must conform to 44-CHAR MVS data set naming convention) • Content-Length - objects up to 2000MB are Custom Headers used for: ibm-oam-storage-class ibm-oam-management-class ibm-oam-retention-period ibm-oam-deletion-hold
GetObject	Retrieves an object or portion of an object (OSREQ RETRIEVE)	• Bucket (required) • Key (required) • Range (optional)	Refer to **PutObject** for the bucket and key naming restrictions. Custom Headers used for: ibm-oam-explicit-recall ibm-oam-object-view
DeleteObject	Deletes an object including OAM managed backups (OSREQ DELETE)	• Bucket (required) • Key (required)	Refer to **PutObject** for the bucket and key naming restrictions.

Usage & Invocation (2)

S3 Operation	Function	Supported Parameters	Requirements
HeadObject	Returns the meta data (response elements) for an object (OSREQ QUERY) Only the request for a single object is currently supported. The response elements map to what is returned through OSREQ QUERY.	• Bucket (required) • Key (required)	Refer to **PutObject** for the bucket and key naming restrictions.
GetObjectTagging	Returns the meta data (tag-set pairs) for an object (OSREQ QUERY). Only the request for a single object is currently supported. The tag-set pairs map to what is returned through OSREQ QUERY.	• Bucket (required) • Key (required)	Refer to **PutObject** for the bucket and key naming restrictions.

Usage & Invocation (3)

S3 Operation	Function	Supported Parameters	Requirements
PutObjectTagging	Changes policy-related information for an object using tag-set pairs (OSREQ CHANGE) Supports an update of the object's storage class, management class, retention period, event expiration and deletion hold specification.	• Bucket (required) • Key (required) Does not support the x-amz-storage-class parameter, instead the storage class can be specified along with the management class using OAM custom headers Does not support the AWS S3 Expires parameter. Instead, expiration set through traditional OAM methods and supported custom headers.	Refer to **PutObject** for the bucket and key naming restrictions. The following tag-set pairs can be specified in the request body: ibm-oam-storage-class ibm-oam-management-class ibm-oam-retention-period ibm-oam-deletion-hold ibm-oam-event-expiration

Note: for requirements around the OAM custom headers and expiration refer to the **z/OS DFSMS OAM Application Programmer's Reference**

Usage & Invocation – GetObject (1)

Request Headers Example:

```
Method=GET
URL=https://OAM_Liberty_Server_Web_URL/group01/group01.s001.s001
Headers={'X-Amz-Date': b'20230118T164059Z',
         'X-Amz-Content-SHA256':
           b'e3b0c44298fc1c149afbf4c8996fb92427ae41e4649b934ca495991b7852b855',
         'Authorization':
           b'AWS4-HMAC-SHA256
           Credential=s3accesskey/20230118/production/s3/aws4_request,
           SignedHeaders=host;x-amz-content-sha256;x-amz-date,
           Signature=29b2f7215e9d62c28710e57ffe2e4edbdc40f7db96a80de5a0191d0783293fe0'}
```

The signature can also be passed in a pre-signed request using the HTTP query parameters and may look something like the following:

https://OAM_Liberty_Server_Web_URL/group01/group01.s001.s001?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=s3accesskey%2F20240216%2Fproduction%2Fs3%2Faws4_request&X-Amz-Date=20240216T162920Z&X-Amz-Expires=10&X-Amz-SignedHeaders=host&X-Amz-Signature=315c7f3bdda8873544aceb6b8e14e7c38b97fa58978e24c3ffe74c72102fc85d

Usage & Invocation – GetObject (2)

Response headers and body example:

Mapped HTTP response code noting success or failure and an ID number that represents the request. Optionally, the OSREQ return, and reason codes can also be returned.

```
Headers={'Accept-Ranges': 'bytes',
         'Content-Range': 'bytes 0-10/85'
         'Content-Length': '85',
         'Content-Type': 'application/octet-stream',
         'Date': 'Mon, 15 Jul 2024 19:19:20 GMT',
         'Last-Modified': 'Mon, 15 Jul 2024 13:43:15 GMT',
         …
         'x-amz-request-id':' ABCDEFGH12345678',
         'ibm-oam-osreq-rc':'xxxxxxxx',
         'ibm-oam-osreq-rsn':'yyyyyyyy',
         'ibm-oam-osreq-rc2':'zzzzzzzz'}
Body={<object_data>}
```

