DFSMS Object Support Overview: Data Archiving with OAM

Session: 17809

Erika Dawson
z/OS DFSMS Product Architect
(OAM and SMStape)
IBM Corporation
Agenda

- What is OAM’s Object Support?
- Who uses OAM’s Object Support?
- What are the Benefits of OAM’s Object Support?
- What are the Capabilities of the Support?
- How do you Configure?
Introducing OAM

Object Access Method “OAM”
- Store and manage byte-stream “unstructured” object data
- Integrated with DFSMSdfp since 1989 (no separate license)
- Introduced to replace microfiche and support IBM’s optical storage devices
- Non-object support in OAM used with SMStape

Management of Data
- Policy management integrated with SMS policy constructs
- Store and manage data on the storage best suited to the need
- Retain data for as long as needed, specific to the needs of the data

Storage Hierarchy
- Store to disk, optical, and tape (real or virtual)
- Manage data within the storage hierarchy (moving data “down” and back “up” as needed)
- Advanced capabilities: WORM*, encryption*, archive retention (deletion hold), data co-location

*Note: WORM and Encryption provided by the storage device

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
What is OAM’s Object Support?

- Access method used to **store, access and manage** objects

- An **object** is a named stream of bytes (1-2000MB)

- **Objects** are streams of bytes that have no specific format or record orientation and **varying access time** requirements

- Similar in functionality to DFSMSShsm and the Tivoli Storage Manager (Spectrum Protect)
  - we're a reference data and information lifecycle manager for **objects** and object **media**
  - we manage **unstructured** (byte-stream) data versus structured data (traditional data sets) managed by DFSMSShsm
What is OAM’s Object Support?

- Store and transition object data across a storage hierarchy based on storage management policies defined through SMS.
  - Provide data movement, retention and expiration management
    - Provide **life cycle management of the objects** and volume management of the media
    - Provide **archive retention capabilities** (event based retention, deletion protection, retention protection, and deletion-hold)
    - Provide **data co-location** at the object storage group level
  - Objects can be stored directly to disk, optical, or tape (and can be moved within the storage hierarchy based on policies)
  - Provide support for WORM storage devices to meet compliance needs
What is OAM’s object support?

- The data archiving solution on z Systems (z/OS) for unstructured “object” data; one of the fastest growing data segments

- Provide operating system support for emerging data types:
  - Originally for microfiche replacement
  - Today provide support for electronically scanned images (check images, medical images, etc.)
  - “Records” such as billing statements, financial records, legal records, email, etc.

- Each object identified by a two part name
  - 1-44 character object name
  - 1-44 character collection name
Who Uses OAM?

- Assembler programming interface (OSREQ) used by
  - IBM's Content Management products to store data on z/OS platform
    - *IBM DB2 Content Manager, IBM DB2 Content Manager OnDemand, IBM DB2 ImagePlus*
  - Customer written applications
  - Supports MVS (Batch/TSO), CICS and IMS environments

- Industries that use OAM’s object support

- Used to store millions of “objects” of varying sizes
What is OAM’s Object Support?

APPLICATIONS

- STORE
- RETRIEVE
- QUERY
- CHANGE
- DELETE

APIS

OSREQ

OBJECT/MEDIA LIFE CYCLE MANAGEMENT

- DISK
- OPTICAL
- TAPE

Time

Transition

Backup

Expiration

Deletion

(up to two backup copies)
What are Benefits of OAM?

- Ability to store and manage extremely large quantities of data
- Flexible
  - Storage hierarchy consisting of any combination of disk, optical, and tape
  - Rules for transitioning between levels in storage hierarchy
  - Lifecycle management (creation to expiration), SMS-based management
- Safe and Secure
  - Integrated backup and recovery facilities
  - Automatic access to backup data if primary copy unavailable due to media or library failures
  - Encryption and WORM support (when configured and supported by the storage device)
  - Archive retention controls to ensure objects are not changed or deleted

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
What are Benefits of OAM?

