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DFSMS Object Support: Data Archiving with OAM

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9008



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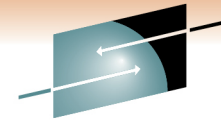
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DFSMS/OAM Main Functional Areas

OAM

“OBJECT” SUPPORT

OBJECT: unstructured data, 1 byte to 2000M

Access Method to store, access, and manage objects through life cycle.

Volume management for optical and tape removable media on which objects reside.

TAPE LIBRARY SUPPORT

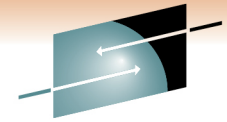
Central manager for tape libraries

- Interaction with many z/OS and DFSMS components
- Support to display/manage volumes/library
- Tape library-related interfaces (used internally/externally by multiple components/vendor products)
- Installation exits at key processing points during volume life cycle for tape management systems

What is OAM's Object Support?



- DFSMSdfp component (no separate license required)
- Access method used to store, retrieve, delete and manage **objects**
- Each object is a named byte stream.
 - no record orientation, no required structure, high volume, varying access-time requirements
- Objects can range in size from 1 byte to 2000 MB
- Each object identified by a two part name:
 - 1 to 44 character collection name
 - 1 to 44 character object name
- Object storage hierarchy consists of **disk (DB2 DASD or File System), optical and tape.**
- OAM provides an Application Programming Interface (API) called the **OSREQ** macro (Assembler macro).



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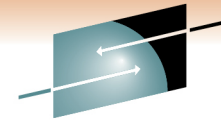
What is OAM's object support?

- Store and transition object data across the storage hierarchy (disk, optical and tape) based on storage management policies defined through SMS:
 - provide data movement, retention and expiration management (life cycle management of the objects and volume management of media)
 - objects can be directly stored to any level in the OAM storage hierarchy (don't have to transition from disk first)
 - provide support for up to 2 backup copies (with auto access to backups)

What are Benefits of OAM?

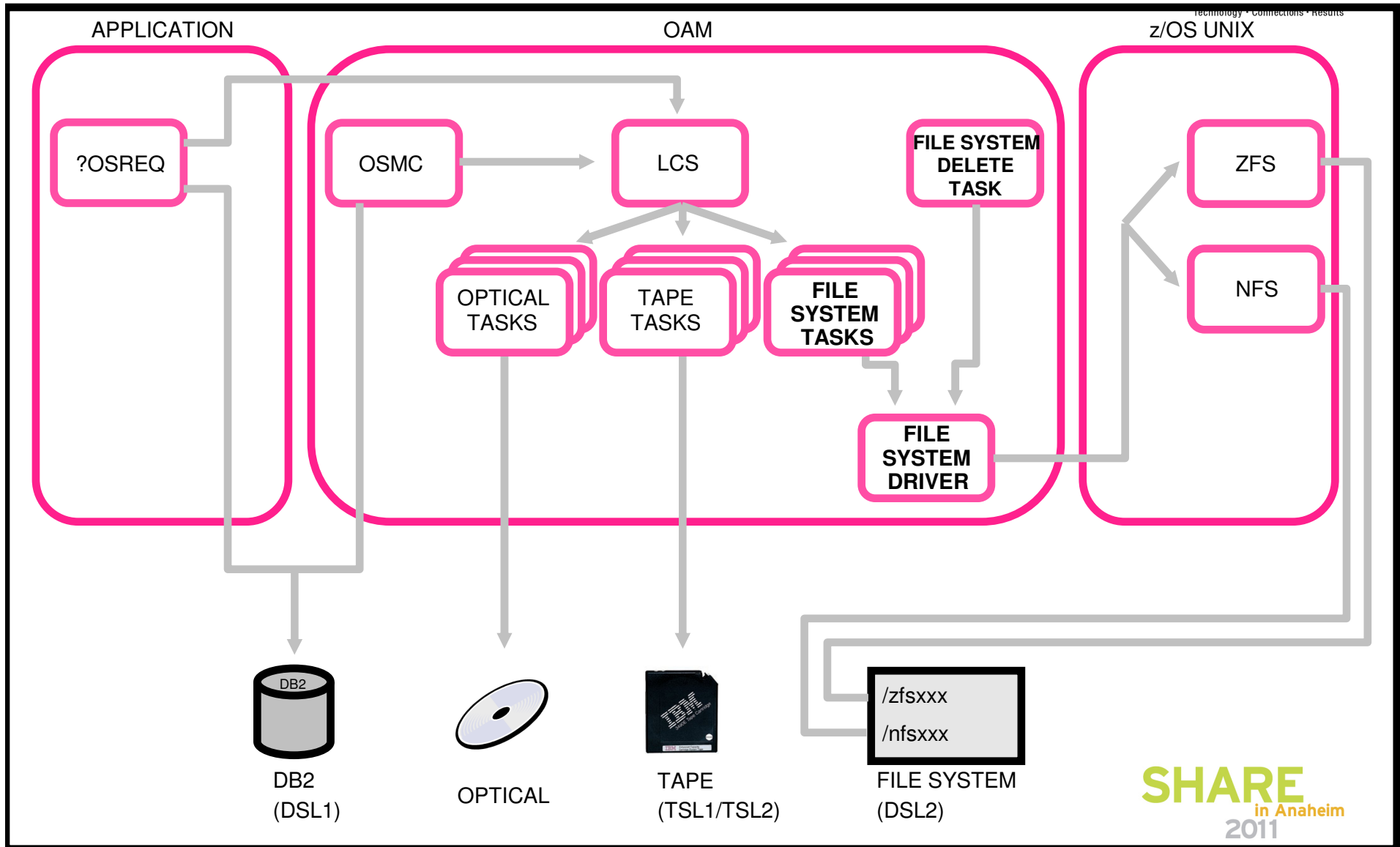


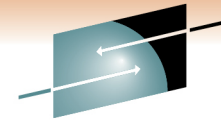
- Ability to store and manage extremely large quantities of data.
- Support for optical libraries on an MVS (z/OS) platform.
- Support for Write Once Read Many (WORM) optical media for permanent retention of legal records.
- Flexible storage hierarchy consisting of any combination of disk, optical and tape.
- Flexible rules for transition between levels in storage hierarchy.
- SMS-based management of the data from creation to expiration.
- Integrated backup and recovery facilities.
- Automatic access to backup data if primary unavailable due to media or library failures.
- Media management, expiration and recycle.
- Archive retention controls to ensure objects not changed or deleted.



