DFSMS Object Support Overview: Data Archiving with OAM

Session: 17809

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IBM Corporation

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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

What is OAM's Object Support?

- **Access method used to <u>store</u>, <u>access</u> and <u>manage</u> *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 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)

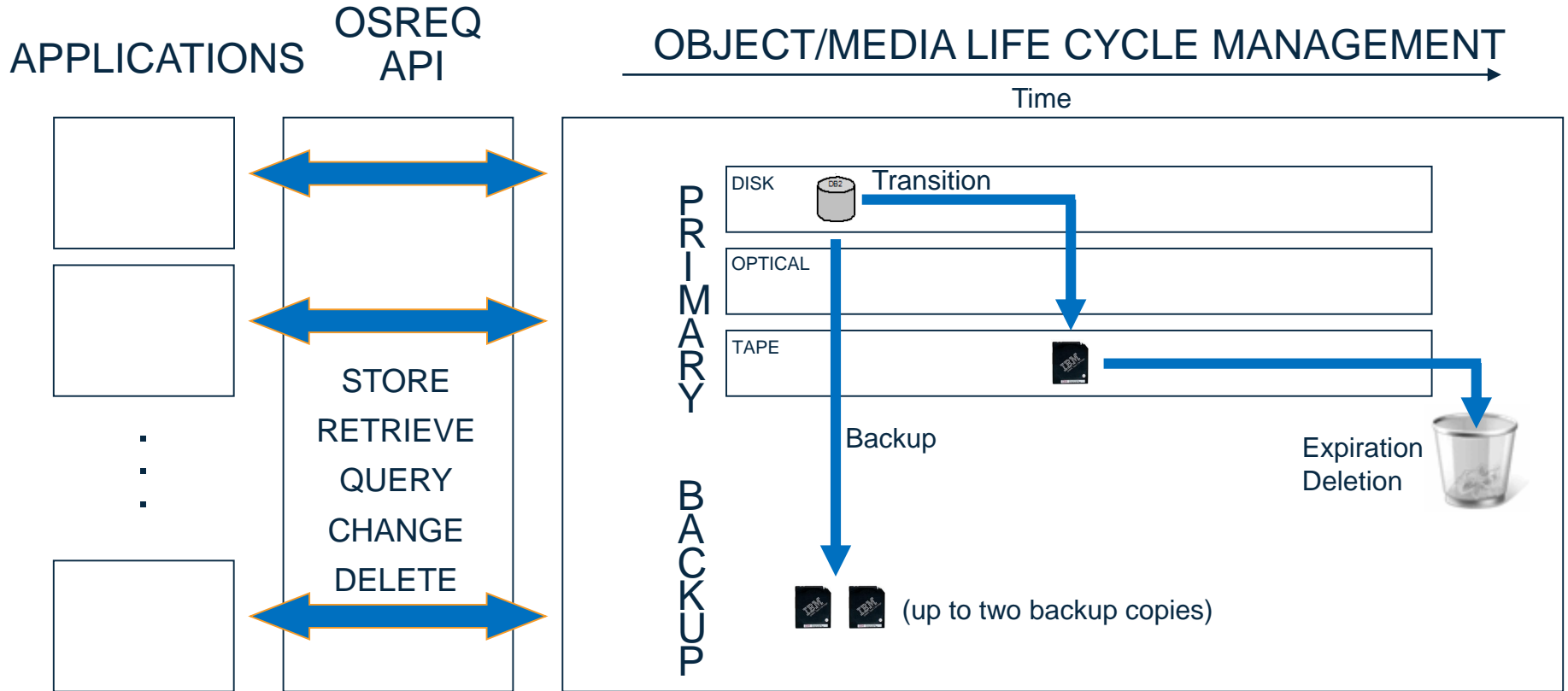 - Provide support for WORM storage devices to meet compliance needs

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

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 is OAM's Object Support?

