PDS, PDSE, GDG, HFS, USS and Other Strange z/OS Animals

A Trip Through the Mainframe Menagerie

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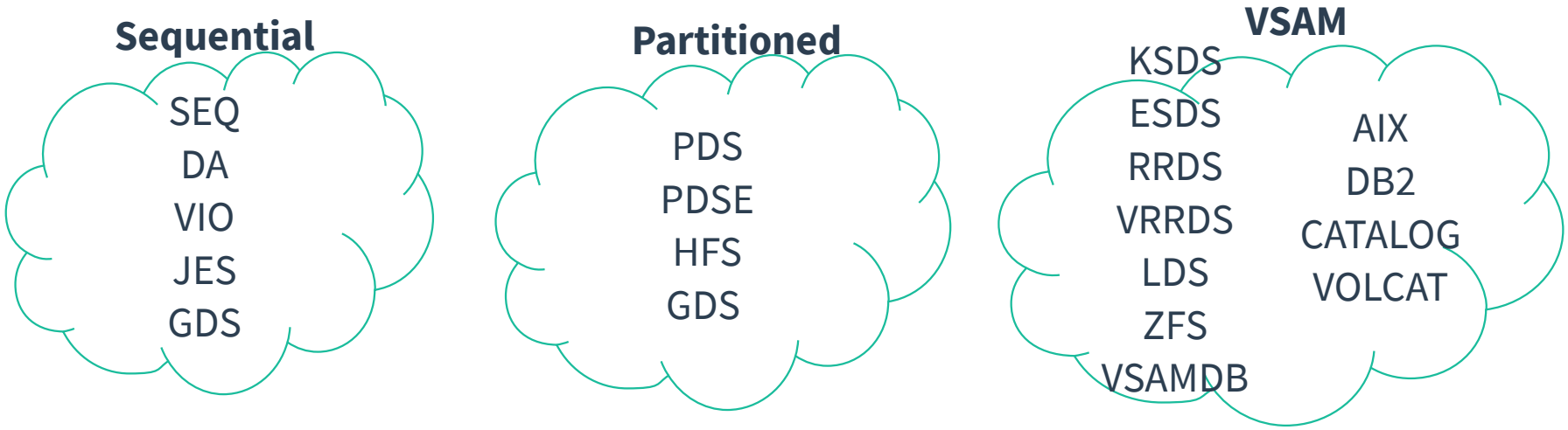
Many Different Dataset Types

