IMS Catalog and IMS Open Database

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Agenda

- IMS Metadata
- IMS Open Database and Universal Drivers (V11)
- IMS Catalog for Metadata (V12)
- IMS Catalog Lifecycle
- IMS Catalog Database
- Enablement and Implementation of the IMS Catalog
- Application Programming with the IMS Catalog
IMS Metadata

• Databases partially defined in the IMS DBD
  • Only key/searchable fields needed by applications
  • Remaining segment data is not defined
• Remaining database segment definition is within Applications
  • COBOL COPYBOOKs and PL/I INCLUDEs map all the segment data
  • Applications can have different mappings for one segment
### IMS Metadata

<table>
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<tr>
<th>ord#</th>
<th>lastName</th>
<th>firstName</th>
<th>payment</th>
<th>type</th>
<th>date</th>
</tr>
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<td>CHAR</td>
<td>CHAR</td>
<td>CHAR</td>
<td>CHAR</td>
<td>DATE</td>
</tr>
<tr>
<td>1011000100110</td>
<td>10110000001010010101</td>
<td>1011011001000100110</td>
<td>0010110101110100101001001001001001010</td>
<td>0110100101010001011101110101</td>
<td>01110101001001</td>
</tr>
</tbody>
</table>

```xml
<PurchaseOrder number="113246">
  <lastName>IBM</lastName>
  <firstName>IMS</firstName>
  <date>04/26/1968</date>
  <payment type="MC">5414 2263 4895 1145</payment>
</PurchaseOrder>
```
DBD + PSB = IMS DB Schema

Physical Disk Data

| A | B | C | B | D | D |

IMS Hierarchy

A
  a b c d
B
  e f g
  j k l
C
  h i

DBD, PCB, Copybooks

Program I/O Area

| A | B | C |

DBD/PCB Schema
Changes to DBD Statement

- **DBD**
  - ENCODING=
    - Specifies default encoding of all character data in the database defined by this DBD
    - Value can be overridden in individual segments or fields

- **SEGM**
  - EXTERNALNAME=
    - Optional alias for NAME= parameter used by Java application programs to refer to segment

- **FIELD**
  - CASENAME=
    - Name of the map case when alternative mappings are defined for fields in a segment
  - DATATYPE=
    - Specifies the external data type of the field
  - EXTERNALNAME=
    - Optional alias for the NAME= parameter used by Java application programs to refer to field

- **DFSMARSH**
  - Specifies the DATATYPE converter routine to transform binary data to external data format

- **DFSMAP**
  - Defines alternative field mappings in a segment

- **DFSCASE**
  - Defines a map case for a segment type that uses DFSMAP alternative field mapping

- **REMARKS=**
  - Optional user comments: 1- to 256-character field added to DBDGEN statement
Data Types

• Data types have multiple metadata elements
  • **Application data type**
    • Universal drivers use application data type to present data to clients
  • **Physical data type**
    • Universal drivers use physical data type to marshal/unmarshal data to and from the database
  • **Example**
    • Application data type is DECIMAL(10,2) [decimal with precision 10 and scale 2]
    • Physical data type is a signed packed decimal (AD community doesn’t need to know this)
• New data type support
  • **Structs** (nested n levels with no constraint on element data types)
    • Accessed via SQL and DLI
  • **Arrays** (nested n levels with no constraint on element data types)
    • Accessed via SQL and DLI
  • **User-defined**
    • Name of UDT can be defined to the catalog and intended to be used at runtime by Universal drivers to marshal/unmarshal data
    • Can be part of a Struct or Array element
Changes to PSB PCB Statement

• PCB
  • EXTERNALNAME=
    • Optional alias for the PCB label or the PCBNAME= parameter
    • Java application programs use the external name to refer to the PCB
  • REMARKS=
    • Optional user comments: 1- to 256-character field added to PSBGEN statements
Local File for IMS Java Metadata

- IMS Explorer parses DBD, PSB and COBOL or PL/I source code
  - Generates PSBNAMEDataBaseView.java and .class files
  - Export as .jar file to file system where application is deployed
- Key points
  - Metadata deployed to multiple file locations
  - Metadata offline and not guaranteed to be current
IMS Open Database (IMS V11)

