DFSMS Object Support Overview and Recent Enhancements: Data Archiving with OAM

Session: 21325

Albert Dennes
OAM Level 3 Team Lead and Development
IBM Corporation

Derek Erdmann
OAM Level 2 Team Lead
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?
- Recent Enhancements

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 capabilities, data co-location

***Note**: WORM and Encryption provided by the storage device

What is OAM's object support?

- **Access method used to store, access and manage** *objects*
- **An** *object* **is a named stream of bytes (1B-2000MB)**
- *Objects* are streams of bytes that have no specific format or record orientation and **varying access time** requirements
- Similar in functionality to DFSMShsm 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 DFSMShsm

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

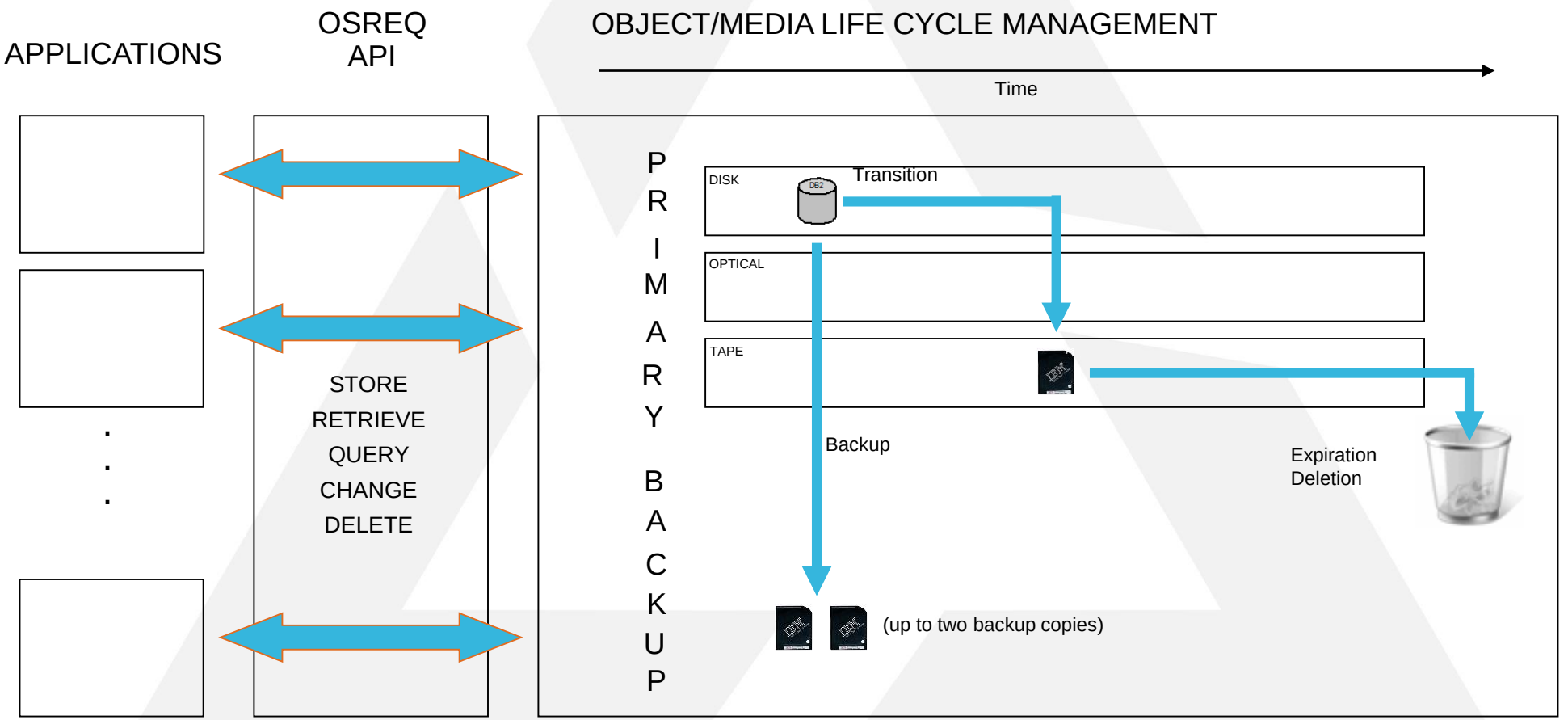
What is OAM's object support?

- 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

What is OAM's object support?



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
  - ***Banks, Insurance Companies, Health Industry, Service Industry, Telecommunications Companies, Financial Industry, State and Federal Government Agencies, Airline Industry, etc.***
- Used to store millions of "objects" of varying sizes

What are Benefits of OAM?