- Types of z/OS Dataset Organization



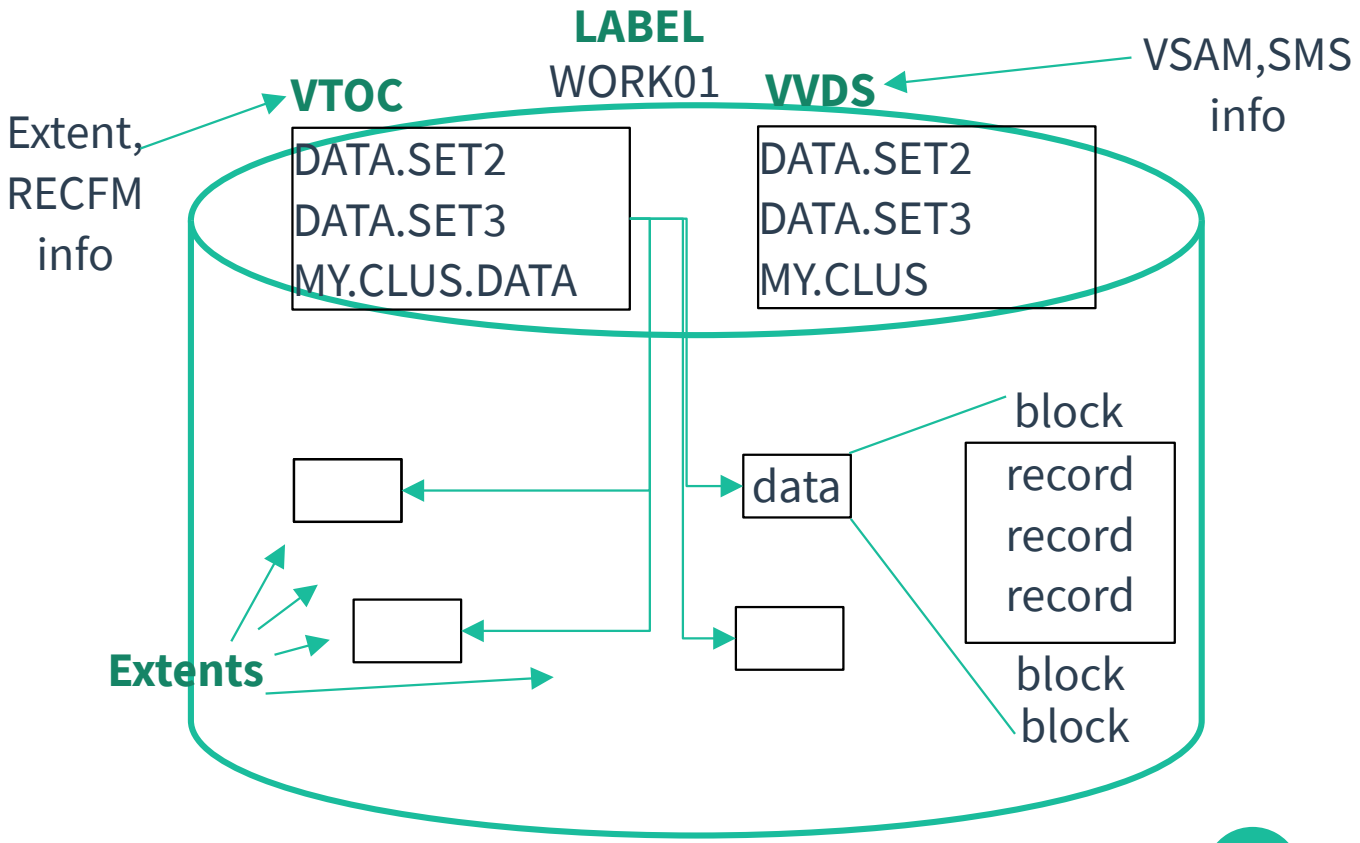
- Different Access Methods
  - QSAM, BSAM, BDAM, BPAM, VSAM, DIV, OAM, shell

