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VSAM

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VSAM Fundamentals

- Course Objective
  - Introduction to VSAM
  - VSAM Data Set organization
  - IDCAMS

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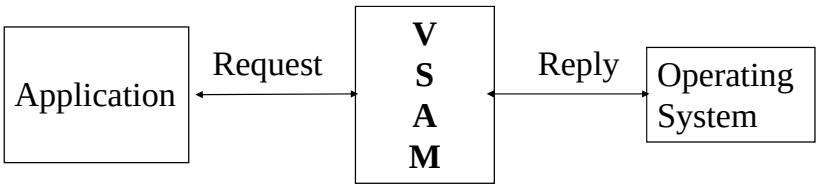
What is VSAM?

- VSAM is Virtual Storage Access Method
- It is a method used to move data between Disk and Main Storage
- VSAM operates in Virtual Environment
- VSAM acts as interface between Operating System and Application Program



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Types of VSAM data sets

- ESDS Entry Sequenced Data Set
- KSDS Key Sequenced Data Set
- RRDS Relative Record Data Set
- LDS Linear Data Set

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Traditional access methods

- QSAM (Queried Sequential Access Method)
- BSAM (Basic Sequential Access Method)
  - for 'flat' files
- ISAM (Index Sequential Access Method)
  - for Index files
- BDAM (Basic Direct Access Method)
  - for direct access files

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VSAM History

- 1973 - VSAM was introduced with ESDS & KSDS
- 1975 - Alternate Index, RRDS, Catalog Recovery features introduced
- 1979 - VSAM re-introduced with ICF (Integrated Catalog Facility)
- 1983 - DFP / VSAM ran under MVS / XA & (Data Facility Product)
- 1987 - DFP / VSAM 2.3 introduced with LDS
- 1988 - VSAM 3.1 under MVS / ESA with DFSMS (Data Facility Storage Management System)
- 1991 - VSAM 3.3 introduced with variable length records for RRDS.

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Advantages

- One method to support all types of data retrieval
- Can be a stand alone file or within a DBMS
- Supports fixed and Variable Records
- One utility, IDCAMS, to manage everything (IEBGENER for seq files, IEBCOPY for PDS, IEBISAM for ISAM files)
- Supports alternate index
- Device Independence (EXPORT and IMPORT)
- Portable across systems
- Modular, catalog contains all the information
- Catalogs are protected by internal security

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Disadvantages

- Require lot of DASD space
- For KSDS, primary key cannot be changed
- Performance can be slow because of complexity of Index
- Only resides on DISK

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IDCAMS

- Handles VSAM data sets (exclusively)
- Some of the functions
  - Creates (DEFINE)
  - Copies (REPRO)
  - Prints (PRINT)
  - Delete (DELETE)
  - Lists Characteristics (LISTCAT)

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VSAM data set organization

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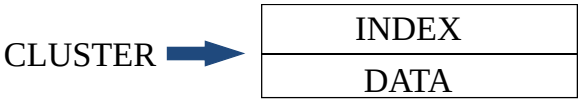
VSAM data set organization

- VSAM Data Set can contain three major components
  - CLUSTER (Catalog entry)
  - INDEX
  - DATA (Actual data)
- Data Set is referred by cluster name in JCL



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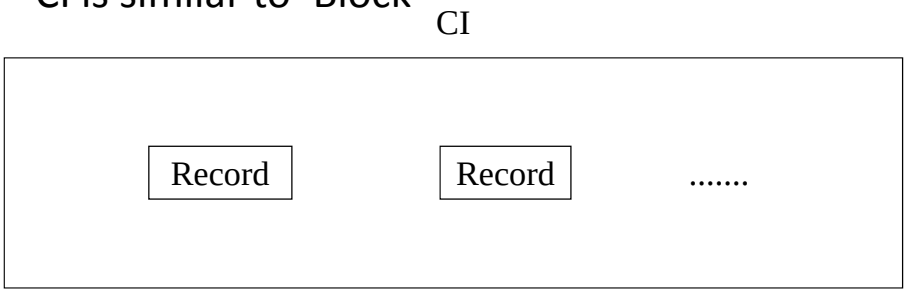
VSAM internals

- CONTROL INTERVAL (CI)
- VSAM stores Data and Index in Control Intervals (CI)
- CI is similar to 'Block'