• Enables access to IMS databases anywhere in the Enterprise directly from local and distributed Java clients!
  • Clients use industry standard DRDA (Distributed Relational Database Architecture) to communicate with IMS Connect
    • Universal Drivers
      • Universal DB Resource Adapter (JEE)
      • Universal JDBC Driver
      • Universal DLI Driver
    • Roll Your Own

Opens the IMS Databases
Makes IMS DB Connectivity and Application development simpler

IMS Connect becomes the TCP/IP gateway to IMS Transactions and IMS Data
Solution Highlights – Connectivity

• Type 4 Driver Support
  • Universal drivers support Type 4 connectivity to IMS databases from TCP/IP enabled platforms and runtimes
    • WebSphere Application Server
    • Windows
    • zLinux
    • z/OS
    • Standalone Java SE

• Type 2 Driver Support
  • Universal drivers support Type 2 connectivity to IMS databases from z/OS runtimes
    • WebSphere Application Server for z/OS
    • IMS Java dependent regions (JMP & JBP)
    • CICS
  • All environments zAAP eligible (includes zAPP on zIIP)
IMS Open Database

J2EE
JDBC
DLI

Universal drivers

Distributed (e.g.; LUW)

TCP/IP

TCP/IP

Mainframe

z/OS

IMS

IMS

IMS

IMS

IMS

IMS

IMS

IMS

IMS

IMS

IMS

IMS

IMS
Solution Highlights – Universal Drivers

• Three Universal drivers
  • Universal DB Resource Adapter
    • JEE deployment
    • Standard Java SE deployment
    • WebSphere Appl. Server
    • SQL Calls
  • Universal JDBC driver
    • Non-JEE and JEE deployment
    • Standard Java SE deployment
    • SQL Calls
  • Universal DLI driver
    • Non-JEE and JEE deployment
    • Standard Java SE deployment
    • DL/I call concepts (SSA, command codes)
Solution Highlights – JEE Deployment

• Universal DB Resource Adapter
  • JCA 1.5
    • XA transaction support
      • Manage multiple datasource connections in a single UOW
    • Local transaction support
      • Manage multiple datasource connections each in their own UOW
    • Connection pooling
      • Connections released for future use
    • Connection sharing
    • Multiple programming models available
      • JDBC (Universal JDBC driver incorporated)
      • CCI with SQL interactions
      • CCI with DLI interactions
Solution Highlights – JDBC

• Universal JDBC driver
  • Significant enhancements to classic JDBC offered in IMS 9 and IMS 10
    • Standardized SQL support for an SQL subset
      • Keys of parent segments are included in tables as foreign keys
    • XA transaction support (type 4)
    • Local transaction support (type 4)
  • Concurrency control
    • Control release of distributed locks
  • Updatable result set support
  • Batch support
    • Fetch multiple rows in a single network call
  • JDBC metadata discovery support

• Standard SQL and metadata discovery enables significant integration opportunities for IMS
  • Use metadata stored in the IMS Catalog
  • Enable JDBC tooling to work with IMS DBs
Solution Highlights – DLI

- Universal DLI driver
  - Java implementation of the DL/I API
  - Complete DL/I support for database access
  - All IMS command codes supported
  - Can mix usage of JDBC and DLI drivers in the same application
    - SQL cannot always express what DLI offers
Solution Highlights – Java Dependent Region

- Java dependent region resource adapter
  - Java framework for applications operating in an IMS container
    - Message queue processing
    - Program switching
      - Deferred and immediate
    - Transaction demarcation
  - GSAM support
  - Additional IMS call support necessary for IMS transactions
    - INQY
    - INIT
    - LOG
    - Etc
  - Shipped with Type 2 Universal drivers
Open Database Manager - ODBM

- z/OS address space
  - Common Service Layer component
- Functions
  - Receives database connection requests from IMS Connect
  - Translates incoming database requests from DDM protocol to DL/I calls
  - Manages ODBA or DRA interface to IMS
  - Sends/receives byte string to/from IMS
  - Translates responses into DDM protocol for the client
  - Send results set back to client
- Provides isolation of application containers from IMS
  - Abend of container during DL/I call does not cause IMS U0113 abend
- Distributed Syncpoint (global transaction) requires RRS on z/OS
- Use of RRS with ODBM is optional
  - If RRS=Y (default), ODBM uses ODBA interface
  - If RRS=N, ODBM uses DRA interface (like DBCTL interface)
Open Database Manager - ODBM