How Data is Stored on z/OS DASD

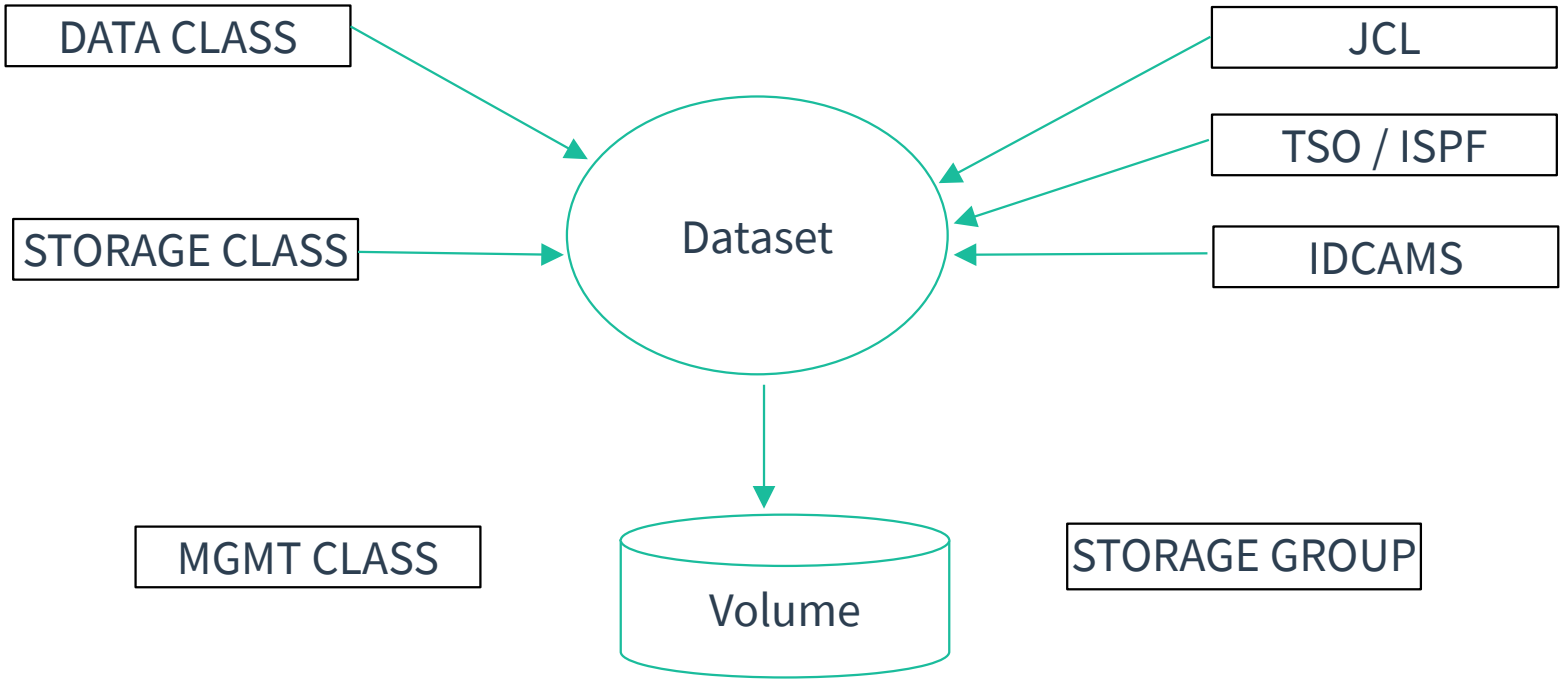
Catalog

DSN	VOLSER
DATA.SET1	TSO001
PAYROLL.X	TSO002
MY.DS.ONE	CICS04
DATA.SET2	WORK01
DATA.SET3	WORK01
MY.CLUS	
MY.CLUS.DATA	WORK01
MY.CLUS.INDEX	WORK02
...	

Maximum 59 vols per dataset



Dataset Attributes and System Managed Storage



Terms – RECFM, LRECL, BLKSIZE

- **RECFM – Record Format**
  - Fixed – all records are equal length, may be blocked
  - Variable – records and blocks preceded by RDW and BDW
  - Undefined – records of varying lengths (usually load modules)
  - Unix (USS) files – can be treated as records, text or binary stream
- **LRECL - Logical Record Length – length of all (or largest) record**
- **BLKSIZE – Length of a block (one or more records)**
  - Blocking factor = no. of records per block

`RECFM=F/FB/FBS`

`RECFM=V/VB/VBS`

`RECFM=U`

`FILEDATA=`

`LRECL=`

`BLKSIZE=`

Terms – DSORG and Access Method

- **Sequential Organization**
  - DSORG = PS / PSU
  - DSORG = DA
- **Partitioned Organization**
  - DSORG = PO
- **VSAM**
  - RECORG = KS / ES / RR / LD
- **zFS or HFS**

Access Method

QSAM – read/write records
BSAM – read/write blocks
BDAM – read/write blocks
BPAM – read/write directory
BSAM – read/write blocks
VSAM – read seq, by key, direct, et al
BSAM/QSAM/VSAM read/write
USS services

Access Method calls

OPEN/CLOSE
GET/PUT
READ/WRITE
many more

Dataset Organization: Sequential Data Sets

- Sequential Data Sets

DSORG=PS / PSU / DA

  - **BASIC**
    - Ordinary sequential dataset, 16 extents per volume, max 65,535 trks ***total*** size
  - **LARGE**
    - May exceed 65,535 tracks (to 16,777,215 trks per volume)
  - **EXTENDED FORMAT (*STRIPED*)**
    - May exceed to 65,535 tracks. Up to 123 extents per volume.
    - From one to 59 stripes (volumes). The stripes are read/written *in parallel*
    - 32-byte 'invisible' block suffix for each block

Version 1 – original suffix
Version 2 – FLASHCOPY suffix

PREFERRED or REQUIRED

Dataset Organization: Partitioned Data Sets

- **Partitioned Data Sets**

DSORG=PO, DSNTYPE=, SPACE=(**dir**, pri, sec)

  - **PDS**
    - Directory and members. Directory size is fixed when created, directory is alphabetical.
    - 16 extents per volume, single volume, limited to 65,535 trks
  - **LIBRARY (PDSE)**

Version 1 – original format
Version 2 – Member Generations

    - Directory and members. Directory is expandable and indexed. Internally, all 4K blocks
    - 123 extents per volume, single volume, may exceed 65,535 tracks