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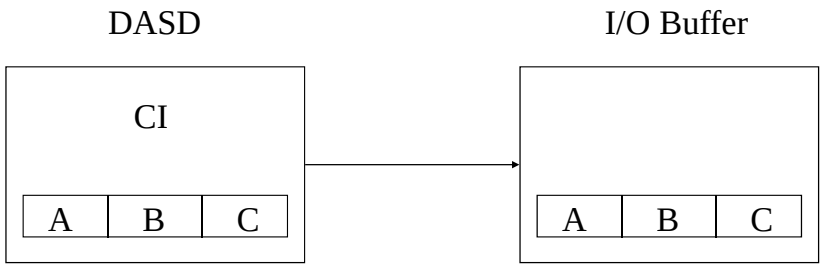
Control Interval

- CI is the unit of retrieval between DASD and I/O Buffer (Virtual Storage)



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Control Interval

- CI contains
  - Records (or DATA)
  - Free space (Optional)
  - Control Interval Definition Field (CIDF)
  - Record Definition Field (RDF)

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RDF and CIDF

- RDF
  - 3 bytes long
  - Indicates length of records
  - And also, how many adjacent records are of the same length
- CIDF
  - 4 bytes long
  - One per CI
  - Indicates Free space

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CONTROL AREA (CA)

- CIs are grouped into CA
- Can have more than one CA in a VSAM data set
- CA is VSAMs internal unit for allocating space
- Smallest is a TRACK, and the largest is a CYLINDER
- VSAM determines CA size & number of CIs in CA based on
  - CI size specified
  - Record size

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Index

- Separate entity
- Organized similar to Data component (CI & CA)
- Has different CI size
- VSAM builds Index when data is loaded
- Index is organised as Inverted Binary Tree
- VSAM compresses keys to conserve space
- Can have several Levels of Indexes
  - Lowest level of index is called ‘Sequence set’
  - Next level is called index set

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CI & CA Split

- CI split happens while
  - Adding new records or extending an old record
  - And not enough room in the CI to complete the operation
- CI split may trigger a CA split
- Splits generally degrades performance
- Specify freespace to reduce CI & CA splits

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ESDS

- Similar to Sequential File
- Sequenced by the order in which data is entered/loaded
- New Records are added at the end only (chronological order)
- Supports both Fixed and Variable formats
- Contains only CLUSTER & DATA components
- Only sequential access in Batch Cobol Programs
- Random access is supported in on-line applications (CICS) using Relative Byte Address (RBA)
- Alternate Index is supported in on-line applications (CICS)
- NO primary index

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RRDS

- Has only CLUSTER and DATA components
- Records are stored in numbered, fixed length slots
- Each slot is given a number 'Relative Record Number (RRN)'
- VSAM determines the number of slots by
  - Size of CI
  - Length of Record
- Records can be deleted physically
- Empty slots are filled up with new records without shifting existing records
- No primary Index or Alternate Index
- Supports Fixed and Variable formats
- RRN cannot be changed

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KSDS

- Has all three components of VSAM (CLUSTER, INDEX and DATA)
- Key sequenced
- Primary key should be
  - Unique
  - Same position in every record
  - Is not split (has to be contiguous)
- Records can be deleted physically
- Primary key cannot be changed
- Allows Alternate Index
- Has all the access methods
  - Sequential
  - Random
  - Dynamic (SKIP sequencial)

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VSAM dataset choice

	KSDS	ESDS	RRDS
Less DASD		✓	
On-line Direct Access	✓		✓
Batch Sequential		✓	
Alternate Index	✓		
Static data			✓
Ease of programming and maintenance	✓		

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Working with VSAM Datasets

Access Method Services (AMS)
IDCAMS

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IDCAMS

- Normally executed in Batch
- Always has the following JCL structure

```
//STEP010 EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//SYSIN DD*
<IDCAMS command from col.2  to  col.72>
/*
//*
```

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Basic IDCAMS Commands

- DEFINE (Cluster, Alternate Index etc.)
- BUILDINDEX (Alternate Index)
- REPRO (Cluster)
- LISTCAT (Catalog Entries)
- IMPORT / EXPORT (Cluster)
- VERIFY (Cluster)

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Basic define command syntax for cluster

```
DEFINE CLUSTER                -
(NAME (XIND.NLT.CLUSTER)      -
CYLINDERS (5 1)               -
    VOLUMES (WOR01)           -
    <Data set type>           -
)
```

{`-' is the continuation character and are normally aligned}

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Define Command (Contd..)