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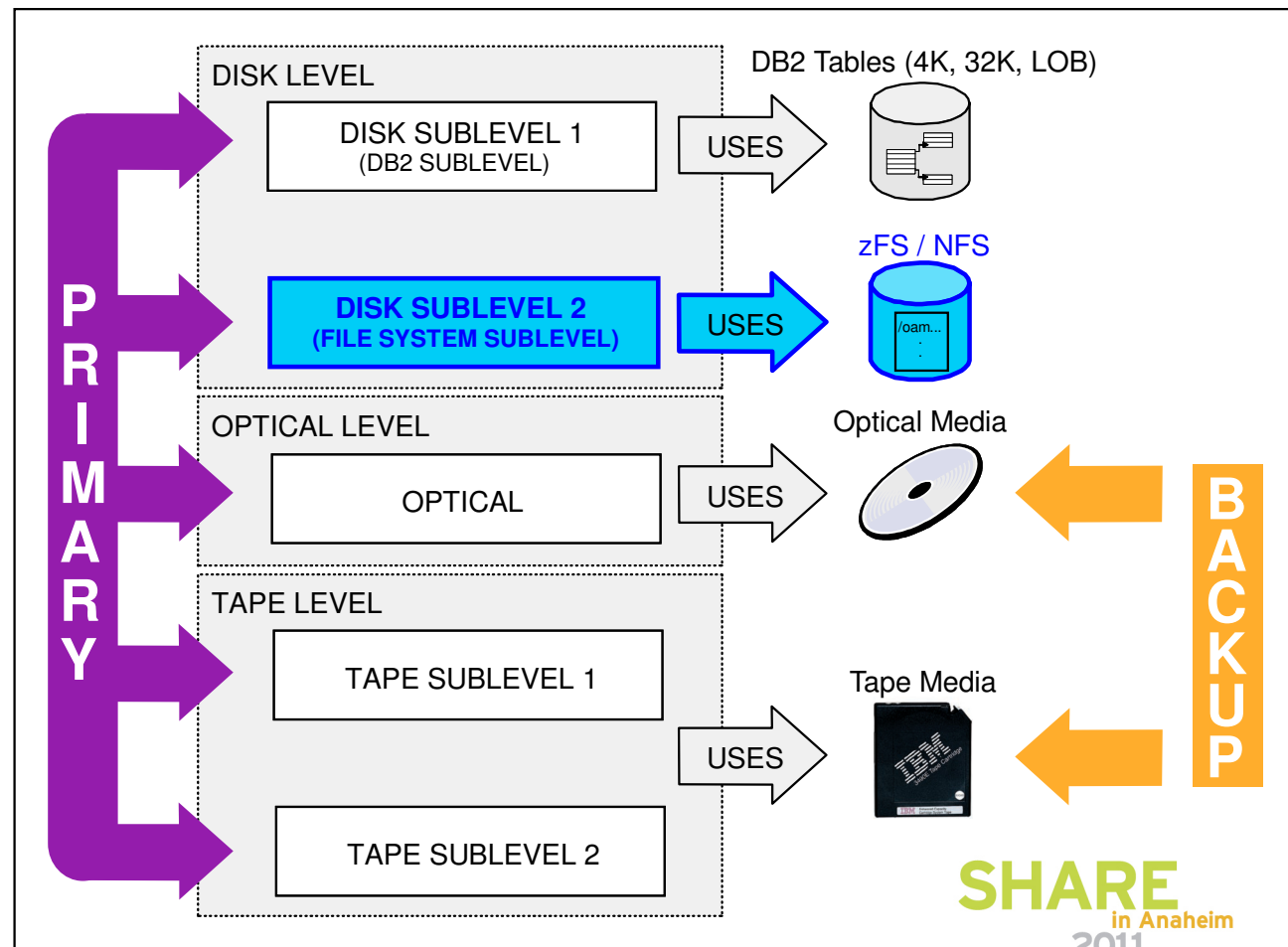
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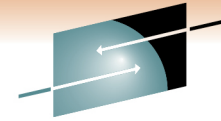




OAM Storage Hierarchy

- Disk Level
 - DB2/DASD sublevel
 - File System sublevel (*z/OS V1R13*)
- Optical Level
- Tape Level
 - Tape sublevel 1
 - Tape sublevel 2