PREFERRED or REQUIRED

If no DSORG and no directory, SPACE, then IGDSMSxx HONOR_DSNTYPE_PDSE determines format (PS/PDSE)

PDSE Member Generations

- **JCL Keywords**
  - MAXGENS= (default 0)
  - REFDD= copy Member Generations limit from referenced dataset
- **Systemwide MAXGENS limit specified in IGDSMSxx**
- **IEBCOPY does not copy Member Generations**
  - Use DFSMSdss dump/restore instead
  - TSO XMIT and IDCAMS REPRO also copy *only the most recent generation*

Dataset Organization – DSNTYPE=

- BASIC
- LARGE
- EXTREQ / EXTREQ(1) / EXTREQ(2)
- EXTPREF / EXTPREF(1) / EXTPREF(2)
- PDS / LIBRARY / LIBRARY(1) / LIBRARY(2)
- HFS
- PIPE

Dataset Organization: HFS

- **Hierarchical File System Dataset** DSORG=PO, DSNTYPE=HFS, SPACE=(**dir**, pri, sec)
  - **HFS**
    - Collection of files and directories, accessible by USS
    - 4K block structure with attribute and name directories and subdirectories
    - **Deprecated** (use VSAM zFS), cannot be copied via IEBCOPY
    - 16 extents per volume, single volume, limited to 65,535 trks

If no DSORG and no directory, SPACE, then IGDSMSxx HONOR_DSNTYPE_PDSE determines format (PS/HFS)

Generation Data Groups and Generation Data Sets

- **GDG (DSN=MY.GDG)**
  - Collection of like-named non-VSAM datasets (sequential or PDS/PDSE)
    - Catalogued in a ‘sphere’ record, so that JCL need not change
    - Generations kept in chronological order, and automatically deleted as necessary
  - Reference by relative (or absolute) generation number
  - GDG ‘Base name’ refers to all datasets in the collection (‘GDG-all’)
- **GDS (DSN=MY.GDG(+1) DSN=MY.GDG.G0001V00)**
  - An individual generation – may be ACTIVE, DEFERRED, or ROLLED OFF
  - Absolute *version numbers* can be used to replace generations

DEFINE GDG Attributes

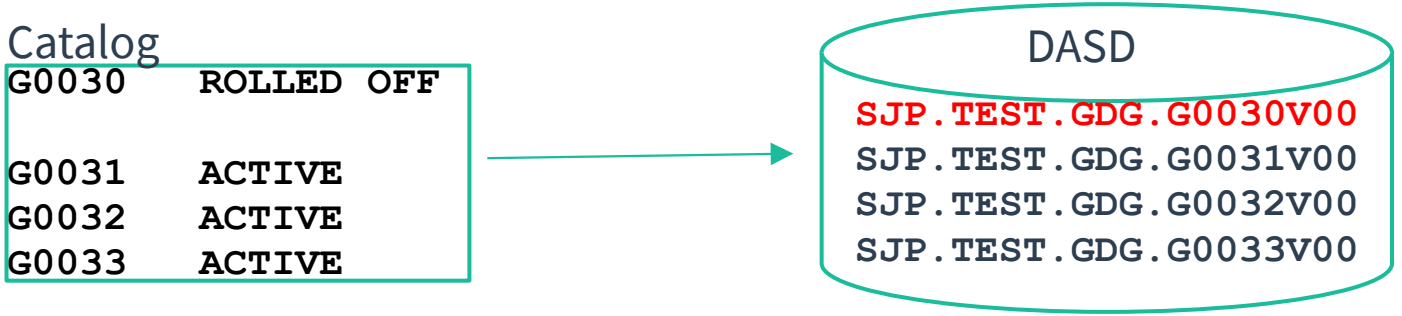
- IDCAMS DEFINE GDG(base-name) LIMIT(1-999)

```
EXTENDED/NOEXTENDED - more than 255 gens?
EMPTY/NOEMPTY       - remove all gens when over LIMIT?
SCRATCH/NOSCRATCH   - scratch from DASD (not tape) at EMPTY time?
PURGE/NOPURGE       - delete at scratch time even if unexpired
FIFO/LIFO           - read order for GDG-all
(GDGORDER JCL parm)
```