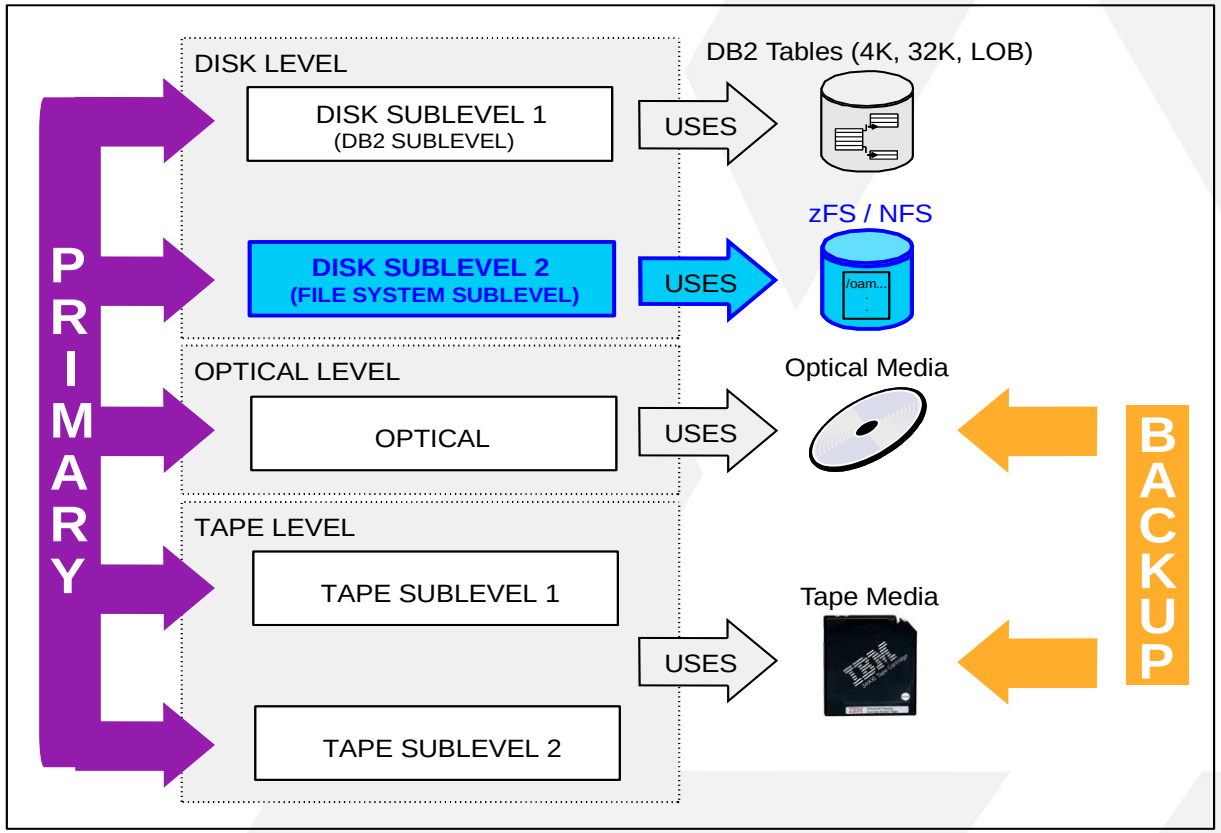
- ✓ Ability to store and manage extremely large quantities of data
- ✓ Flexible
  - **Storage hierarchy consisting of any combination of disk, optical, and tape**
  - **Rules for transitioning between levels in storage hierarchy**
  - **Lifecycle management (creation to expiration), SMS-based management**
- ✓ 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**

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

OAM Architecture & Storage Hierarchy

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

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/reclamation 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