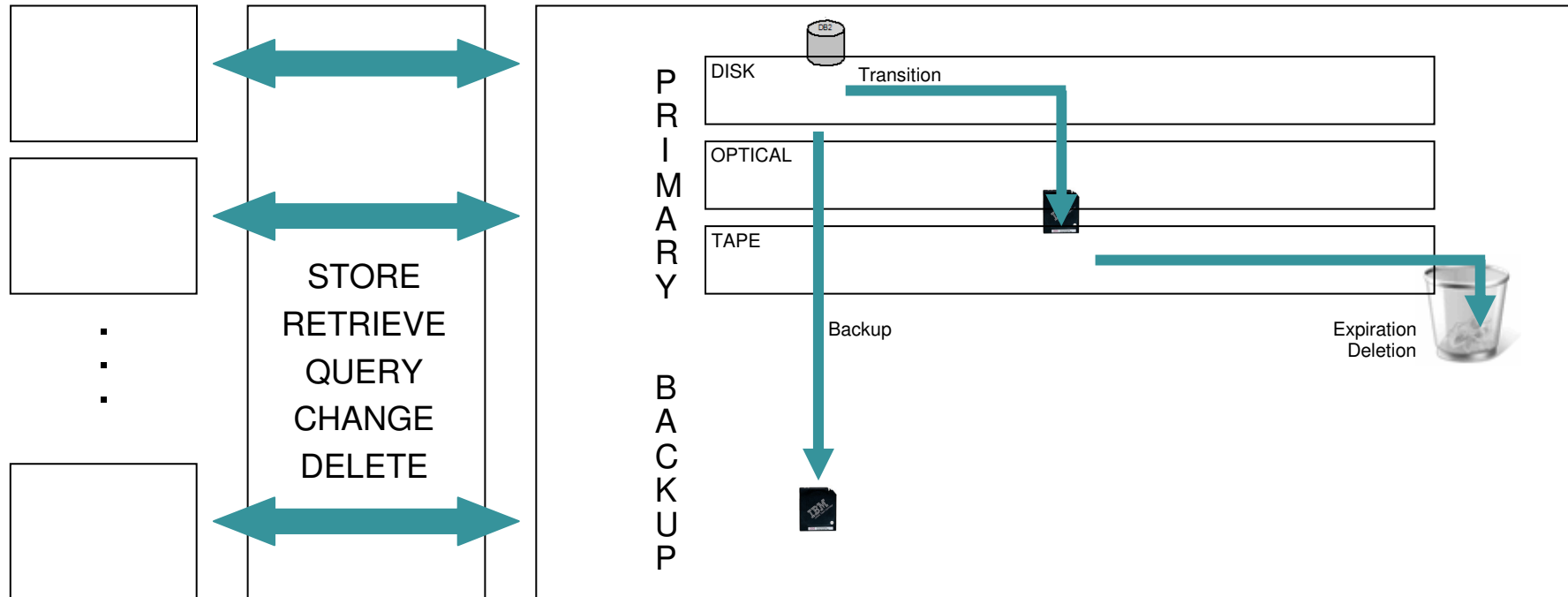
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OAM Object Support - Conceptual View

APPLICATIONS

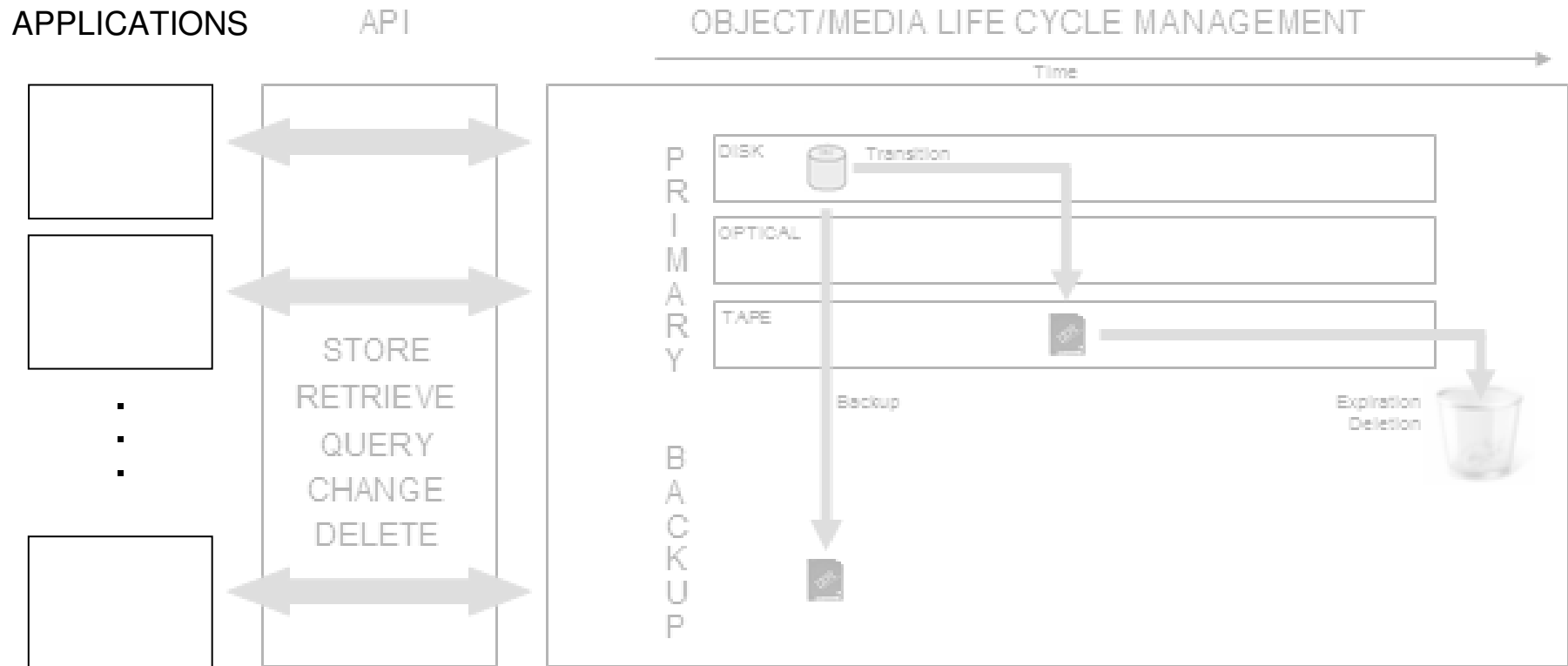
API

OBJECT/MEDIA LIFE CYCLE MANAGEMENT





OAM Object Support – Applications



Applications

- IBM DB2 Content Manager
- IBM DB2 Content Manager OnDemand
- IBM DB2 ImagePlus
- Vendor/Customer written