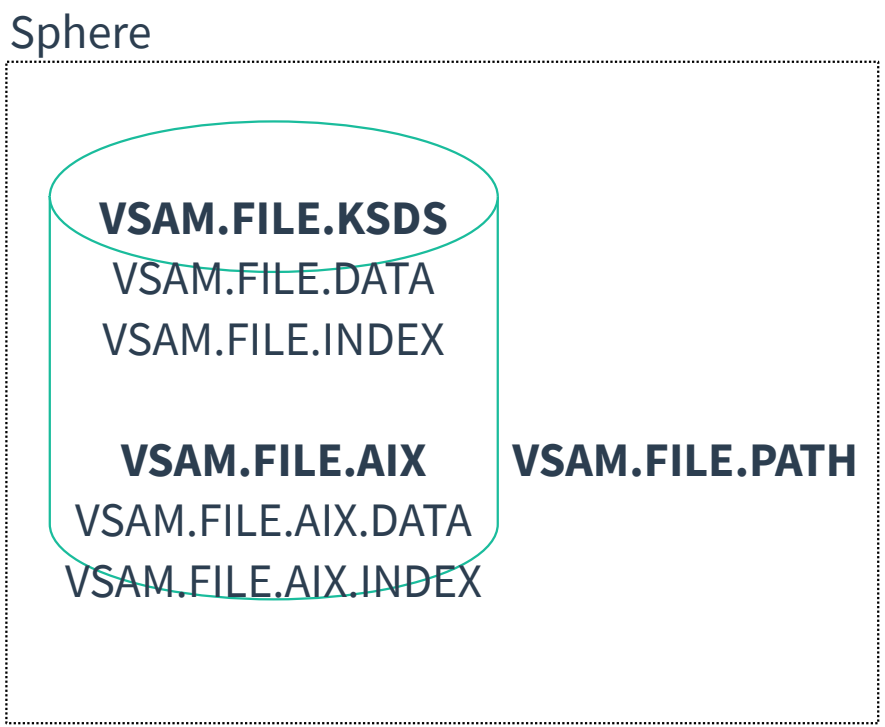
GDG and GDS Processing

```
//DEFGDG EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
 DEF GDG(NAME(SJP.TEST.GDG)   LIMIT(3) )
```

```
// EXEC PGM=SOMEPGM
//DD1 DD DSN=SJP.TEST.GDG(+1),UNIT=SYSALLDA,SPACE=(TRK,1),DISP=(,CATLG)
//DD1 DD DSN=SJP.TEST.GDG(+2),UNIT=SYSALLDA,SPACE=(TRK,1),DISP=(,CATLG)
//DD1 DD DSN=SJP.TEST.GDG(+3),UNIT=SYSALLDA,SPACE=(TRK,1),DISP=(,CATLG)
//DD1 DD DSN=SJP.TEST.GDG(+4),UNIT=SYSALLDA,SPACE=(TRK,1),DISP=(,CATLG)
```



VSAM Clusters, Components, and Attributes



- **KSDS**
  - Records in key order
  - Multiple components per cluster
- **ESDS**
  - Records in sequential order, access by RBA
  - USS files treated as ESDS by VSAM access meth
- **RRDS**
  - Access by record number; fixed or variable
- **LINEAR**
  - 4K unstructured blocks, access via DIV
  - **DB2** datasets are linear datasets
  - **zFS** datasets are linear datasets

VSAM Data Class Attributes

- **Defaults**
  - Maximum 123 extents per volume, 255 extents total, 4GB max size
- **Extended Format (Striped)**
  - Volumes written in parallel
  - Allows PARTREL and SMB
- **Extended Addressability**
  - Can exceed 4G in size
- **Extent Constraint Removal**
  - Can exceed 255 extents (total max = 123*59 = 7257 extents)