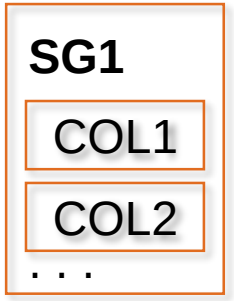
SMS “ACS” Routine Interaction

- **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***

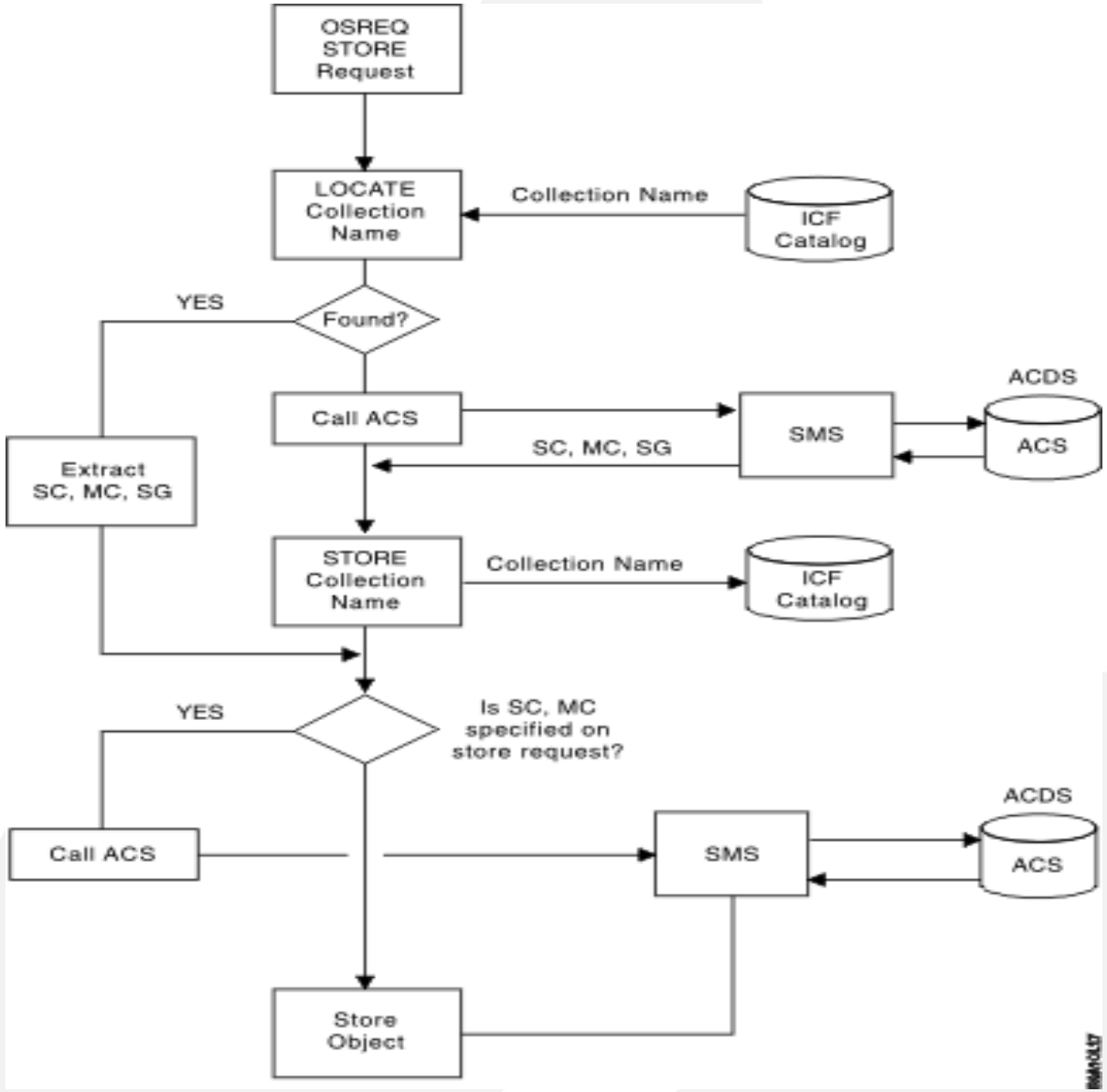
Appending SG name optional

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

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

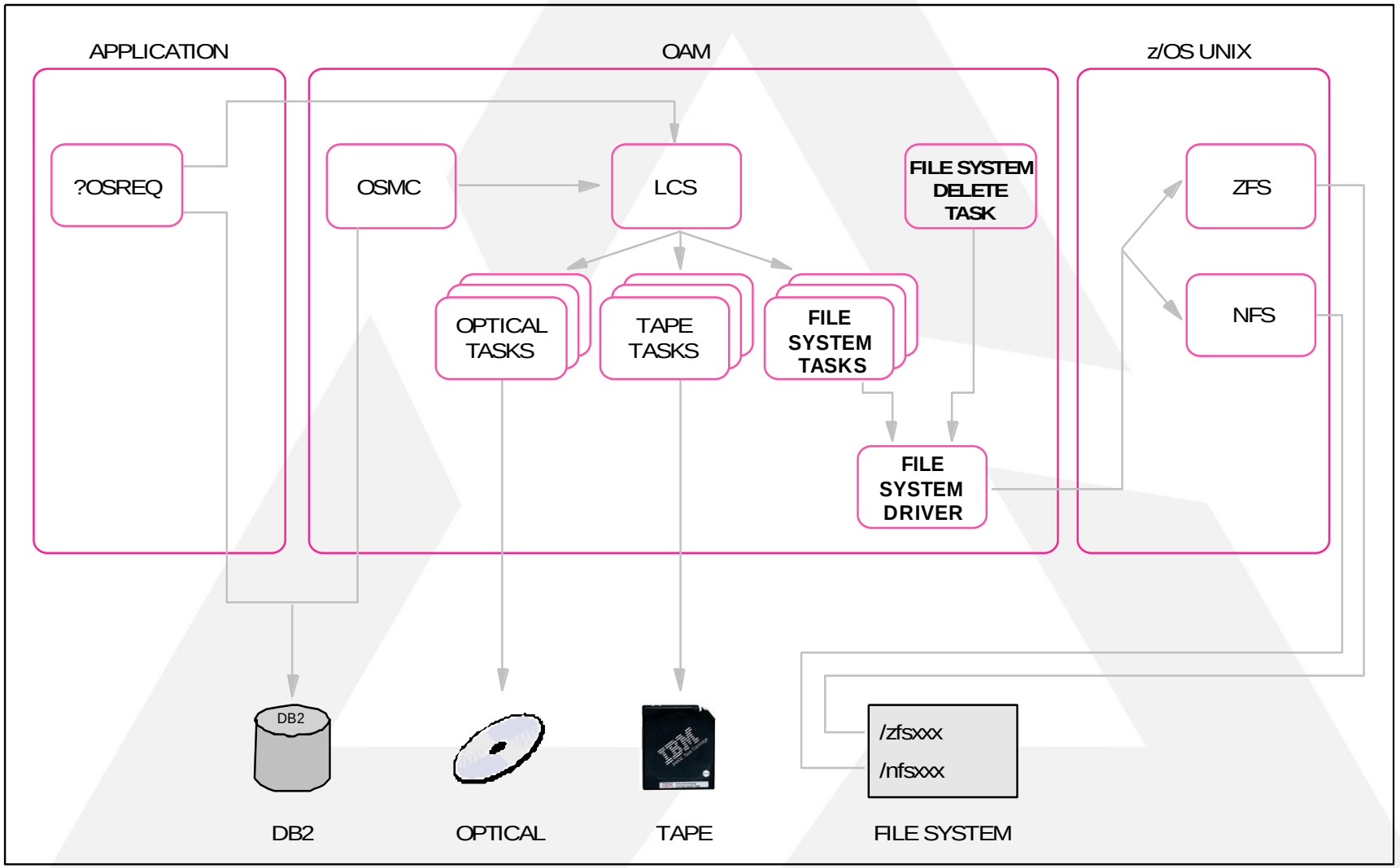
Object Metadata

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