- Media management, expiration and recycle capabilities
- Integration with SMS constructs
  - Storage Class – placement in the hierarchy
  - Storage Group – object grouping (data co-location)
  - Management Class – duration and movement within hierarchy
  - Data Class – media selection for tape
- Can store directly to *any* level of the OAM hierarchy
- Can retrieve all or part of an object
- PARMLIB tuning capabilities through CBROAMxx

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
IBM DB2 used for object directory “metadata” and storage-related configuration data

Storage Hierarchy

① **Disk Level**
- DB2 sublevel
- File System sublevel
  - Each object stored as individual file
  - Supported file systems (zFS & NFS)

② **Optical Level**

③ **Tape Level**
- Tape sublevel 1
- Tape sublevel 2

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
OAM Components

- **OSR** - Object Storage and Retrieval (OSREQ API)
  - Provides application interface into OAM
    - IBM Content Management and customer written applications

- **LCS** - Library Control System
  - Provides removable media, library, and file system support

- **OSMC** - OAM Storage Management Component
  - Provides storage management for objects
Functions that OAM “OSR” Provides

- Provides **OSREQ** Application Programming Interface (API) for objects:
  - **Store**
    - In its entirety - passing the entire object
    - In parts (STOREBEG/STOREPRT/STOREEND) – passing pieces
  - **Retrieve**
    - Primary or Backup Copy
    - Part or all of an object
    - Initiate Immediate Recall of objects to disk layer (DB2 or FS)
    - Automatic access to backup
  - **Query** - information about objects
  - **Change** - SMS constructs associated with objects; retention
  - **Delete** - manually delete an object
Functions that OAM “LCS” Provides

- Provides removable media and library management support
  - Read/Write support for …
    - tape and optical media
    - file system (zFS or NFS)
  - Media migration/expiration/reclamations support
  - Cartridge entry/eject support
  - Vary online/offline for …
    - libraries and drives
  - Display status for …
    - libraries, drives, and volumes
- Maintains volume record information (for tape and optical media used for object storage)
- Statistics (SMF Type 85 record)
Functions that OAM “OSMC” Provides

- Provides storage management for objects
  - Object movement within storage hierarchy based on SMS storage class
  - Automatic backup of objects based on SMS management class
    - immediate or deferred
  - Automatic expiration of objects based on SMS management class
  - Volume and object recovery
  - Volume media migration, expiration, and reclamation utility
OAM/SMS Relationships

- Each object assigned an SMS **management** and **storage class**

- **Management class parameters**
  - **Retention**
    - determines when an object expires
  - **Auto Backup**
    - determines if object is backed up
  - **Number of Backup Versions**
    - determines the number of backup copies created (up to 2)
  - **Backup Frequency**
    - determines when the first backup copy is created (when an object is initially stored or during the OSMC cycle)
  - **Transition**
    - determines when primary copy of object transitions to new management and/or storage class
OAM/SMS Relationships …

- **Storage class parameters**
  - INITIAL ACCESS RESPONSE SECONDS (IARS)
  - SUSTAINED DATA RATE (SDR)
  - OBJECT SUB-LEVEL (OSL)
  - Specified combination of values determine if the object resides on disk (in DB2 or in a file system) or on “removable” storage (tape or optical)
Object Storage Groups

- Provides a mechanism to segregate and group related OAM objects (e.g., all objects belonging to the same application or the same type, size, etc.)

- An OBJECT storage group consists of
  - a DB2 database (called the Object Storage Database)
  - (optionally) a set of optical disk volumes (library-resident or shelf-resident)
  - (optionally) a set of tape volumes (library-resident or shelf-resident)
  - (optionally) a mountable file system

- OBJECT storage groups defined through the ISMF Storage Group Application
Object Backup Storage Groups

- Contains the backup copy(s) of OAM objects
  - each object can have up to two backup copies; up to two backup storage groups can be associated with an object
- Multiple object backup storage groups supported
- An OBJECT BACKUP storage group consists of
  - a set of optical disk volumes (library-resident or shelf-resident)
  - a set of tape volumes (library-resident or shelf-resident)
- Defined through the ISMF Storage Group Application
- Backup storage groups associated with Object Storage groups through SETOSMC statements in CBROAMxx member of PARMLIB
ACS routines used to implement the installation’s object policies

ACS environments (STORE, CHANGE, and CTRANS) used to assign the storage class, management class and storage group for …

- OSREQ STORE command (&ACSENVIR='STORE')
- OSREQ CHANGE command (&ACSENVIR='CHANGE')
- OSMC cycle (&ACSENVIR='CTRANS')

ACS environment (ALLOC) used when storing objects to tape

- During allocation (&ACSENVIR='ALLOC')
  - OAM.PRIMARY.DATA.storage-group-name
  - OAM.BACKUP.DATA.storage-group-name
  - OAM.BACKUP2.DATA.storage-group-name