- IMS Connect and Open Database Manager work together as a DRDA server for IMS data
- Allows distributed access to IMS Databases via TCP/IP using the IMS Universal Database Drivers
- Enables use of SQL database query language for access to IMS Databases
Open Database Manager - ODBM

- ODBM Setup and Configuration
  - PROCLIB members
    - ODBM BPE Configuration
    - ODBM BPE exit list
    - ODBM Initialization member – CSLDIxxx
    - ODBM Configuration member – CSLDCxxx
  - CSLODBM procedure
  - ODBM execution parameters
- New type-2 commands
  - QUERY ODBM TYPE(option)
  - UPDATE ODBM START|STOP(TRACE)
  - UPDATE ODBM START|STOP(CONNECTION)
  - UPDATE ODBM TYPE(CONFIG)
- Four new ODBM exit routines
IMS Catalog for IMS Java Metadata (IMS V12)

Contains IMS program & database resources, and relevant application metadata

- Database Definitions
  - Segments
  - Fields

- Application Program Specifications
  - Arrays and Structures
  - Field data types and data type conversion
  - Field redefines
  - Alternative Field maps for a segment

IMS Catalog Metadata

- COBOL & PLI source
- IMS Explorer
- PSB & DBD source
- ACBLIB
- Extended PSB source
- Extended DBD source
- DBDGEN / PSBGEN / ACBGEN
ACBGEN will populate ACBLIB and catalog in same UOW
  • Populates ACBLIB with *standard* ACB info and *extended* info
  • Populates the catalog with *extended* info

Key points
  • Trusted, online, IMS metadata stored in the IMS catalog
  • Only way to update catalog is via the Populate Utility or ACBGEN process
  • Extended info is acquired via the IMS Explorer
  • Extended info stored in ACBLIB members for recoverability
The IMS Catalog Database

- Contains metadata related to an IMS system’s databases & programs
  - DBD and PSB and Application information
- IMS PHIDAM/OSAM HALDB database
  - Defined with 4 Data Set Groups (DSGs)
- One Secondary Index
- Unique feature → “Unregistered Catalog Database”
  - DBRC use is optional for the IMS Catalog database
    - Only HALDB that isn’t required to be defined to DBRC
    - IMS can manage allocation/creation of catalog database
    - Done via parameters in the “CATALOG” section of DFSDFxxx PROCLIB member
The IMS Catalog Database

- IMS provides the DBD and PSB source code and object code for the Catalog database
- PHIDAM DBD name is DFSCD000
- PSINDEX DBD name is DFSCX000
  - Used to connect DBDs to PSBs that reference them
- PSBs provided to access the Catalog database
  - Initial load process - DFSCPL00
    - Used by the Catalog Populate Utility
  - Update access - DFSCP001
    - Used by the new ACBGEN Utility
  - Read access - DFSCP000 (COBOL/HLASM), DFSCP002 (PL/I), and DFSCP003 (PASCAL)
- Default catalog PCB is DFSCAT00
- ACBGEN required for all catalog PSBs

Let’s look at the IMS Catalog database physical structure...
Physical Catalog Record Structure

- Key value: **DBDbbbbbdbdname1**
- Key value: **PSBbbbbbpsbname1**

---

**Diagram Details**:
- **HEADER** (RESOURCE HEADER)
- **RESERVED**
- **DBD**
- **AREA**
- **CAPXDBD**
- **DBDRMK** (REMARKS)
- **DBDVEND**
- **SEGM**
- **PSB**
- **PCB**
- **DSET** (DATASET)
- **DSETRMK** (REMARKS)
- **AREARMK** (REMARKS)
- **AREARMK** (REMARKS)
- **FLD** (FIELD)
- **CAPXSEGM**
- **LCHILD**
- **SEGMRMK** (REMARKS)
- **PSBRMK** (REMARKS)
- **PSBVEND**
- **PCBRMK** (REMARKS)
- **SS** (SENSEG)
- **SSRMK**
- **SF** (SENFLD)
- **SFRMK** (REMARKS)
- **CMARRMK** (REMARKS)
- **CMAR**
- **DFSCX000**