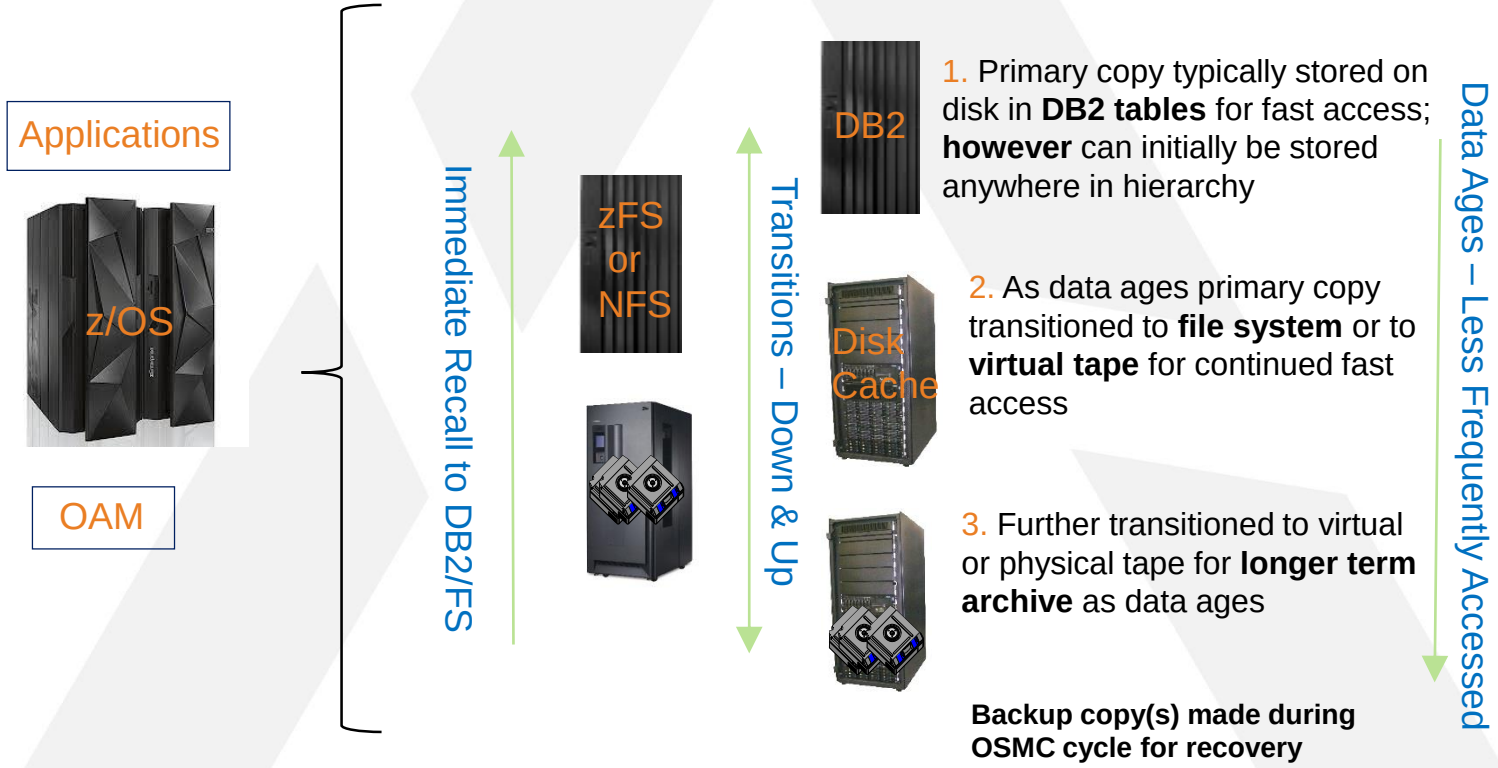
OAM Archive Retention

- **Deletion-hold** - prevent object deletion while object is in deletion-hold
- **Deletion-protection** - prevent object deletion prior to object's expiration date
- **Retention-protection** - don't allow expiration date to be changed to an earlier date and prevent object deletion prior to object's expiration 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