- NAME is a positional keyword parameter and must be coded first.
- Other keywords can be placed anywhere
- `+' sign is used for continuation within a field

- e.g.

```
DEFINE CLUSTER        -
(NAME (XIND.   +
NLT.CLUSTER))
```

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Record size parameter

- Syntax : RECORDSIZE (Average Maximum)
- Optional :Default : 4086
- Average & Maximum are same for Fixed length records
  - DEFINE CLUSTER -
  - (NAME(XIND.NLT.CLUSTER) -
  - CYLINDERS (5 1) -
  - VOLUMES (WORK01) -
  - RECORDSIZE (120 124) -
  - INDEXED)

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KEYS Parameter

- SYNTAX : KEYS (length offset)
- Used for KSDS only
- Optional : Default Value : Length=64 & Offset=0
  - DEFINE CLUSTER -
  - (NAME (XIND.NLT.CLUSTER) -
  - CYLINDER (5 1) -
  - VOLUMES (WORK01) -
  - RECORDSIZE (120 124) -
  - KEYS(8 0) -
  - INDEXED)

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Dataset type parameters

- KSDS : INDEXED or IXD
- ESDS : NONINDEXED or NIXD
- RRDS : NUMBERED
- LDS : LINEAR

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Data & index components

Required when installation default names are to be overridden

```
DEFINE CLUSTER                                          -
   (NAME (XIND.NLT.CLUSTER)                             -
   CYLINDER (5  1) VOLUMES (WORK01) -
   RECORDSIZE (120   124) KEYS (8   0) INDEXED)         -
DATA                                                    -
   (NAME(XIND.NLT.CLUSTER.DATA))                        -
INDEX                                                   -
   (NAME(XIND.NLT.CLUSTER.INDEX))     -
```

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VOLUMES

- Can specify different volumes for
  - Data component
  - Index component

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MORE AMS COMMANDS

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REPRO

- All purpose load and backup utility command
- Can be used against empty / loaded VSAM file with another VSAM file or sequential file
- Much easier to use than IEBGENER
- Can be used against all four types of VSAM datasets

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REPRO (Contd..)

REPRO INDATASET (DSN) or INFILE (DD1)
OUTDATASET (DSN) or OUTFILE(DD2)

SKIP (count)
COUNT (count)

FROMKEY
FROMADDRESS
FROMNUMBER

TOKEY
TOADDRESS
TONUMBER
REUSE/REPLACE

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Repro (Contd..)

- INFILE or INDATASET parameter is mandatory, similarly OUTFILE or OUTDATASET is mandatory
- All other parameters are optional
- SKIP specifies number of input records to skip before beginning to copy
- COUNT specifies number of output records to copy

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Repro (Contd..)

- REUSE parameter
  - Can be used only if the VSAM dataset was originally defined with REUSE option
  - Has the effect of logically deleting records before loading
- REPLACE parameter
  - Replaces the records for which primary keys are matching between input and output records
  - If not specified, the matching key records are untouched
  - If the target is ESDS the records are appended and REPLACE is inappropriate.

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Repro - Example

```
//REPRO EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//DD2 DD DSN=XIND.NLT.CLUSTER.BACKUP,DISP=SHR
//DD1 DD DSN=XIND.NLT.CLUSTER, DISP=SHR
// SYSIN DD*
REPRO INFILE (DD1) OUTFILE (DD2) REUSE
/ *
```

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EXPORT/IMPORT

- Used for backup and recovery
- Catalog information also is exported along with the data, unlike REPRO
- DFSMS classes are preserved
- Cluster deletion and redefinition are not necessary during the import
- Can be easily ported to other systems

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EXPORT/IMPORT(Contd..)

- Disadvantages
  - The EXPORTED file not reusable until it is imported
  - Slower than REPRO

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VERIFY

- Syntax : VERIFY FILE (<ddname>)

  VERIFY DATASET(<datasetname>)
  - Can be issued from TSO or from a JCL
  - Verifies the catalog HURBA (High Used Relative Byte Address) field and stores the true values from the control block HURBA field.
  - Should be used against cluster name only and not against data or index components
  - Used to rectify some of the problems due to data corruption

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LISTCAT

Used to list the contents of a master or user catalog

LISTCAT CATALOG (name)

ENTRIES (name - of - entries)

LEVEL (generic-leve-names)

Other parms:

ALL	NAME
HISTORY	VOLUME
ALLOCATION	NOT USABLE
CREATION (days)	EXPIRATION

OUTFILE (dd name)

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DELETE

- DELETE <object name> (parameters)
- Example : DELETE XIND.NLT.CLUSTER
  - All the parameters are optional
  - Deletes all subordinate objects such as AIX, Path

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Some Common DELETE Parameters

- ERASE / NO ERASE : ERASE writes binary zeroes after deletion
- PURGE / NO PURGE : PURGE allows deletion even though expiration date is still due
- ALTERNATE INDEX Or AIX : Deletes only Alternate index of the cluster
- PATH : Requests only path name to be deleted.
- FORCE / NO FORCE : FORCE deletes the dataset even if it is not empty

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Thank you !