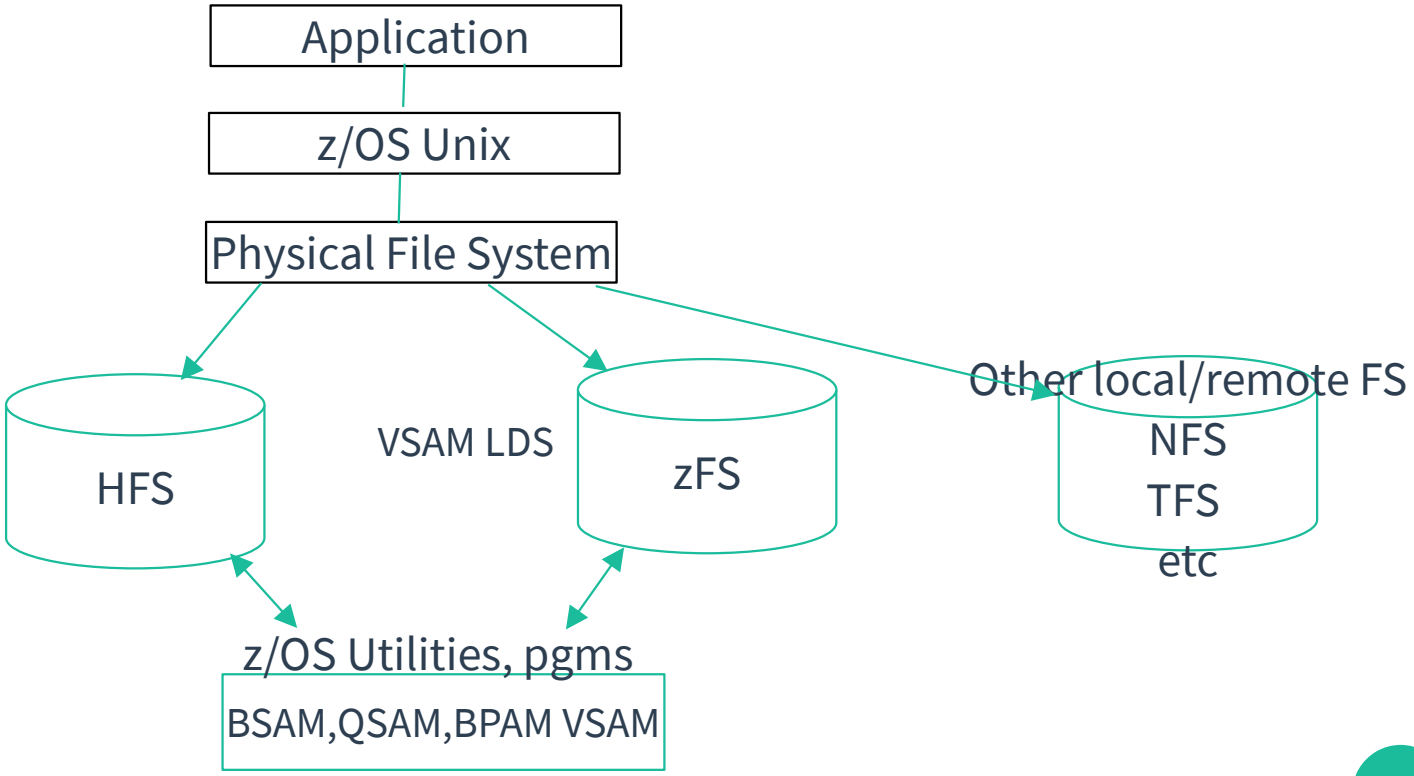
VSAMDB – BSON and JSON (UTF-8)

- NoSQL (Non-relational) Database
  - key: value document store
  - using VSAM KSDS RLS
- Key length/location not fixed, objects can vary in format
- Documents can span VSAM records/CA
- Max record length = 2G
- Allows access by modern APIs

```
DEFINE CLUSTER
   DATABASE(BSON/JSON)   KEYNAME/KEYNAMEU(keyname)
```