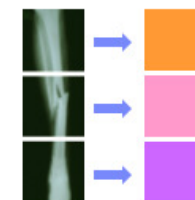
Application Environments

- MVS (Batch/TSO)
- CICS
- IMS

Approximately 50% of OAM customers use the IBM Content Management products

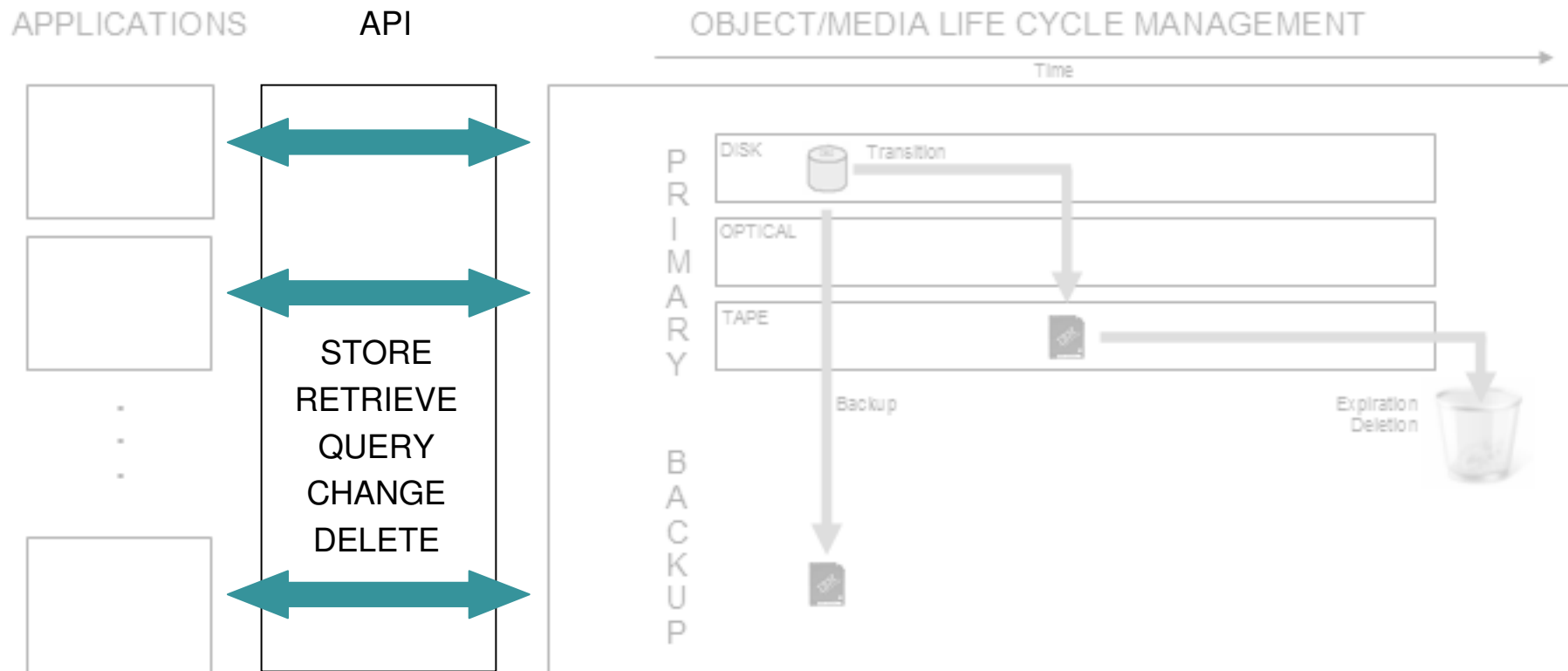
Application Data

- Documents, images, video, etc.



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OAM Object Support – OSREQ API



OSREQ – OAM Application Programming Interface (API)

STORE

- In entirety ($\leq 256M$)
- In parts ($> 256M$) – STOREBEG/STOREPRT/STOREEND

RETRIEVE

- All or part of an object
- Initiate Immediate Recall
- Primary or Backup View
- Automatic Access to Backup