Appending SG name optional
Collections

- A **collection** is a logical grouping of objects having similar characteristics
- Collection Name
  - Provided by the application on the OSREQ invocation
  - Used to catalog a large number of “like” objects
- Catalog entry for a collection
  - Contains a default MC/SC and an associated directory token (storage group name)
  - Helps to locate meta data information about the object in DB2 after it is stored
- Each object storage group can contain many collections
- Every object belongs to a collection
Object Store Sequence

If variable &MEMN (object name) is null, the ACS routines are invoked to specify a storage class, management class, storage group for the collection named in &DSN (set defaults)

If variable &MEMN is not null, this ACS invocation validates the storage class and management class specified by the application for the object named in variable &MEMN

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
OAM Object Databases

- OAM maintains numerous DB2 databases
  - **Object Storage Databases**
    - Object Directory Table (one per object storage group)
    - Object Data Tables (one per storage group for data stored in DB2)
      - 4K, 32K Object Storage Tables, LOB Storage Structures
  - **Object Administration Database**
    - Management Class, Storage Class, and Collection Tables
  - **OAM Configuration Database**
    - Optical - Library, Slot, Drive, Volume, and Deleted Objects Tables
    - Tape Volume Table (different than the TCDB used with SMStape)
    - File System – Delete Table
OAM Object Databases …

- One **Object Directory** table for each Object Storage Group
- Each containing a row of meta-data for each object in the OAM inventory for that storage group
- Meta-data used to locate and manage the objects
## Object Metadata

<table>
<thead>
<tr>
<th>Description</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object Name</td>
<td>ODNAME</td>
</tr>
<tr>
<td>Object Size</td>
<td>ODSIZE</td>
</tr>
<tr>
<td>Object Creation Time Stamp</td>
<td>ODCREATS</td>
</tr>
<tr>
<td>Expiration Date</td>
<td>ODEXPDXT</td>
</tr>
<tr>
<td>Last Referenced Date</td>
<td>ODLREFDT</td>
</tr>
<tr>
<td>Pending Action Date</td>
<td>ODPENDDT</td>
</tr>
<tr>
<td>Collection Name ID</td>
<td>ODCLID</td>
</tr>
<tr>
<td>Storage Class ID</td>
<td>ODSCNUM</td>
</tr>
<tr>
<td>Management Class ID</td>
<td>ODMCNUM</td>
</tr>
<tr>
<td>Object Location Flag</td>
<td>ODLOCFL</td>
</tr>
<tr>
<td>Large Object Support Flag</td>
<td>ODLOBFL</td>
</tr>
<tr>
<td>Primary/Active Object Volser/Location</td>
<td>ODLSLOC/ODSECLOC</td>
</tr>
<tr>
<td>1st Backup Copy Volser/Location</td>
<td>ODBKLOC/ODBKSEC</td>
</tr>
<tr>
<td>2nd Backup Copy Volser/Location</td>
<td>ODBK2LOC/ODBK2SEC</td>
</tr>
<tr>
<td>Object Status Flags</td>
<td>ODSTATF</td>
</tr>
<tr>
<td>Retention Protection Date</td>
<td>ODRETDT</td>
</tr>
<tr>
<td>OAM FS Instance ID</td>
<td>ODINSTID</td>
</tr>
</tbody>
</table>

Complete your session evaluations online at [www.SHARE.org/Orlando-Eval](http://www.SHARE.org/Orlando-Eval)
OAM Archive Retention

- **Deletion-hold** - prevent object deletion while object is in deletion-hold

- **Deletion-protection** - prevent object deletion prior to object’s expiration date

- **Retention-protection** - prevent object deletion prior to object’s expiration date, and don't allow expiration date to be changed (explicitly or implicitly) to an earlier date

- **Event-based-retention** - object expiration date dependent on external event notification

- **CBRHADUX** – user exit invoked when an object is deleted (during OSMC cycle)

- **CBRUXSAE** – user exit invoked with the OSREQ API
Storage Hierarchy Options (Options)

1. Primary copy typically stored on disk in **DB2 tables** for fast access; however can initially be stored anywhere in hierarchy.

2. As data ages primary copy transitioned to **file system** or to **virtual tape** for continued fast access.

3. Further transitioned to virtual or physical tape for **longer term archive** as data ages.

Backup copy(s) made during OSMC cycle for recovery.