APPLICATIONS

OSREQ API

STORE
RETRIEVE
QUERY
CHANGE
DELETE

OBJECT/MEDIA LIFE CYCLE MANAGEMENT

Time

PRIMARY

DISK   DB2   Transition

OPTICAL

TAPE

Backup

BACKUP

(up to two backup copies)

Expiration
Deletion

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
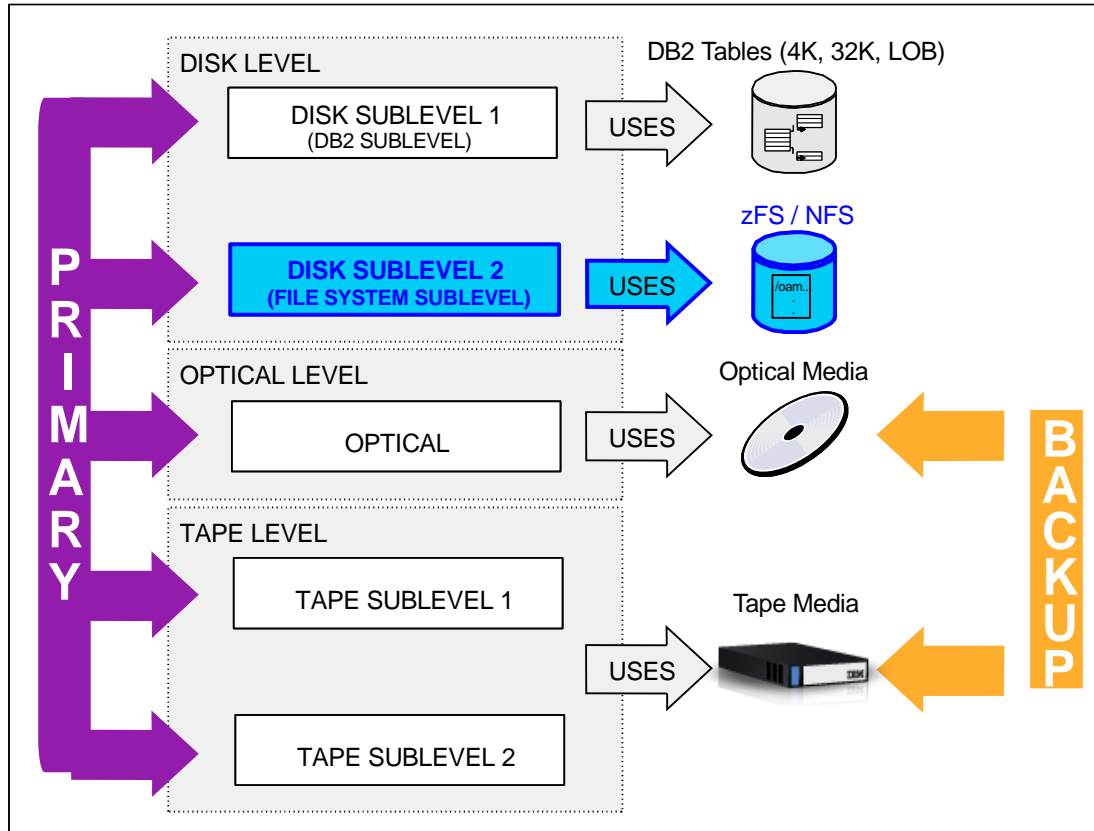
Storage Hierarchy

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:

  - **<u>Store</u>**
    - In its entirety - passing the entire object
    - In parts (STOREBEG/STOREPRT/STOREEND) – passing pieces
  - **<u>Retrieve</u>**
    - 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
  - **<u>Query</u>** - information about objects
  - **<u>Change</u>** - SMS constructs associated with objects; retention
  - **<u>Delete</u>** - 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

SG1

COL1

COL2

. . .