USS Datasets – HFS and zFS

- 4K blocks
- directory
- Data Pages

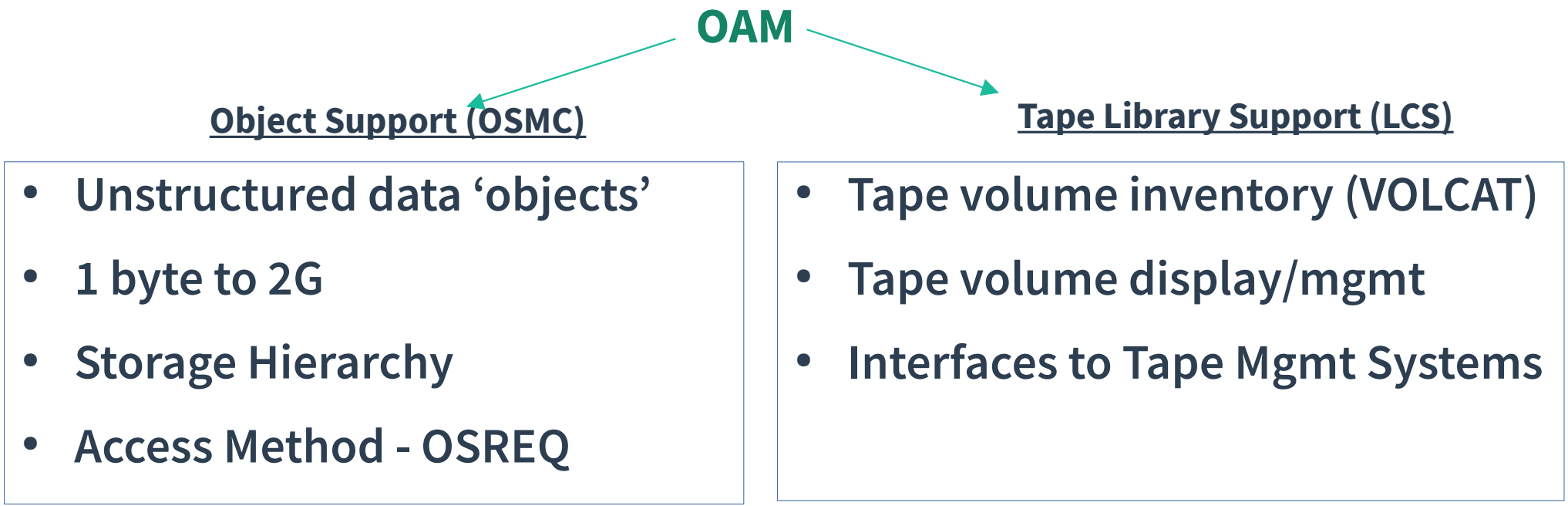


Copying z/OS Data to/from USS (zFS or HFS)

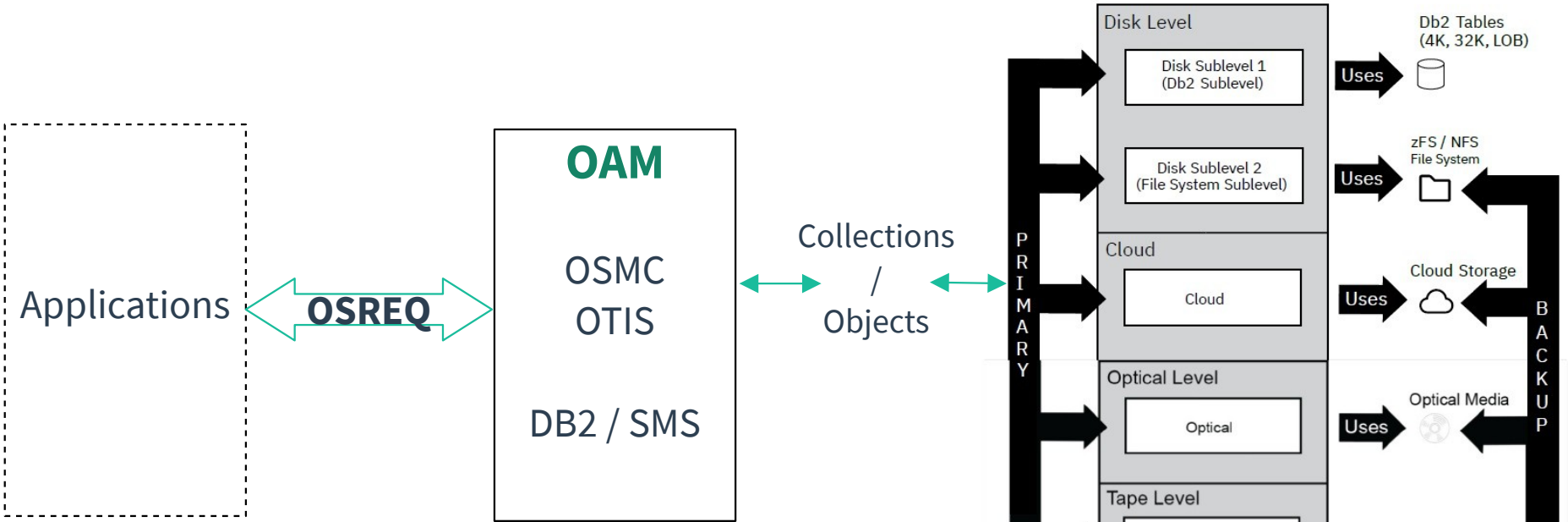
- Unix ‘cp’ or ‘mv’ shell commands
  - `cp "//'STEVE.TEST.TEXT'" steve.new.text`
- TSO Commands
  - OPUT / OPUTX / OGET / OGETX / OCOPY
- PATH, PATHDISP, PATHMODE, PATHOPTS
- FILEDATA

```
//COPYDMP  EXEC PGM=IKJEFT01
//SYSTSPRT DD SYSOUT=*
//TARGET   DD PATH='/u/ibmuser/customer.dump.tersed',
//            PATHDISP=(KEEP,DELETE),
//            PATHOPTS=(OCREAT,ORDWR),
//            FILEDATA=BINARY
//SOURCE   DD DSN=CUSTOMER.DUMP.TERSED,DISP=SHR
//SYSTSIN DD *
 OCOPY INDD(SOURCE) OUTDD(TARGET)
```