---

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
OAMplex Support

- OAM supports the SYSPLEX environment referred to as an OAMplex
  - Interconnected OAMs that …
    - use the same DB2 data sharing group
    - belong to the same XCF group
    - share same SMS configuration
  - Cross-system communication uses the coupling facility
  - Data I/O (read and write)
    - optical reads and writes may be shipped cross-system
    - tape reads may be shipped cross-system
    - tape writes always done on system where requested
    - file system reads and writes done on system where requested
**OAM System Options**

**SYSTEM 1**

- **OAM**
- **DB2**

Non-OAMplex; one system sharing the data (only one OAM address space per system)

**SYSTEM 2**

- **OAM**
  - **OAM 1**
  - **OAM 2**

**SYSTEM 1**

- **OAM**
  - **OAM 1**
  - **OAM 2**

**SYSPLEX1/OAMplex1**

- **DB2**
- **OAM**
  - **OAM 3**

**SYSTEM 3** …

OAMplex – still only one OAM address space per systems with cross-system communication

Use OSMC “Processing System Name” in storage group definition to split the workload

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
OAM Customization

- **IEFSSNxx Parmlib Member**
  - SUBSYS SUBNAME(OAM1) INITRTN(CBRINIT)
  - INITPARM(‘[TIME=GMT][,MSG=x][,OTIS=x][,UPD=x][,MOS=nnnn],
    [LOB=x][QB=x] [DP=x]’)

- **PROGxx Parmlib Member (Dynamic Exit Support)**
  - EXIT ADD EXITNAME(CBRUXTVS_EXIT) MODNAME(ARCTVEXT)
    STATE(ACTIVE) - used during object tape recycle processing

- **OAM Proclib Member**
  - //OAM PROC
    OSMC=YES,MAXS=2,UNLOAD=9999,EJECT=LRW,RESTART=YES,OAM=xx

- **CBROAMxx Parmlib Member**
  - SETOAM (object tape options)
  - SETOPT (general object options)
  - SETOSMC (OSMC storage management options)
  - OAMXCF (used with OAM’s SYSPLEX support)
  - SETDISK (used with OAM’s file system support – new with z/OS V1R13)
  - SETTLLIB (used with OAM’s SMStape support – new with z/OS V2R1)
SETOAM Command processed during OAM initialization to establish the tape related values for the object tape support

Parameters include
- TAPEUNITNAME
- DATACLASS
- L2TAPEUNITNAME
- L2DATACLASS
- TAPECOMPACTTION
- DEMOUNTWAITTIME
- TAPEEXPIRATION
- TAPEFULLTHRESHOLD
- MAXTAPERETRIEVETASKS / SGMAXTAPERETRIEVETASKS
- MAXTAPESTORETASKS / SGMAXTAPESTORETASKS
- TAPEDRIVESTARTUP
- TAPEDISPATCHERDELAY
- MOUNTWAITTIME
- MAXRECYCLETASKS
- TAPERECYCLEMODE
- DSNWITHSGNAME
CBROAMxx PARMLIB member

- **SETOPT Command** processed during OAM initialization to establish general option values for object support

- Parameters include
  - OPTICALREINITMODE
  - OPTICALDISPATCHERDELAY
  - SCRATCHENTRYTHRESHOLD
  - MOUNTWAITTIME
  - UNLOADDRIVES
  - UNLOADTIMER
  - ABUNREAD
  - ABOFFLINE
  - ABNOTOPER
  - ABDB2ERROR
  - ABLOST
  - ABFSERROR
  - ABALL
  - MULTISYSENABLE
- **SETOSMC Command** processed during OAM initialization to establish the Storage Management related values for object support

- **Parameters include**
  - FIRSTBACKUPGROUP
  - SECONDBACKUPGROUP
  - CYCLEWINDOW
  - MAXRECALLTASKS
  - RECALLOPTICAL
  - RECALLTAPE
  - RECALLALL
  - RECALLNONE
  - CLEAROLDLOC
  - RECALLOFF
  - RECALLDISKSUBLEVEL
CBROAMxx PARMLIB member

- **OAMXCF commands** processed at OAM initialization to establish OAMplex related values

- Parameters include
  - OAMGROUPNAME
  - OAMMEMBERNAME
  - XCFTIMEOUT
  - XCFOPTREADA
  - XCFOPTREADM
  - XCFOPTWRITEA
  - XCFOPTWRITEM
  - XCFTAPEREADA
  - XCFTAPEREADM
CBROAMxx PARMLIB member

- **SETDISK commands** processed at OAM initialization to establish disk related values

- SETDISK parameters specified at storage group level

- Parameters include:
  - L2DIR (file system mount point)
  - L2TYPE (ZFS or NFS)

**Mount file system** at mount point for the storage group

SETDISK STORAGEGROUP(SG1 L2DIR(/oam/sg1) L2TYPE(ZFS))
OAM File System Support Overview