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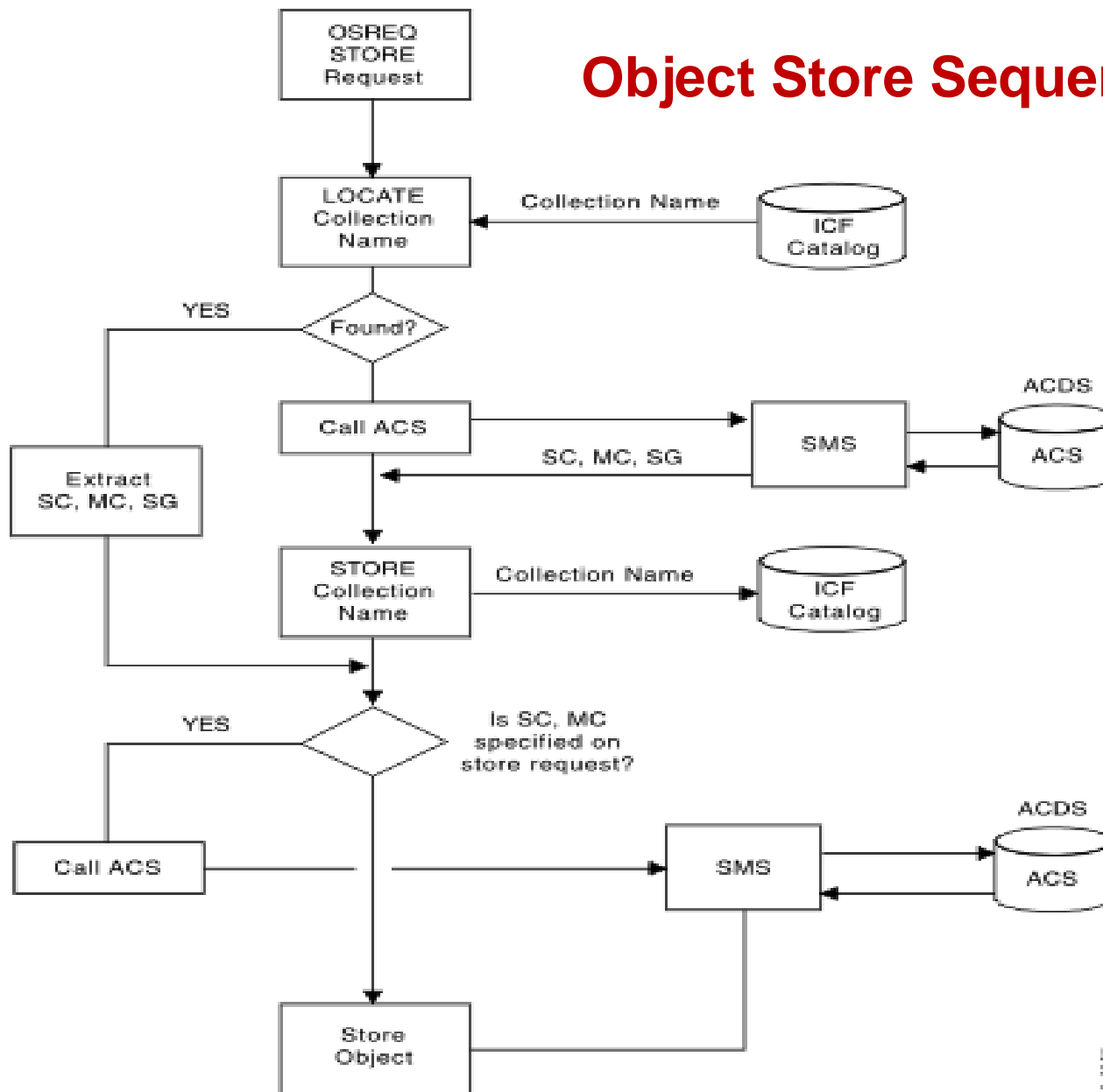
If variable &MEMN (*object name*) is null, the **_ACS_** routines are invoked to specify a storage class, management class, storage group for the collection named in &DSN (set defaults)

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

  - <u>Object Storage Databases</u>
    - 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

  - <u>Object Administration Database</u>
    - Management Class, Storage Class, and Collection Tables

  - <u>OAM Configuration Database</u>
    - 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