QUERY

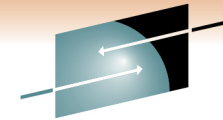
- Obtain information about objects

CHANGE

- SMS constructs associated with objects
- Retention

DELETE

- Manually delete objects



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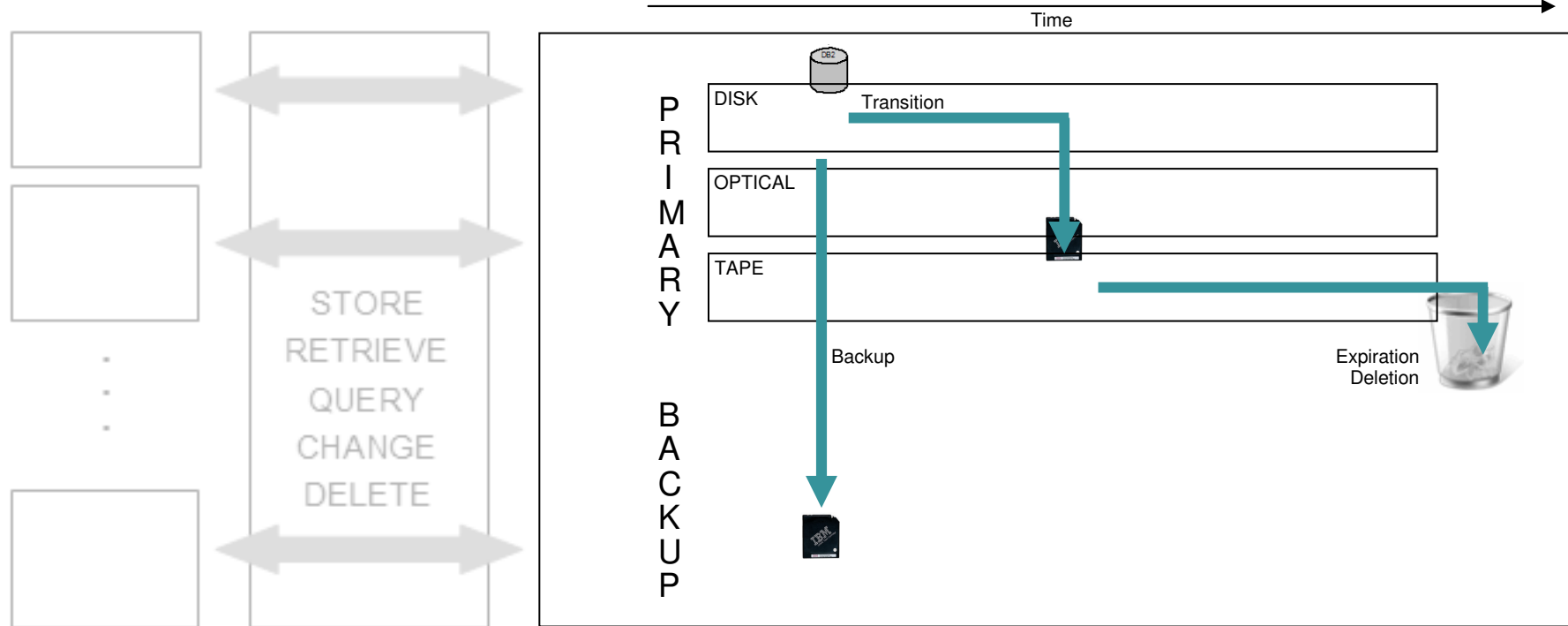
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OAM Object Support – Life Cycle Management and Functions/Utilities

APPLICATIONS

API

OBJECT/MEDIA LIFE CYCLE MANAGEMENT



Flexible OAM Storage Hierarchy with ISMF and OAM PARMLIB Configuration:

- Storage Group – configure hierarchy levels, object grouping
- Storage Class – which hierarchy level
- Management Class – duration

Can store directly to *any* level of the OAM hierarchy

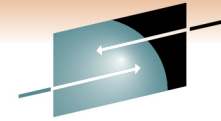
Life Cycle Management

- Objects: Transition, Backups (up to 2; optical/tape), Expiration, Deletion
- Media: Recycle

Functions/utilities:

- Storage Management Cycle
- Immediate Recall to Disk (OSREQ retrieve)
- Immediate Backup (following OSREQ store)
- Library Space Management
- DASD Space Management
- Volume Recovery
- Single Object Recovery
- Move Volume
- Recycle

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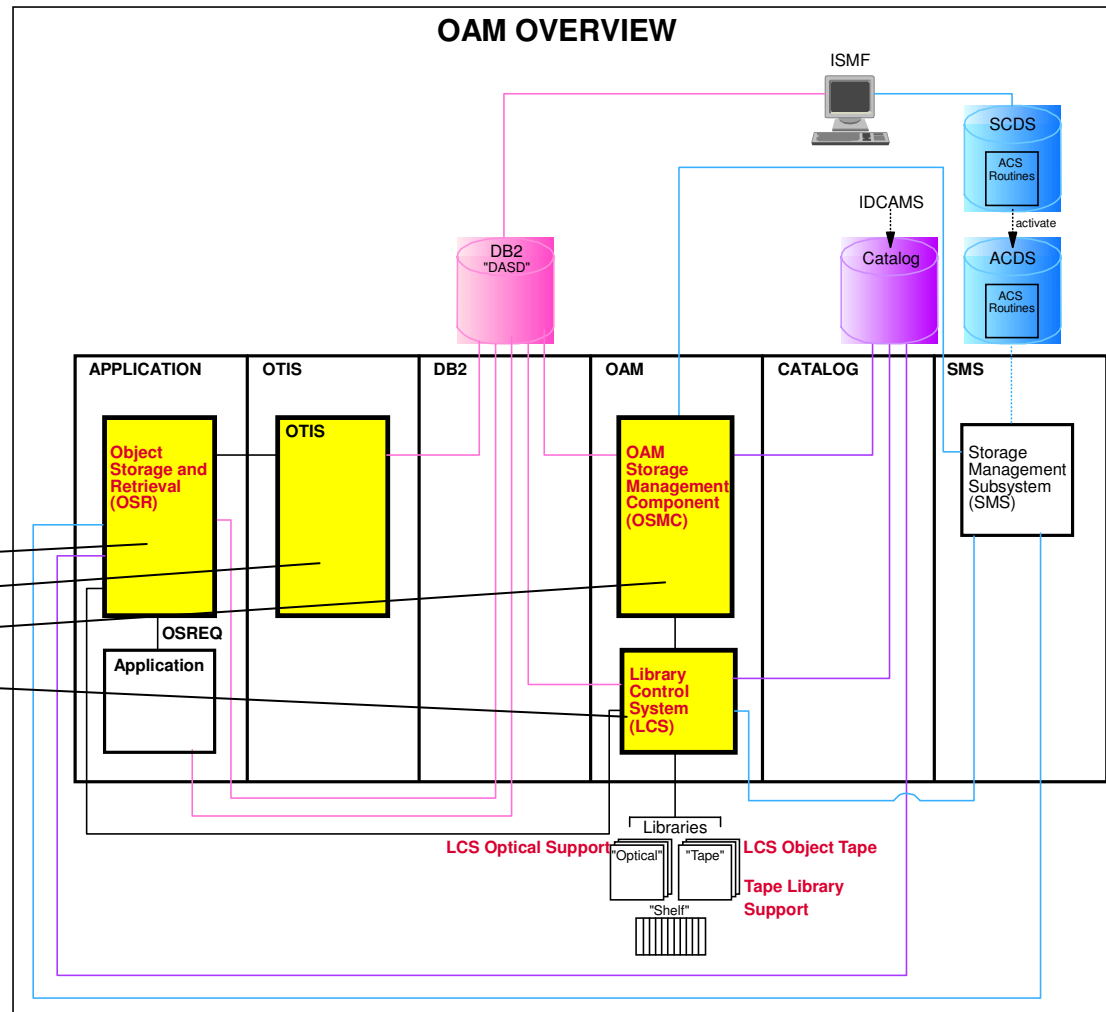
OAM Object Support - Architectural Overview