OAM Interaction



Storage Hierarchy Options

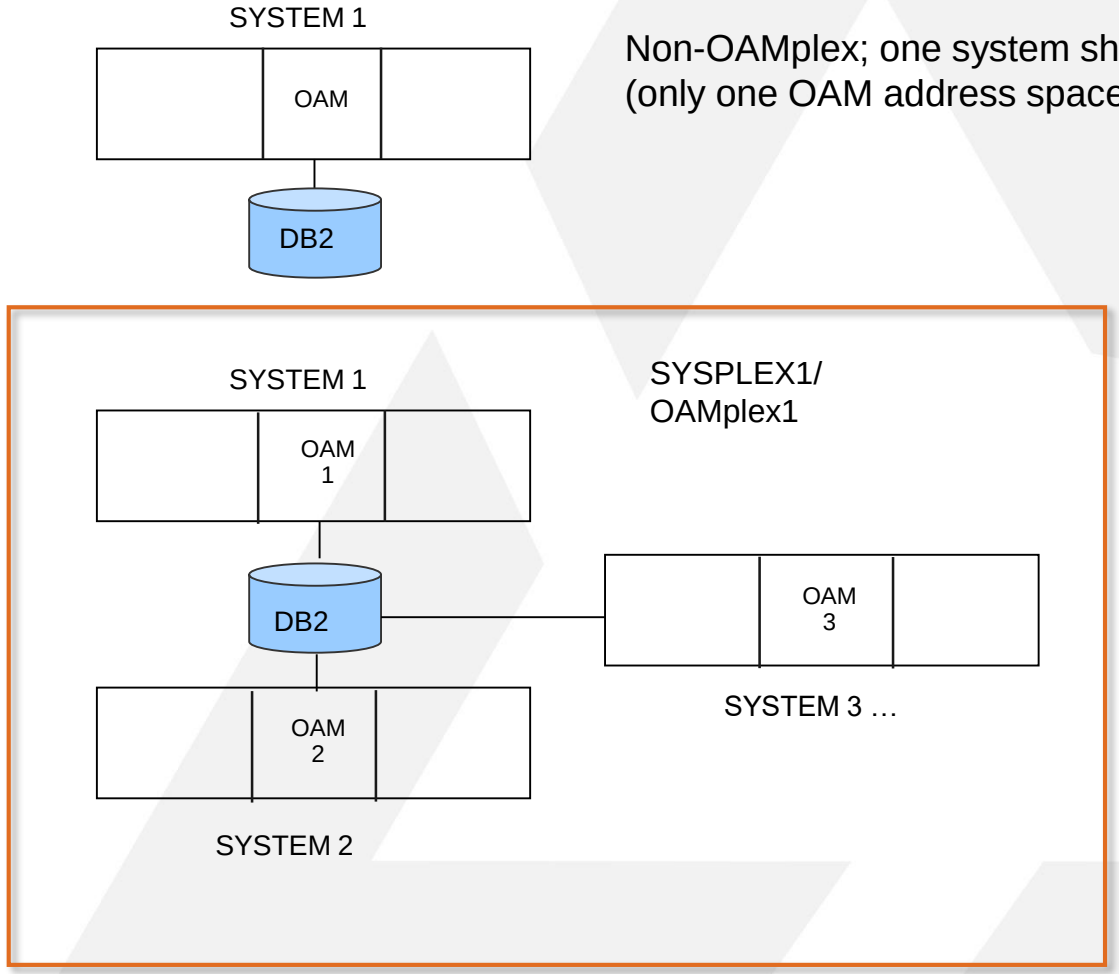


OAMplex Support

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



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

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

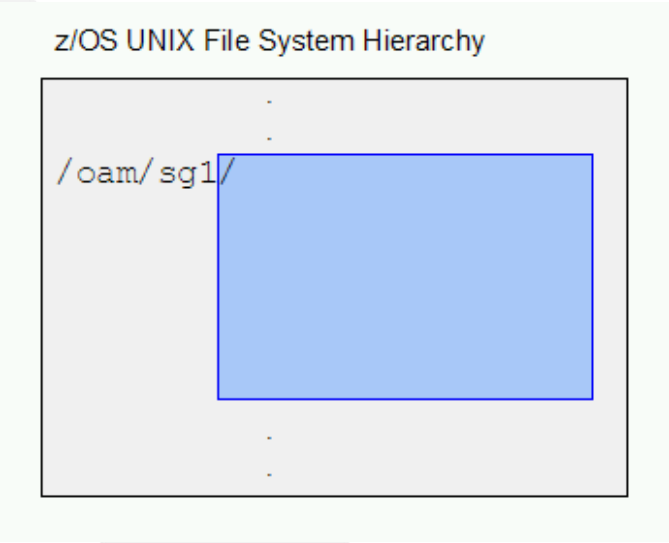
RECENT OAM OBJECT ENHANCEMENTS

OAM File System Support (z/OS V1R13)

- **Second disk tier added as a sublevel** to the OAM storage hierarchy for primary object data (in addition to the existing DB2 disk tier)
- Each object is stored in the file system as an individual file