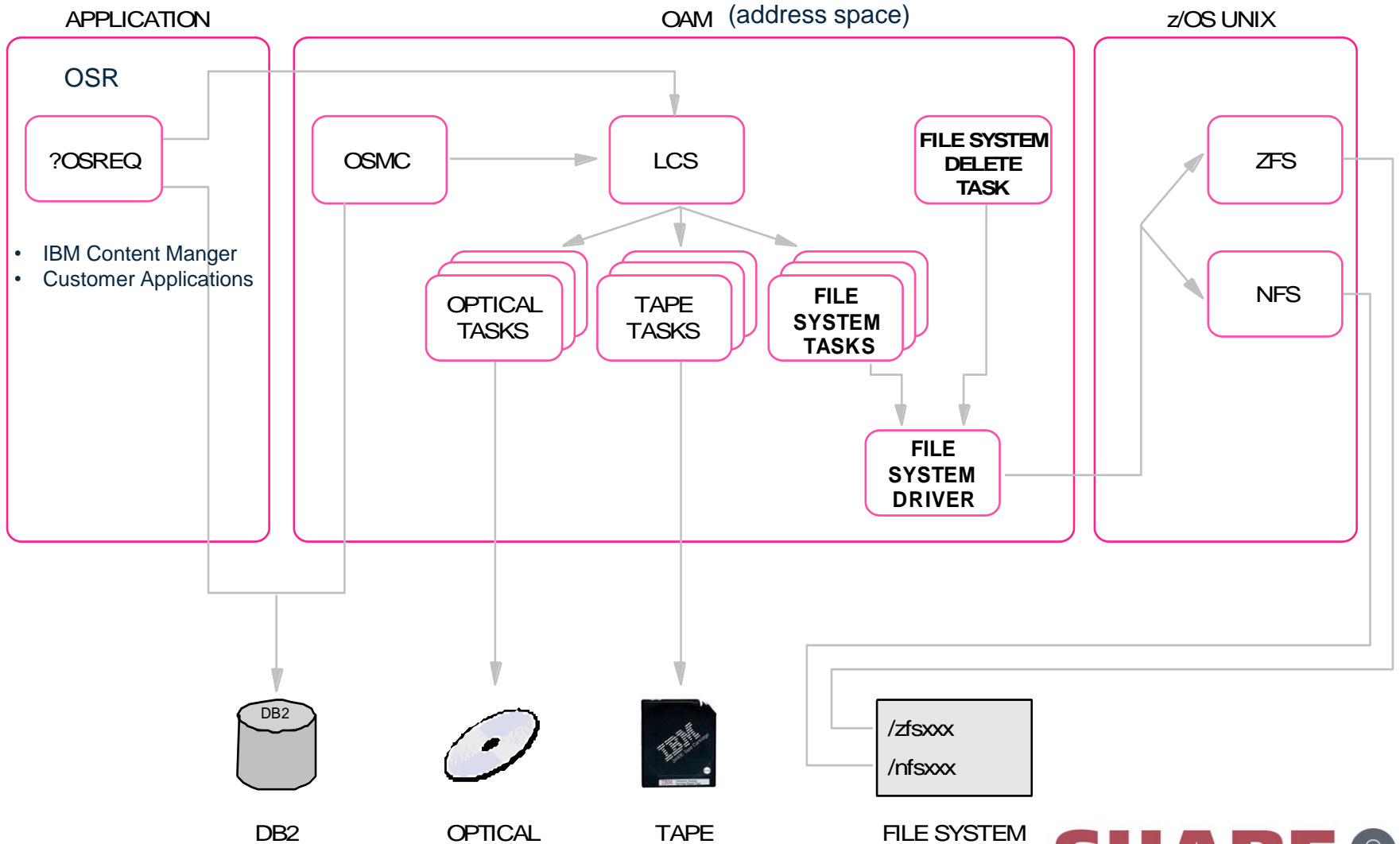 - Meta-data used to locate and manage the objects