Uses DB2

- Meta-data
- Configuration
 - Library
 - Volume
- Object Storage
 - 4K
 - 32K
 - LOB

Subcomponents

- OSR
- OTIS
- OSMC
- LCS

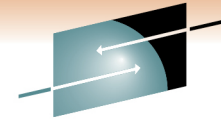


Uses SMS Constructs

- Storage Group
- Storage Class
- Management Class
- Data Class

Uses Catalog

- OAM Collection



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Terminology

- **OAM** - Object Access Method
 - **Object Support**
 - Tape Library Support
- **OSR** - Object Storage and Retrieval
 - Provides application interface into OAM via OSREQ API
- **LCS** - Library Control System
 - Provides removable media library management device support for optical and tape libraries *and file system*
- **OSMC** - OAM Storage Management Component
 - Provides storage management for objects
- **OTIS** – OAM Thread Isolation Support
 - Required for OSREQ API

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Object Storage Group



- 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) on DASD.
 - (optionally) A set of optical disk volumes.
 - (optionally) A set of tape volumes.
- 1 to 8 optical disk libraries can be associated with each OBJECT storage group.
- A tape unit name can be associated with the OBJECT storage group for primary copies written to tape.
- **OAM Deletion Protection and OAM Retention Protection status.**
- OBJECT storage groups defined to OAM/SMS via ISMF Storage Group Application.

Object Backup Storage Group



- Multiple Object Backup Storage Groups per system
- Used by OAM to contain the backup copy(s) of OAM objects.
- An OBJECT BACKUP storage group consists of:
 - A set of optical disk volumes.
 - A set of tape volumes.
- 1 to 8 optical disk libraries can be associated with an Object Backup storage group to have backup copies written to optical.
- **OR** a tape unit name can be associated with an Object Backup storage group to have backup copies written to tape.
- Object Backup storage groups defined to OAM/SMS via ISMF Storage Group Application.
- Object Backup storage groups associated with Object storage groups via SETOSMC statements in CBROAMxx member of PARMLIB
 - can have up to two backup copies, so up to two Object Backup storage groups can be associated with an Object storage group

OAM Collection



- Each collection catalogued in catalog via a non-vsam collection name entry.
- Each collection is recorded in Collection Name Table.
- Each collection is assigned:
 - to an Object storage group
 - collections cannot span storage groups
 - a default management class
 - a default storage class
 - by running the SMS Automatic Class Selection (ACS) routines.
- All objects in a collection are assigned the same management class and storage class unless explicitly overridden on the OSREQ STORE or OSREQ CHANGE invocation.

OAM Databases



- OAM maintains numerous DB2 databases

Object Storage Databases.

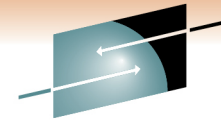
- Object Directory Table
- Object Data Tables
 - 4K, 32K Object Storage Tables, LOB Storage Structures

Object Administration Database.

- Management Class, Storage Class, and Collection Tables

OAM Configuration Database.

- Tape Volume, Library, Slot, Drive, Volume, and Deleted Objects Tables

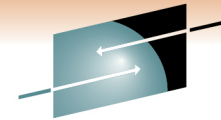


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OAM Archive Retention (z/OS V1R11)

- **Deletion-hold:** Prevent object deletion while object is in deletion-hold mode.
- **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.
 - **Note:** *RP in effect for life of object. If expiration date is ever set to 'forever' the object can never be deleted.*
- **Event-based-retention:** Object expiration date dependent on external event notification.
- CBRUXSAE and CBRHADUX user exits.

OSREQ Macro Interface



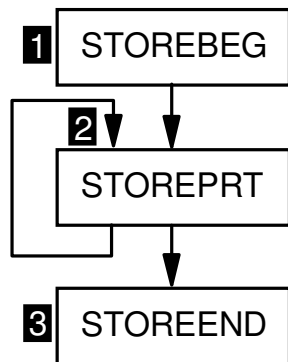
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- **Assembler macro that provides an Application Programming Interface (API) to OAM.**

- **< ACCESS >** Establish connection between application program and OAM.
- **< STORE > or <STOREBEG, STOREPRT, STOREEND >** Store an object into object storage.
- **< RETRIEVE >** Retrieve an object from object storage.
 - Retrieve full or partial object.
 - Retrieve from Primary or Backup view.
 - Initiate Recall to Disk.
 - Auto Access to Backup
- **< QUERY >** Obtain information about an object or objects.
- **< CHANGE >** Modify selected information for an object. Can change management class, storage class and retention criteria.
- **< DELETE >** Delete an object from object storage.
- **< UNACCESS >** Remove connection between application program and OAM.

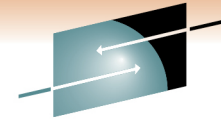
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OSREQ Store Sequence



- **New OSREQ API Function in z/OS V1R10**
 - New store sequence functions for objects >256 MB
 - **STOREBEG** to begin the store sequence
 - one or more **STOREPRT** to store each “part” of the object
 - **STOREEND** to end the sequence and complete the storage of the object or cancel the sequence
 - Only applications *exploiting* this support need to be changed
 - Application provides object to be stored in series of parts
 - Objects >256 MB retrieved using existing OSREQ RETRIEVE (*for a partial object*)

OSREQ TSO/E Command Processor



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- **Installation Verification Program tool. Invokes OSREQ to STORE, RETRIEVE, QUERY, CHANGE, DELETE, COMPARE.**

What are OAM Functions?