SMS Storage Class Construct

Object Storage Database

Example Object Directory Entry (SG1)
- ODNAME
- ODLOCF
- ODINSTID
  - OBJECT1: E 572602

Example Object Directory Entry (SG2)
- ODNAME
- ODLOCF
- ODINSTID
  - OBJECT2: E 3971

CBROAMxx PARMLIB Member

- SETDISK STORAGEGROUP (SG1)
  - L2DIR(/cam/sg1)
  - L2TYPE(2FS)

- SETDISK STORAGEGROUP (SG2)
  - L2DIR(/cam/sg2)
  - L2TYPE(NFS)

Storage Class for OBJECT1 and OBJECT2 specifies to store the object data in the file system sublevel of the OAM storage hierarchy.

"E" in ODLOCF indicates OBJECT1 stored in SG1 file system sublevel and OBJECT2 stored in SG2 file system sublevel.

SETDISK for SG1 specifies a file system location of /oam/sg1 and SETDISK for SG2 specifies a file system location of /oam/sg2.

z/OS UNIX File System Hierarchy

- /cam/sg1/
- /cam/sg2/

zFS File System

NFS File System

OAM

- OBJECT1
- 0110001101000110110110100001
- 01101000010100101101110100001

- OBJECT2
- 001001100100011101001000101011
- 01010010010100101101110100001
OAM Publications

✓ DFSMS Object Access Method Application Programmer's Reference (SC23-6865)
Thank You!
IBM in the AUT.

Sp-

sy.
of those products.
not tested those products and cannot confirm the performance, compatibility, or any
ome of t

website
cor
is a trademark of
trademark policy is available on the
is a trademark or registered trademark of
LLC. The
rag

Processors because customers are authorized to use SEs only to process certain types and/or amounts of workloads as specified
www.ibm.com/systems/support/machine_warranties/machine_code/aut.html ("AUT"). No other workload processing is authorized for
only to execute the processing of Eligible Workloads of specific Programs expressly authorized by IBM as specified in the "Au
This information provides only general descriptions of the types and portions of workloads that are eligible for execution on
Prices subject to change without notice. Contact your IBM representative or Business Partner for the most current pricing in
other claims related to non
Information about non
All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent
your local IBM business contact for information on the product or services available in your area.
This publication was produced in the United States. IBM may not offer the products, services or features discussed in this do
costs and performance characteristics will vary depending on individual customer configurations and conditions.
IBM hardware products are manufactured from new parts, or new and serviceable used parts. Regardless, our warranty terms appl
individual user will achieve throughput improvements equivalent to the performance ratios stated here.
Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an
IBM products is obtained from the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.
Prices subject to change without notice. Contact your IBM representative or Business Partner for the most current pricing in your geography.
This information provides only general descriptions of the types and portions of workloads that are eligible for execution on Specialty Engines (e.g. zIIPs, zAAPs, and IFLs) ("SEs"). IBM authorizes customers to use IBM SE only to execute the processing of Eligible Workloads of specific Programs expressly authorized by IBM as specified in the "Authorized Use Table for IBM Machines" provided at
www.ibm.com/systems/support/machine_warranties/machine_code/aut.html ("AUT"). No other workload processing is authorized for execution on an SE. IBM offers SE at a lower price than General Processors/Central Processors because customers are authorized to use SEs only to process certain types and/or amounts of workloads as specified by IBM in the AUT.

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
Trademarks and Disclaimers …

NOTES:

All customer examples cited or described in this presentation are presented as illustrations of the manner in which some customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics will vary depending on individual customer configurations and conditions.

This publication was produced in the United States. IBM may not offer the products, services or features discussed in this document in other countries, and the information may be subject to change without notice. Consult your local IBM business contact for information on the product or services available in your area.

All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

Information about non-IBM products is obtained from the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Prices are suggested US list prices and are subject to change without notice. Starting price may not include a hard drive, operating system or other features. Contact your IBM representative or Business Partner for the most current pricing in your geography.

Any proposed use of claims in this presentation outside of the United States must be reviewed by local IBM country counsel prior to such use.

The information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

IBM makes no representation or warranty regarding third-party products or services including those designated as ServerProven, ClusterProven or BladeCenter Interoperability Program products. Support for these third-party (non-IBM) products is provided by non-IBM Manufacturers.

IBM may have patents or pending patent applications covering subject matter in this document. The furnishing of this document does not give you any license to these patents. Send license inquiries, in writing, to IBM Director of Licensing, IBM Corporation, New Castle Drive, Armonk, NY 10504-1785 USA.