Object Metadata

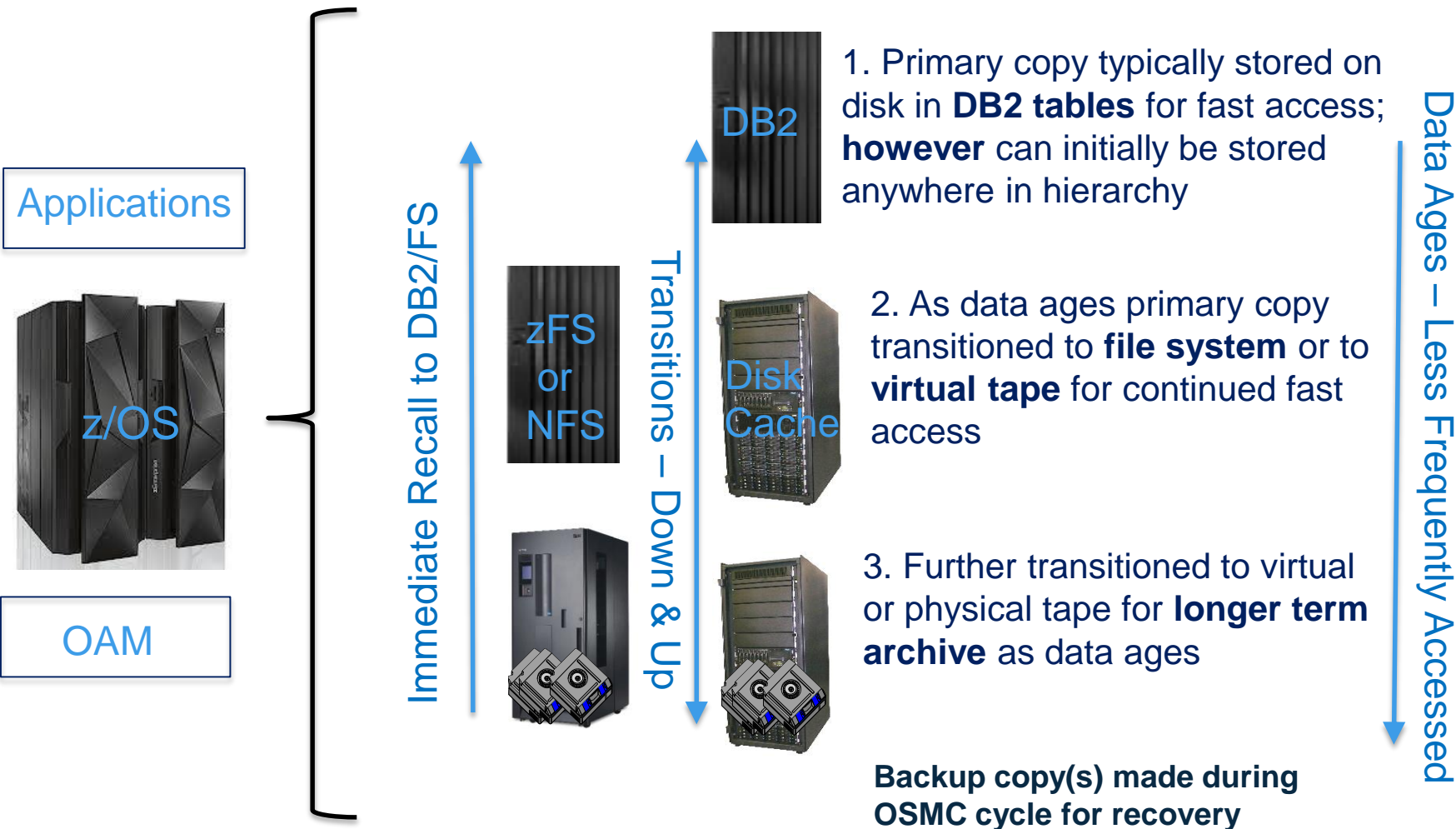| Description	Name
Object Name	ODNAME
Object Size	ODSIZE
Object Creation Time Stamp	ODCREATS
Expiration Date	ODEXPDT
Last Referenced Date	ODLREFDT
Pending Action Date	ODPENDDT
Collection Name ID	ODCLID
Storage Class ID	ODSCNUM
Management Class ID	ODMCNUM
Object Location Flag	ODLOCFL
Large Object Support 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

- **<u>Deletion-hold</u>** - prevent object deletion while object is in deletion-hold

- **<u>Deletion-protection</u>** - prevent object deletion prior to object's expiration date

- **<u>Retention-protection</u>** - 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

- **<u>Event-based-retention</u> -** object expiration date dependent on external event notification