- Provide 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** utilities.

What are OAM Functions? (continued)



- Provide removable media (optical and tape) library management.
 - Read/write data from/to optical and tape media.
 - Optical and tape media migration/expiration/reclamation.
 - Provide cartridge entry/eject capability (optical and tape).
 - Vary online/offline for library drives (optical - tape indirectly).
 - Vary online/offline for libraries (optical and tape).
 - Display library/drive status (optical and tape).
 - Display volume status (optical and tape).
 - Update volume record information (optical and tapes used for objects).
- Statistics
 - SMF Records

OAM/SMS Relationships



- Each object assigned an SMS **management class** and **storage class**.
- **Management Class**
 - **RETENTION** attributes determine when object expires.
 - **AUTO BACKUP** parameter determines if object is backed up.
 - **NUMBER OF BACKUP VERSIONS** parameter determines the number (1 or 2) of backup copies created.
 - **BACKUP FREQUENCY** parameter determines when the first backup copy is created (ie. At object store time or during OSMC cycle).
 - **TRANSITION** attributes determine when primary copy of object transitions to new management and/or storage class.

OAM/SMS Relationships



- **Storage Class**
 - **INITIAL ACCESS RESPONSE SECONDS (IARS)** determines if an object resides on disk or removable media.
 - IARS = 0, object resides on **disk**
 - IARS non-zero, object resides on removable media
 - **SUSTAINED DATA RATE (SDR)** determines if removable media is tape or optical.
 - SDR < 3, object resides on **optical**.
 - SDR ≥ 3, object resides on **tape**.
- **OAM SUBLEVEL (OSL)**
 - OSL = 1, object resides on Sublevel 1
 - OSL = 2, object resides on Sublevel 2

OAM/SMS Relationships



- **Data Class**
 - **Primarily used to steer allocation request into IBM Tape Library.**

OAM/SMS Relationships



- **ACS Routines**

- **Storage Group** (STORE, ALLOC)
- **Management Class** (STORE, CHANGE, CTRANS)
- **Storage Class** (STORE, CHANGE, CTRANS)
- **Data Class** (ALLOC)

Note: ACS routines not run on OSREQ STORE if MC and SC values are pulled from Collection entry in catalog.

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

- EXIT ADD EXITNAME(CBRUXTVS_EXIT) MODNAME(ARCTVEXT)
STATE(ACTIVE)

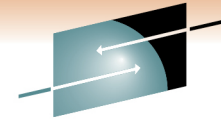
- **OAM** Proclib Member

- //OAM PROC
OSMC=YES,MAXS=2,UNLOAD=9999,EJECT=LRW,REST=YES,OAM=xx,

- **CBROAMxx** Parmlib Member

- SETOAM
- SETOPT
- SETOSMC
- OAMXCF
- SETDISK (z/OS V1R13)

CBROAMxx PARMLIB Member



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

– SETOAM parameters include:

- **TAPEUNITNAME**
- DATACLASS
- L2TAPEUNITNAME
- L2DATACLASS
- TAPECOMPACTION
- DEMOUNTWAITTIME
- TAPEEXPIRATION
- TAPEFULLTHRESHOLD
- MAXTAPERETRIEVETASKS / SGMAXTAPERETRIEVETASKS
- MAXTAPESTORETASKS / SGMAXTAPESTORETASKS
- TAPEDRIVESTARTUP
- TAPEDISPATCHERDELAY
- MOUNTWAITTIME
- MAXRECYCLETASKS
- TAPERECYCLEMODE
- DSNWITHSGNAME

CBROAMxx PARMLIB Member (continued)



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

–SETOPT parameters include:

- OPTICALREINITMODE
- OPTICALDISPATCHERDELAY
- SCRATCHENTRYTHRESHOLD
- MOUNTWAITTIME
- UNLOADDRIVES
- UNLOADTIMER
- ABUNREAD
- ABOFFLINE
- ABNOTOPER
- ABDB2ERROR
- ABLOST
- ABFSERROR
- ABALL
- MULTISYSENABLE

CBROAMxx PARMLIB Member (continued)



- **SETOSMC** Command processed during OAM initialization to establish the Storage Management related values for object support.

–SETOSMC parameters include:

- FIRSTBACKUPGROUP
- SECONDBACKUPGROUP
- CYCLEWINDOW
- MAXRECALLTASKS
- RECALLOPTICAL
- RECALLTAPE
- RECALLALL
- RECALLNONE
- CLEAROLDLOC
- RECALLOFF
- RECALLDISKSUBLEVEL

CBROAMxx PARMLIB Member (continued)



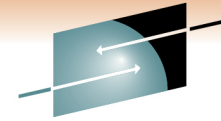
- **OAMXCF** commands processed at OAM initialization to establish OAMplex related values.
 - OAMXCF parameters can be specified at Global level only.
 - OAMXCF parameters cannot be modified dynamically.
 - OAMXCF parameters include:
 - OAMGROUPNAME
 - OAMMEMBERNAME
 - XCFTIMEOUT
 - XCFOPTREADA
 - XCFOPTREADM
 - XCFOPTWRITEA
 - XCFOPTWRITEM
 - XCFTAPEREADA
 - XCFTAPEREADM

CBROAMxx PARMLIB Member (continued)



- **SETDISK** commands processed at OAM initialization to establish disk related values.
 - SETDISK parameters can be specified at storage group level only.
 - SETDISK parameters cannot be modified dynamically.
 - SETDISK parameters include:
 - L2DIR (z/OS V1R13)
 - L2TYPE (z/OS V1R13)