- Primary object data can be transitioned to or initially stored in the file system
- Supports zFS and NFS mountable file systems
- Enabled on SETDISK statement in CBROAMxx member of PARMLIB and through Storage Class settings
- Unique file system and mount point can be setup for each object storage group ***/OAM/SG1***
- OAM meta data continues to be stored in DB2

OAM File System Support …

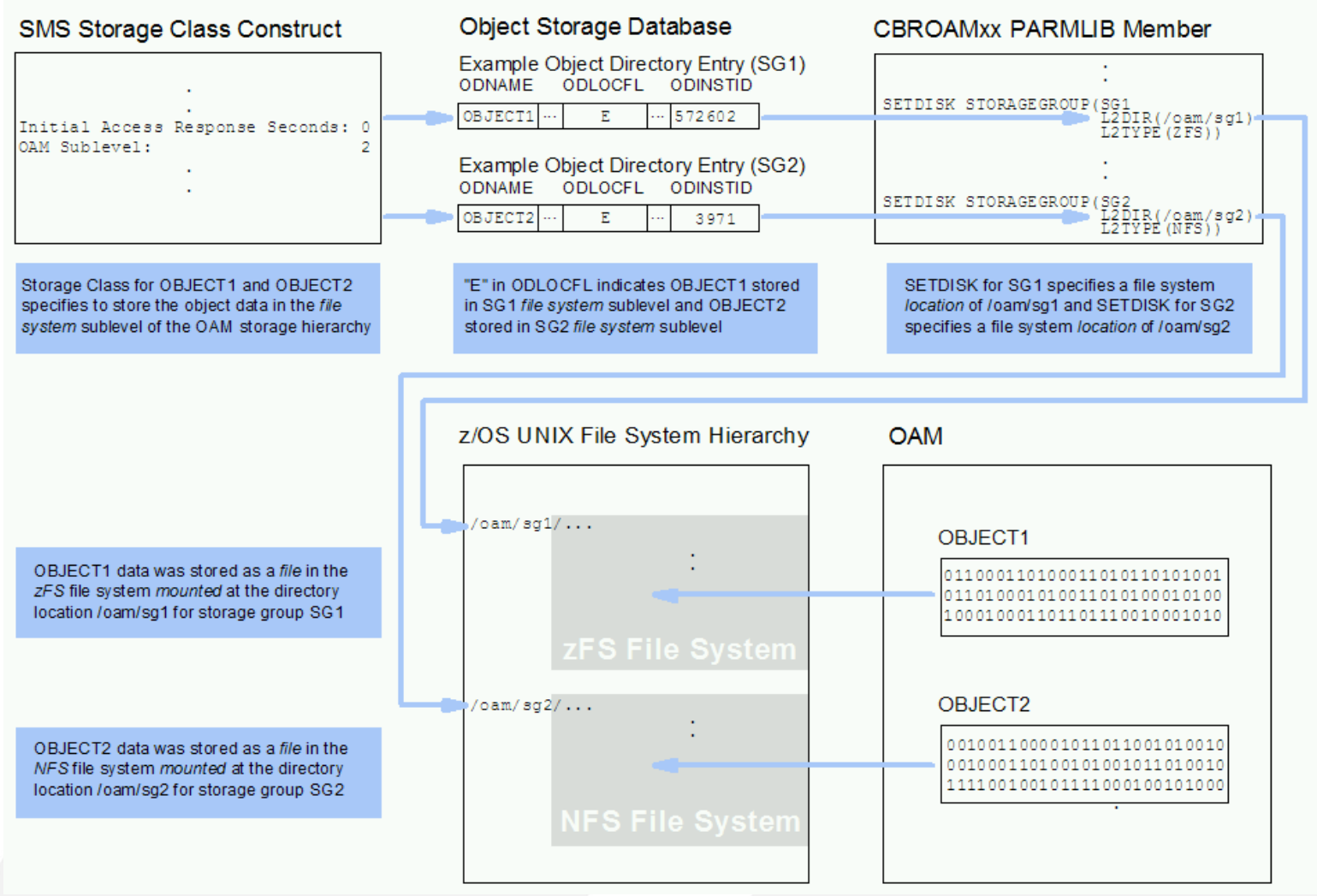
- SETDISK commands processed at OAM initialization to establish disk related values
- SETDISK parameters specified at storage group level
- Parameters include:
  - L2DIR (file system mount point)
  - L2TYPE (ZFS or NFS)