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

- **<u>CBRUXSAE</u>** – user exit invoked with the OSREQ API

OAM Interaction

APPLICATION — OAM (address space) — z/OS UNIX

OSR

?OSREQ

OSMC → LCS

FILE SYSTEM DELETE TASK

ZFS

NFS

- IBM Content Manger
- Customer Applications

OPTICAL TASKS

TAPE TASKS

FILE SYSTEM TASKS

FILE SYSTEM DRIVER

DB2

OPTICAL

TAPE

FILE SYSTEM

/zfsxxx
/nfsxxx

Storage Hierarchy Options (Options)

Applications

z/OS

OAM

Immediate Recall to DB2/FS

Transitions – Down & Up

DB2

zFS or NFS

Disk Cache

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

Data Ages – Less Frequently Accessed

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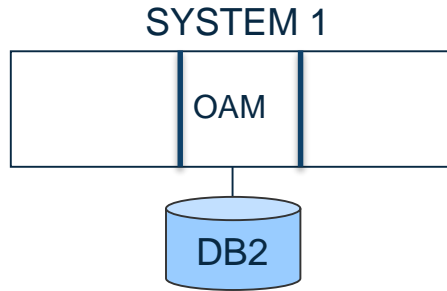
Non-OAMplex; one system sharing the data
(only one OAM address space per system)

SYSPLEX1/
OAMplex1

SYSTEM 1

OAM
1

DB2

OAM
3

SYSTEM 3 …

OAM
2
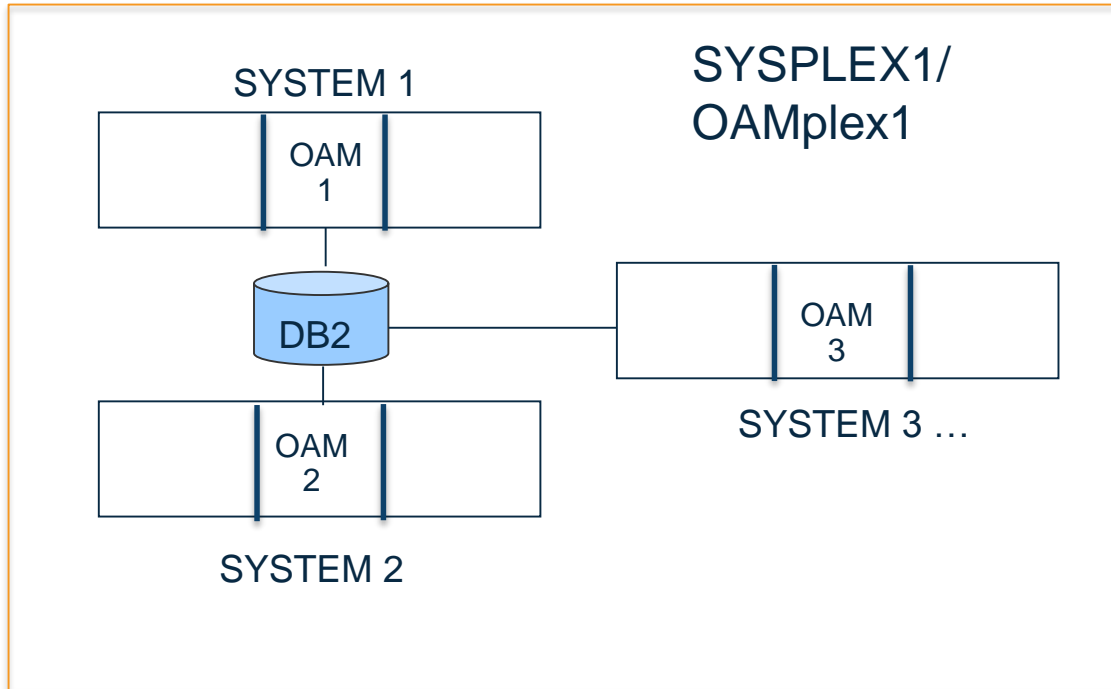
SYSTEM 2

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

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)
  - SETTLIB   (used with OAM's SMStape support – new with z/OS V2R1)

CBROAMxx PARMLIB member

- **SETOAM Command** processed during OAM initialization to establish the tape related values for the object tape support

- Parameters include
  - TAPEUNITNAME
  - DATACLASS
  - L2TAPEUNITNAME
  - L2DATACLASS
  - TAPECOMPACTION
  - 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