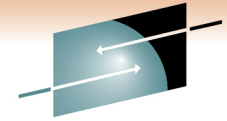
Object Storage Database - Metadata



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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
Object Active Volser	ODLSLOC/ODSECLOC
1 st Backup Copy Volser	ODBKLOC/ODBKSEC
2 nd Backup Copy Volser	ODBK2LOC/ODBK2SEC
Object Status Flags	ODSTATF
Retention Protect Date	ODRETDT
OAM FS Instance ID	ODINSTID



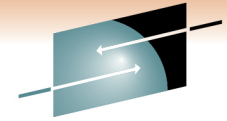
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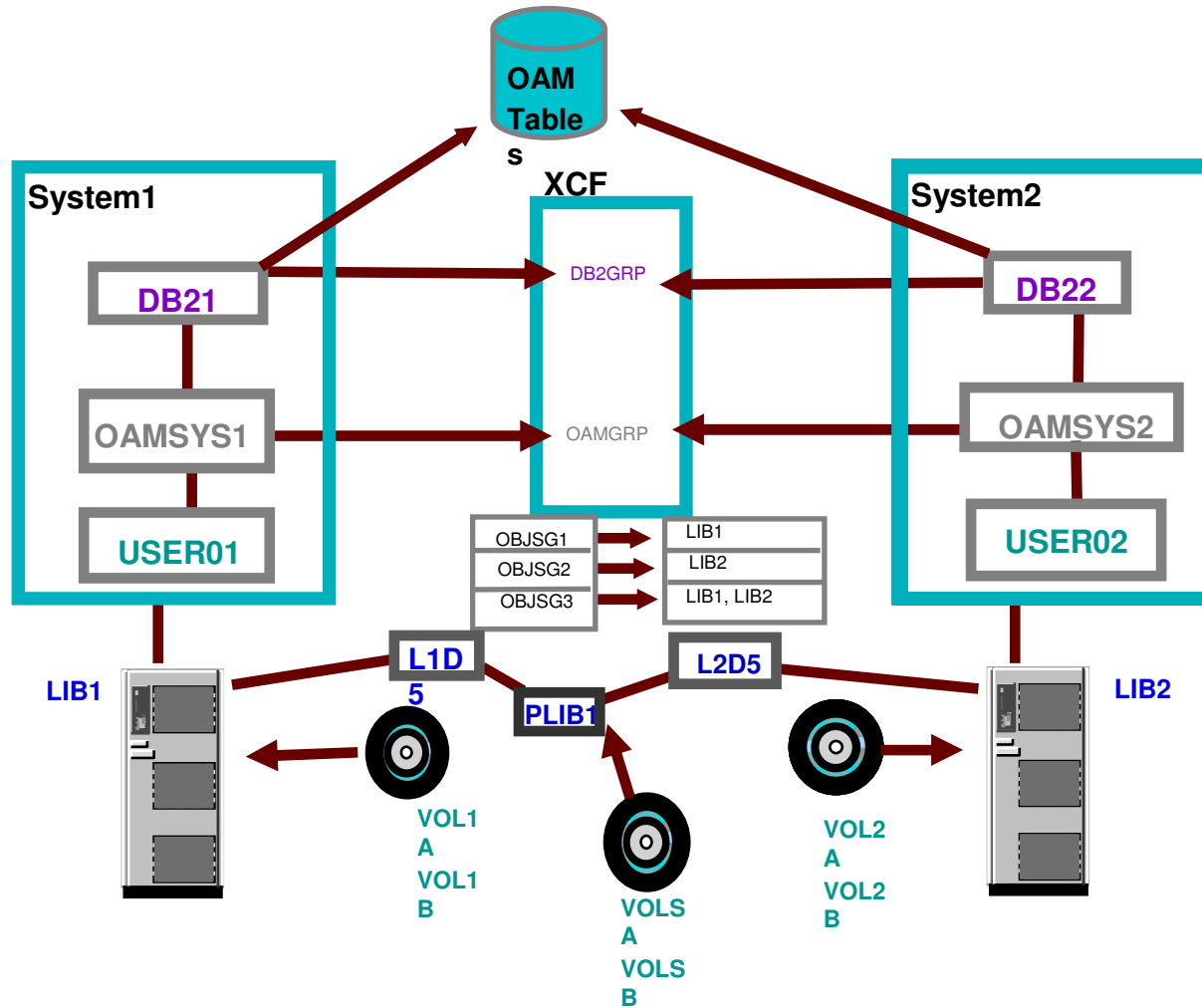
OAMplex Support

- OAM supports the parallel sysplex environment:
 - Using DB2 datasharing for all DB2 tables
 - When all OAMs connected to DB2s that belong to the same DB2 datasharing group and all OAMs belong to the same XCF group
 - Shared configuration
 - Shared objects
 - Communications via coupling facility
 - Optical reads and writes may be shipped cross-system
 - Tape reads may be shipped cross-system
 - Tape writes always done on system where requested

Example of an OAMPLEX



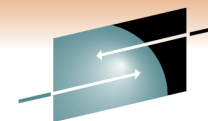
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Appendix



- *z/OS DFSMS Object Access Method (OAM) Planning, Installation, and Storage Administration Guide for Object Support, SC35-0426*
- *z/OS DFSMS Object Access Method (OAM) Application Programmer's Reference, SC35-0425*
- *z/OS DFSMSdfp Diagnosis Reference, GY27-7618*
- *z/OS System Messages Vol 4 (CBD-DMO) , SA22-7634*
- *z/OS Migration Guide, GA22-7499*
- *z/OS DFSMS Using the New Functions, SC26-7473*
- *z/OS DFSMSdfp Storage Administration, SC26-7402*



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