Mount file system at mount point for the storage group

SETDISK STORAGEGROUP(SG1 L2DIR(/oam/sg1) L2TYPE(ZFS))

OAM File System Support …



Start Storage Group Command (z/OS V1R13)

- **Wildcard capability** added to the start storage group command
  - MODIFY OAM,START,STORGRP,*groupname*
- Rightmost character of ***groupname*** can be a single asterisk
- Applies to both Object and Object Backup storage groups
- Examples:
  - F OAM,S,STORGRP,GROUP***** — **Starts processing for all Object and Object Backup storage groups that begin with GROUP**
  - F OAM,S,STORGRP,***** — **Starts processing for all Object and Object Backup storage groups defined in the ACDS**

  Note: F OAM,S,OSMC can be used to start processing for all Object storage groups, **but does not include Object Backup storage groups**
- Used to simplify OSMC storage group processing

Store and Retrieve Tasks (z/OS V1R13)

- Object tape **store and retrieve tasks dynamically changeable**
  - MODIFY OAM,UPDATE,SETOAM can be used to **dynamically** change the CBROAMxx (PARMLIB) values for:
    - SGMAXTAPESTORETASKS via **SGMAXTPS**
    - SGMAXTAPERETRIEVETASKS via **SGMAXTPR**
- Specifies distribution of tasks used for storing/retrieving at the ***storage group*** **level**
- An update to CBROAMxx member of PARMLIB and associated restart of OAM address space is no longer needed
  - Can have more retrieve tasks during the day and store tasks in the evening for OSMC
- Global MAXTAPESTORETASKS and MAXTAPERETRIEVETASKS settings are not dynamically changeable

Expiration Date Extended (z/OS V1R13)

- Increased maximum retention/expiration to **93000** days (254+ years)

	Previous	V1R13
Management Class Expire after Days Non-usage	9999	93000
Management Class Expire after Date/Days	9999	93000
Management Class Retention Limit	9999	93000
OSREQ API RETPD	32767	93000
OSREQ API EVENTEXP	32767	93000

- **NOLIMIT** remains as an additional option to retain objects “forever”
- Global change in DFSMS to address longer retention periods exceeding 27 years

Support for Larger Tape Block Sizes (z/OS V2R1)

- Support tape block sizes **up to 256 KB** (previously supported 32KB block sizes)
- Enabled on SETOAM statement in CBROAMxx member of PARMLIB – **TAPESDB(LARGE)**
  - Global SETOAM setting
- Volume supports larger block sizes when 1st object is written to the volume
- Maximum block size for the volume is set to the **optimal block size for the device** or the **maximum permitted block size**, whichever is less
  - Maximum permitted block size is obtained from Data Class or the TAPEBLKSZLIM keyword in DEVSUPxx (PARMLIB)
- Volumes that support block sizes > 32 KB are not accessible from prior releases
  - OAMplex consideration

Automatic Backup Deletion (z/OS V2R1)

- Provided support for **automatic removal of unneeded backup copies**
- Enabled on SETOSMC statement in CBROAMxx member of PARMLIB - **BACKUPDELETE=ON**
- OSMC will delete existing backup copies that exceed the number required by object's current management class
  - For example, when objects transition to TS7700 Virtualization Engine with multi-cluster grid capability, two OAM managed backup copies may no longer be needed
- **SMF Changes -** OAM SMF Record Type 85 (Subtype 32)
  - New flag indicates whether automatic backup deletion was enabled during OSMC processing
  - New fields show number of backup copies and total bytes deleted as a result of automatic backup deletion

ATAM Coexistence Support (z/OS V2R1)