CBROAMxx PARMLIB member

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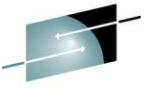 - L2DIR (file system mount point)
  - L2TYPE (ZFS or NFS)

Mount file system at mount point for the storage group

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

z/OS UNIX File System Hierarchy

/oam/ sg1/
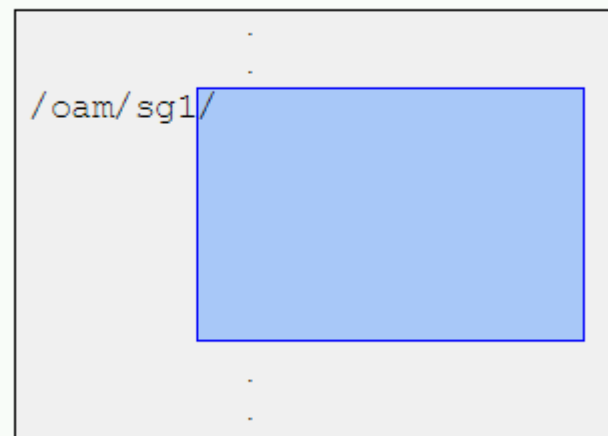
OAM File System Support Overview

SMS Storage Class Construct

```
            .
            .
Initial Access Response Seconds: 0
OAM Sublevel:                    2
            .
            .
```

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

Object Storage Database

Example Object Directory Entry (SG1)
ODNAME	ODLOCFL	ODINSTID
OBJECT1 ⋯	E	⋯ 572602

Example Object Directory Entry (SG2)
ODNAME	ODLOCFL	ODINSTID
OBJECT2 ⋯	E	⋯ 3971

"E" in ODLOCFL indicates OBJECT1 stored in SG1 *file system* sublevel and OBJECT2 stored in SG2 *file system* sublevel

CBROAMxx PARMLIB Member
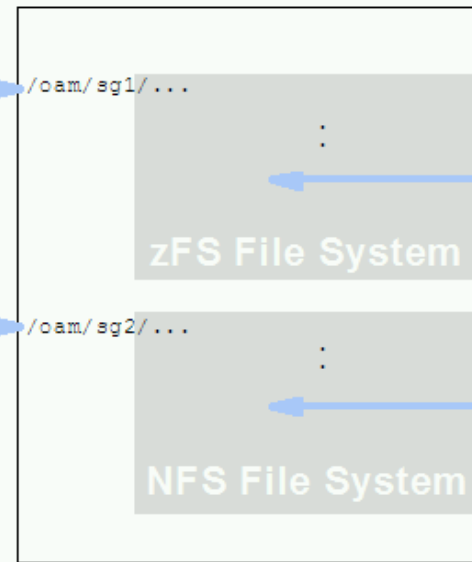
```
            .
            .
SETDISK STORAGEGROUP(SG1
            L2DIR(/oam/sg1)
            L2TYPE(ZFS))
            .
            .
SETDISK STORAGEGROUP(SG2
            L2DIR(/oam/sg2)
            L2TYPE(NFS))
```

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

```
/oam/sg1/...
            .
            .
```
zFS File System

```
/oam/sg2/...
            .
            .
```
NFS File System

OBJECT1 data was stored as a *file* in the *zFS* file system *mounted* at the directory location /oam/sg1 for storage group SG1

OBJECT2 data was stored as a *file* in the *NFS* file system *mounted* at the directory location /oam/sg2 for storage group SG2

OAM

OBJECT1
```
011000110100011010110101001
011010001010011010100010100
100010001101101110010001010
```

OBJECT2
```
001001100001011011001010010
001000110100101001011010010
111100100101111000100101000
            .
```

OAM Publications

- ✓ DFSMS Object Access Method Application Programmer's Reference (SC23-6865)

- ✓ DFSMS Object Access Method Planning, Installation, and Storage Administration Guide for Object Support (SC23-6866)

- ✓ DFSMS Object Access Method Planning, Installation, and Storage Administration Guide for Tape Libraries (SC23-6867)

Thank You !

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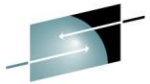
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