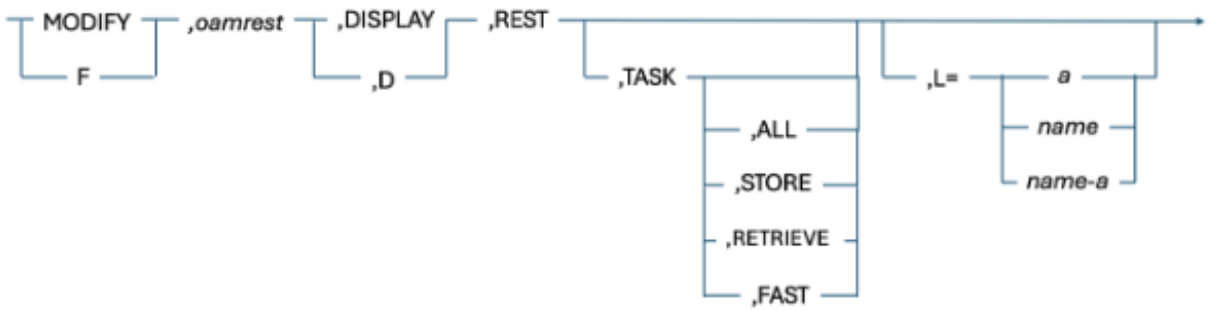
Optional: Specified in Liberty server property - com.ibm.oam.restapi.osreq.codes=true

Usage & Invocation - HeadObject

Response header example. Refer to mapping macro **CBRIQEL (OSREQ QUERY)** for additional information:

```
Headers={'Date': 'Mon, 15 Jul 2024 19:19:20 GMT',
         'Content-Type': 'application/octet-stream',
         'Accept-Ranges': 'bytes',
         'Content-Length': '100',
         'Last-Modified': 'Mon, 18 Jul 2023 13:43:15 GMT',
         'x-amz-request-Id': 'ABCDEFGH12345678',
         'ibm-oam-osreq-rc':'00000000',
         'ibm-oam-osreq-rsn':'00000000',
         'ibm-oam-osreq-rc2':'00000000',
         'ibm-oam-object-name': 'OAM.OBJECT1',
         'ibm-oam-collection-name': 'OAM.SGROUP1',
         'ibm-oam-estimated-retrieve-time': '300',
         'ibm-oam-primary-location': 'D',
         'ibm-oam-management-class': 'MCD01',
         'ibm-oam-storage-class': 'DB2DASD','
         'ibm-oam-object-size': '100',
         'ibm-oam-creation-date': '2024-04-23',
         'ibm-oam-creation-time': '09.07.17.123123',
         'ibm-oam-expiration-date': '2030-04-23',
         …}
```

Operator Commands




```
MODIFY OAMREST-taskid,DISPLAY,REST

CBR8830I oamrest-taskid status:
Started Procedure Parameters:
WolaGroup (G1):     aaaaaaaa
WolaName2 (G2):     bbbbbbbb
WolaName3 (G3):     cccccccc
RegisterName (RN):  ddddddddddd
Db2SSID (DS):       eeee


MODIFY oamrest-taskid,DISPLAY,REST,TASK

CBR8840I oamrest-taskid task summary:
Tasktype  Activetask#  Totaltask#  WorkQRequest#
tsktype1          aaa         bbb            ccc
tsktype2          aaa         bbb            ccc
tsktype3          aaa         bbb            ccc

MODIFY oamrest-
taskid,DISPLAY,REST,TASK,{ALL|STORE|RETRIEVE|FAST}

CBR8845I oamrest-taskid task detail:
Task type: [ALL|STORE|RETRIEVE|FAST]
Taskname  Taskaddr  Active  Duration
tskname1  tskaddr1    a     bbbbbbbb
tskname2  tskaddr2    a     bbbbbbbb
```