DFSMS / OAM


OAM
Object Support (OSMC)
Tape Library Support (LCS)
• Unstructured data ‘objects’
• 1 byte to 2G
• Storage Hierarchy
• Access Method - OSREQ
• Tape volume inventory (VOLCAT)
• Tape volume display/mgmt
• Interfaces to Tape Mgmt Systems

OAM Access Method and Storage Hierarchy



Attributes for All Types of Datasets

- **COMPACTION (Data Class attribute)**
  - YES/NO – do/do not compress; default compression type in IGDSMSxx
  - GENERIC – use ‘dictionary building block’ algorithms in SYS1.DBBLIB
  - TAILORED – use dataset-specific compression (sequential datasets only)
  - ZEDC – use zEDC hardware compression
- **Encryption**
  - Dataset key label specified in RACF, JCL **DSKEYLBL=**, or Data Class
  - Compression is performed *first*
  - Almost all types of datasets
    - Sequential EF always Version 2; no BDAM or BLKSIZE < 16

IGDSMSxx Defaults

- **DSNTYPE(LIBRARY / PDS / HFS)**
  - Default for dataset with no DSNTYPE but with directory space specified
- **HONOR_DSNTYPE_PDSE(YES / NO)**
  - create PDS/HFS even if no DSORG and no directory blocks, otherwise create PS
- **MAXGENS_LIMIT(0-2,000,000)**
  - Maximum value that can be specified in JCL
- **PDSE_VERSION(1 / 2)**
  - Default version for DSNTYPE=LIBRARY
- **PS_EXT_VERSION(1 / 2)**
  - Default version for sequential EF
- **USEEAV(YES/NO)**

IGGCATxx GDG Defaults

- **GDGEXTENDED(YES/NO)**
  - Allow or disallow EXTENDED operand
- **GDGFIFOENABLE(YES/NO)**
  - Allow or disallow FIFO operand
- **GDGPURGE(YES/NO)**
  - Default fort PURGE operand
- **GDGSCRATCH(YES/NO)**
  - Default fo SCRATCH operand

Documentation

- **Research**
  - **z/OS Basic Skills Information Center - z/OS concepts**
  - DFSMS Using Data Sets SC23-6855

- **Redbooks**
  - ABCs of z/OS System Programming – Volumes 1-13 (Volume 3 = *DFSMS*)
  - z/OS Distributed File Service zSeries File System Implementation z/OS V1R13 SG24-6580
  - Hierarchical File System Usage Guide SG24-5482 (archived)

- **Reference**
  - MVS Initialization and Tuning Reference SA23-1380
  - MVS JCL Reference SA23-1385
  - DFSMS Object Access Method Planning, Installation, and Storage Administration Guide for Object Support SC23-6866

Summary / Q and A

- Next webinar planned for Sept. 28, 2021, 11:00AM Eastern

Can You Keep a Secret? Understanding z/OS Encryption

SHARE Virtual Experience On-Demand Webinars

- What Good are DFSMShsm Exits? What Can I Do with Them?
- It's All on Tape - DFSMSrmm and REXX

Reminders

- DTS Products release 7.1 available at www.dtssoftware.com
- Product use available for a year – just ask!
- Send your ACS routines or DTS product rules for analysis

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