- Support added to **OAM's dynamic allocation processing to assist ATAM**
  - IBM Tivoli Automated Tape Allocation Manager for z/OS typically used for tape device sharing across sysplex boundaries; keeps the devices offline until needed during allocation
- Enabled on SETOAM statement in CBROAMxx member of PARMLIB **-ALLOCRETRYMINUTES**
- Specifies how long (in minutes) OAM will retry a dynamic allocation request before issuing CBR6400D
  - CBR6400D Unable to allocate tape drive for tape *volser* in storage group *storage-group-name*. Reply 'C' to cancel or 'R' to retry.
- Value of 0 bypasses retry processing and immediately issues CBR6400D
- CBR6400D is used as a trigger mechanism for ATAM to vary devices online

OSREQ Store Sequence Processing (z/OS V2R1)

- **Reduced size limit** for OAM (OSREQ) store sequence processing
  - STOREBEG/STOREPRT/STOREEND (introduced in z/OS V1R10)
  - Enabled objects >256MB to be stored in pieces (minimum size 1 MB)
- OSREQ store sequence can now be used on smaller object sizes
  - Minimum object size now **50 MB+1** (previously **256 MB+1)**
  - Provides option for storing objects in 50 MB+1 to 256 MB size range
    - Original STORE support or STOREBEG/STOREPRT/STOREEND

OSREQ 64-Bit Buffer Support (z/OS V2R2)

- Applications using OSREQ API can store objects using **64-bit addressable virtual storage**
- Objects stored using 64-bit buffers can also be retrieved using 31-bit buffers and vice versa
  - there are no coexistence considerations with lower level systems
- **However**, **applications** that exploit the OSREQ 64-bit buffer capability must run on a z/OS V2R2 system
- With 64-bit buffers only a single OSREQ STORE and OSREQ RETRIEVE is needed
  - With 31-bit buffers, larger objects (>256M) needed to be stored in pieces (STOREBEG, STOREPRT, STOREEND) and retrieved using multiple OSREQ invocations

What's coming in z/OS 2.3 for OAM Object?

- Multiple OAM address spaces on one LPAR
- Removal of the dependency on Catalog to store collection information
- Separation of the OAM Object and OAM Tape address spaces

Join us tomorrow at 8:30AM in the Narragansett Ballroom A for Session 21327, DFSMS Data Archiving and OAM: Classic versus Multi

OAM Publications

- ✓DFSMS Object Access Method Application Programmer's Reference (SC23-6865-01)
- ✓DFSMS Object Access Method Planning, Installation, and Storage Administration Guide for Object Support (SC23-6866-01)
- ✓DFSMS Object Access Method Planning, Installation, and Storage Administration Guide for Tape Libraries (SC23-6867-01)

THANK YOU!

Trademarks and Disclaimers

AIX*	DFSMSdfp	DS6000	IBM*	MQSeries*	Redbooks*	System Storage	Tivoli*	z/OS*
BladeCenter*	DFSMSdss	DS8000*	IBM eServer	MVS	REXX	System x*	WebSphere*	zSeries*
BookManager*	DFSMShsm	Easy Tier	IBM logo*	OS/390*	RMF	System z	z10 BC	z Systems
DataPower*	DFSMSrmm	FICON*	IMS	Parallel Sysplex*	SYSREXX	System z9*	z10 EC	
DB2*	DFSORT	FlashCopy*	InfinBand*	PR/SM	RMF	System z10	z/Architecture*	
DFSMS	Domino*	HiperSockets	Language Environment*	RACF*	SYSREXX	System z10 Business Class	zEnterprise*	

* Registered trademarks of IBM Corporation

The following are trademarks or registered trademarks of other companies.

Adobe, the Adobe logo, PostScript, and the PostScript logo are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States, and/or other countries.

Cell Broadband Engine is a trademark of Sony Computer Entertainment, Inc. in the United States, other countries, or both and is used under license therefrom.

Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

IT Infrastructure Library is a registered trademark of the Central Computer and Telecommunications Agency which is now part of the Office of Government Commerce.

ITIL is a registered trademark, and a registered community trademark of the Office of Government Commerce, and is registered in the U.S. Patent and Trademark Office.

Java and all Java based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

Linear Tape-Open, LTO, the LTO Logo, Ultrium, and the Ultrium logo are trademarks of HP, IBM Corp. and Quantum in the U.S. and

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

OpenStack is a trademark of OpenStack LLC. The OpenStack trademark policy is available on the OpenStack website.

TEALEAF is a registered trademark of Tealeaf, an IBM Company.

Windows Server and the Windows logo are trademarks of the Microsoft group of countries.

Worklight is a trademark or registered trademark of Worklight, an IBM Company.

UNIX is a registered trademark of The Open Group in the United States and other countries.

* Other product and service names might be trademarks of IBM or other companies.

Notes:

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 individual user will achieve throughput improvements equivalent to the performance ratios stated here.

IBM hardware products are manufactured from new parts, or new and serviceable used parts. Regardless, our warranty terms apply.

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 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.

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 inquires, in writing, to IBM Director of Licensing, IBM Corporation, New Castle Drive, Armonk, NY 10504-1785 USA.