Usage & Invocation - Java Message Service (JMS)

Message Queue supported for each OAM function (same queue or a unique queue per function supported)

- STORE
- RETRIEVE
- DELETE
- QUERY
- CHANGE

Event notifications sent for the specified functions above

- Success
- Fail
- All

Usage & Invocation - Diagnostic Logging

Liberty Log Entries created by OAM

- Severe (Error)
- Warning
- Audit (Security)
- Info
- Finest (Debug)

Each log entry is associated with a request ID

Usage & Invocation - Liberty Server Properties

Numerous liberty property settings used by the support for customization, in particular:

- **com.ibm.oam.restapi.region.*production*=*db2a***
  - **Optional.** This property allows an alias to be specified for the region name on S3 requests.
  - S3 request that specifies the region name of "*production*" will be directed to the OAM instance associated with Db2 SSID of "db2a".

- **com.ibm.oam.restapi.cda.group=*group***
  - **Required.** Specifies the Cloud Data Access (CDA) group name under which the S3 access keys are stored.

… …

Usage & Invocation - RACF (or equivalent)

STGADMIN Facility Class

- STGADMIN.CBR.RESTAPI.STORE (to store an object - PUT)
- STGADMIN.CBR.RESTAPI.RETRIEVE (to retrieve an object - GET)
- STGADMIN.CBR.RESTAPI.DELETE (to delete an object - DELETE)
- STGADMIN.CBR.RESTAPI.QUERY (to query an object – HeadObject and GetObjectTagging)
- STGADMIN.CBR.RESTAPI.CHANGE (to change policies associated with an object – PutObjectTagging)

…

Interactions & Dependencies

Software Dependencies

This support uses existing capabilities in the IBM WebSphere Liberty Application Server.

- **For z/OS 3.1, refer to the following APARs:**
  1. OAM APAR OA64282
  2. Alternate CDA panels for key entry (OA65068)
  3. DFPMKDIR support (OA65069) for code installation (/usr/lpp/dfsms/oam).
  4. Program Property Table (PPT) support for CBRWOLA (OA66996)

- **Code Levels**
  - Java 11 version 11.0.17.0 or greater
  - z/OS Liberty version 24.0.0.9 or greater

Hardware Dependencies - None

Exploiters - Client exploitation

Upgrade & Coexistence Considerations

- To exploit this solution, all systems in the Plex must be at the new z/OS level: No
  - Only the systems wishing to exploit the new (REST) support need to be at 3.2 and/or 3.1 with the associated APARs. Objects stored through REST can be retrieved through OSREQ.
- List any toleration/coexistence APARs/PTFs: None (objects stored through REST can be retrieved through OSREQ and vice versa)
- List anything that doesn't work the same anymore: All existing OAM functionality continues to work as-is.

Installation & Configuration (1)

- Below is a high-level overview of the installation steps:

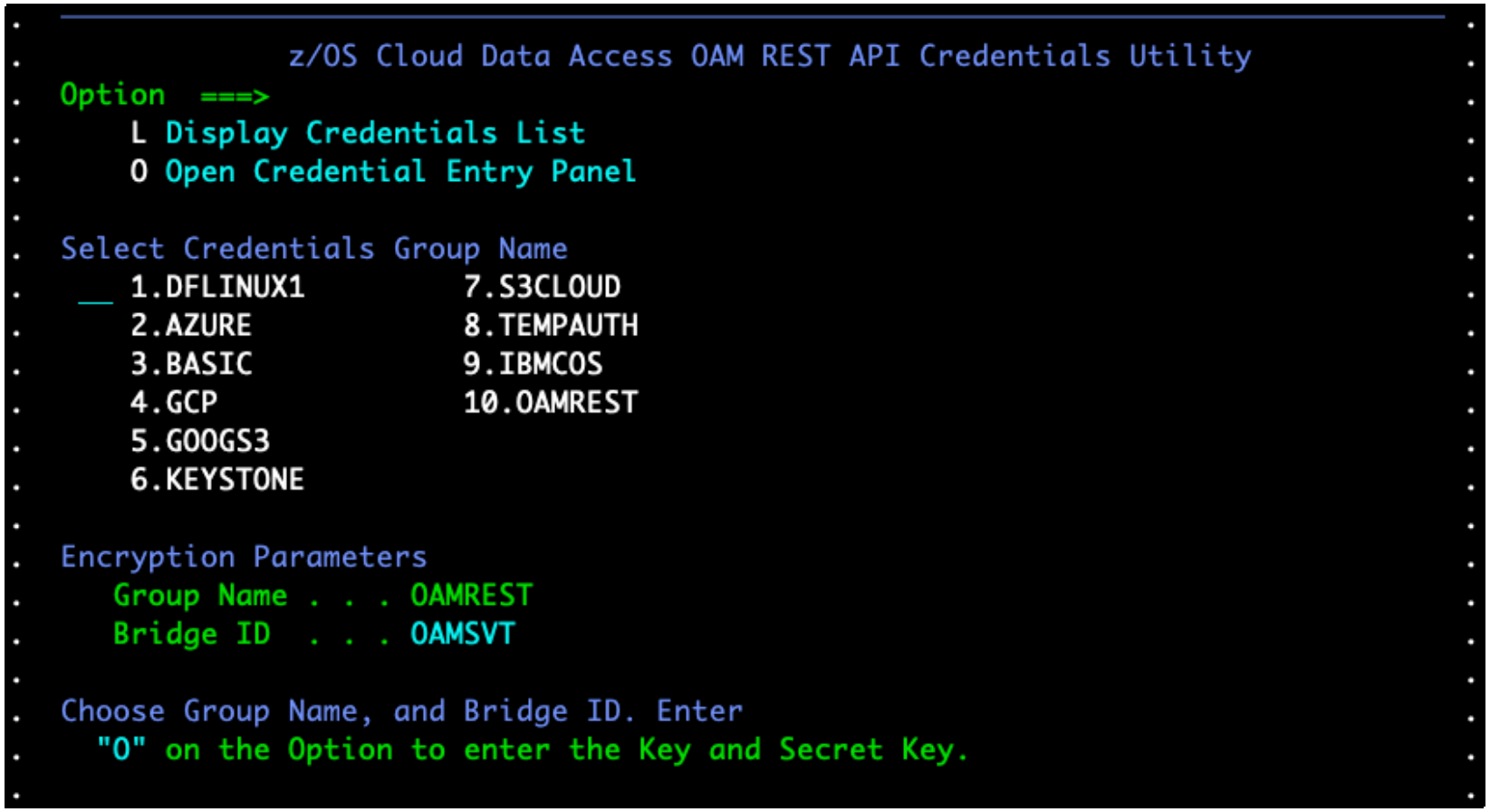
1. Install the 4 APARs noted on slide 21 (this support is also targeted to be in the base for z/OS 3.2).
2. OA64282; this will create the new CBRWOLA AC(1) load module in LINKLIB and an oamrest.ear file in the /usr/lpp/dfsms/oam Unix directory.
3. Create a z/OS Liberty Server – it is recommended that OAM is the only application running on this server.
4. Enable authorized services for z/OS Liberty - grants the z/OS Liberty server authority to access the optimized local adapters service via the Liberty Angel process.
5. Install and enable required features in the z/OS Liberty server (jaxrs-2.1, zosLocalAdapters-1.0, jca-1.7 and jndi-1.0).
6. Configure z/OS Liberty server properties.
7. Enable the z/OS Liberty server to use optimized local adapters.
8. Secure the z/OS Liberty server.
9. Deploy the OAM REST API Application in /user/lpp/dfsms/oam/oamrest.ear.
10. Configure Cloud Data Access (CDA) – used to securely store the S3 credentials used by the OAM REST API.

Installation & Configuration (2)

11. Create the Access Key and Secret Access Key S3 credentials and add them to Cloud Data Access (CDA) using the REST API Credentials ISPF panel (CDA ISPF enhancements available with OA65068).
12. Grant RACF Permissions for STGADMIN.CBR.RESTAPI.*function.*
13. Modify and run the CBRWPROC sample.
14. Start OAM REST API components (Angel Process, z/OS Liberty Server, the OAM Bridge Program (OAMREST).
15. Submit the S3 request.

Cloud Data Access (CDA) Panels (1)

New TSO command: `EX 'SYS1.SAXREXEC(GDKRESTC)'`



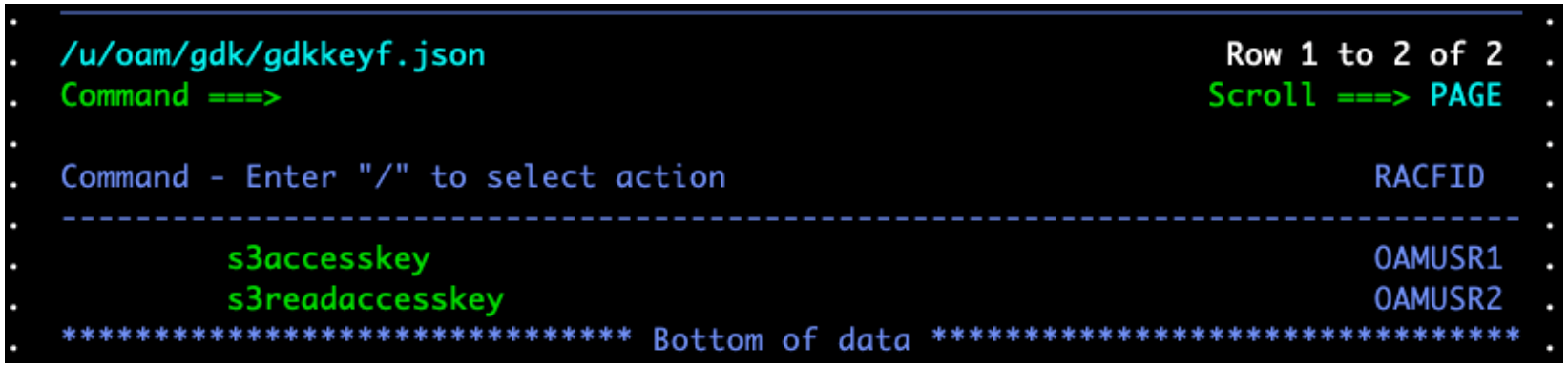
Cloud Data Access (CDA) Panels (2)

Add Credentials

```
            z/OS Cloud Data Access OAM REST API Credentials Utility

 Option  ===>
    S Save Credentials                          C Clear Secret Key Field
                                                   (for hidden input)
 Encryption Parameters
    Group Name . . .  OAMREST
    KeyLabel . . . .  GDK.OAMSVT.OAMREST.Annnnn
    Keystore . . . .  /u/oam/gdk/gdkkeyf.json

 Authorization Parameters
    RACF ID  . . OAMUSR1
    Access Key . S3ACCESSKEY


    Secret Key . ********************



 Enter the RACF ID associated with the credentials, along with the Access Key
 and Secret Access Key the user will use to access the OAM S3 REST API.
```

Cloud Data Access (CDA) Panels

List Credentials



Summary

- Clients have written their own (HLASM) application to store and retrieve their unstructured (byte-stream) data they want managed by OAM.
- Support for a REST API has been our most voted on requirement.
- One of the main reasons being a diminishing skills base that understands HLASM.
- With this support clients can simplify their use of OAM using an industry standard REST (S3) API supported by OAM.
- All existing OAM functionality continues to work as-is with the main change being the new REST (S3) front end.
- Existing OAM objects can be retrieved through the new REST interface enabling full combability with the existing (OSREQ) support.

Appendix

- For information on the existing OSREQ parameters and API, refer to the OAM Application Programmer's Reference and for additional information on the AWS S3 interface refer to https://docs.aws.amazon.com/AmazonS3/latest/API/Welcome.html.