---

**Secondary Index Key values**:
- **DBD**
  - **dbdname1**
- **PSB**
  - **psbname1**

---

**Legend**
- **DSG A**
- **DSG B**
- **DSG C**
- **DSG D**
Supported by Existing Database Utilities

- HALDB Index/ILDS Rebuild utility (DFSPREC0)
- HD Reorganization Unload utility (DFSURGU0)
- HD Reorganization Reload utility (DFSURGL0)
- Batch Backout utility (DFSBBO00)
- Database Recovery utility (DFSURDB0)
- Database Image Copy utility (DFSUDMP0 / DFSUDMT0)
  - Only batch image copies for an unregistered Catalog
New Utilities for the IMS Catalog

- **IMS Catalog Populate utility** (DFS3PU00)
  - Loads or inserts records into the IMS catalog
  - Estimates the size of the IMS catalog data sets

- **ACB Generation and Catalog Populate utility** (DFS3UACB)
  - Generates the ACBLIB members and loads the IMS catalog metadata in one unit of work

- **IMS Catalog Alias Names utility** (DFS3ALI0)
  - Defines a complete list of catalog aliases to IMS

- **IMS Catalog Copy utility** (DFS3CCE0, DFS3CCI0)
  - Copies IMS catalog database definitions and metadata between IMS systems
    - Migrate an IMS catalog database from a test to production environment
    - Copy a production IMS catalog database to another installation for system cloning or DR purposes (etc…)

- **IMS Catalog Partition Definition Data Set utility** (DFS3UCD0)
  - When DBRC is not used to manage the catalog database: creates the IMS catalog partition definition data set and populates it with information about the IMS catalog HALDB partitions

- **IMS Catalog Record Purge utility** (DFS3PU10)
  - Removes unnecessary versions of IMS catalog records from the IMS catalog database based on criteria that you specify
IMS Batch Processing with the Catalog

- Enabling the IMS catalog for IMS batch processing
  - Specify DFSDFxxx member on job EXEC parm
  - Requires JCL change to implement
- Exit Routine (DFS3CDX0)
  - Optional Catalog Definition user exit routine
  - Alternative to specifying DFSDFxxx member through job JCL
  - Available if users cannot or choose not to modify job JCL

Chapter 9. IMS catalog definition and tailoring

The IMS catalog is an optional system database that stores metadata about your databases and applications. As a system database, IMS performs many of the tasks required to define the catalog for you. If you need greater control, you can perform some of these tasks yourself.

The following topics provide the information you need to define and enable the IMS catalog.
IMS Catalog Enablement

- Add catalog DBDs and PSBs to your DBDLIB, PSBLIB & ACBLIB
- Copy DBD and PSB object code from SDFSRESL to your DBDLIB and PSBLIB

```plaintext
//CPYCMEM EXEC PGM=IEBCOPY
//SDFSRESL DD DSN=SDFSRESL,DISP=SHR
//DBDLIB DD DSN=MYIMS.DBDLIB,DISP=OLD
//PSBLIB DD DSN=MYIMS.PSBLIB,DISP=OLD
//SYSIN DD *
COPY OUTDD=DBDLIB,INDD=((SDFSRESL,R)),LIST=YES
SELECT MEMBER=(DFSCD000,DFSCX000)
COPY OUTDD=PSBLIB,INDD=((SDFSRESL,R)),LIST=YES
SELECT MEMBER=(DFSCPL00,DFSCP000,DFSCP001,DFSCP002,DFSCP003)

//CATACB EXEC PGM=DFSRRRC00,PARM='UPB'
//STEPLIB DD DSN=SDFSRESL,DISP=SHR
//DFSRESLB DD DSN=SDFSRESL,DISP=SHR
//IMS DD DSN=MYIMS.DBDLIB,DISP=SHR
// DD DSN=MYIMS.DBDLIB,DISP=SHR
//IMSACB DD DSN=IMS.ACBLIB,DISP=OLD
//SYSIN DD *
BUILD PSB=(DFSCPL00)
BUILD PSB=(DFSCP001)
BUILD PSB=(DFSCP000)
```

N.B. The MODBLKS resources for the Catalog databases and programs do not need to be defined!
IMS Catalog Enablement

- Modify DFSDFxxx PROCLIB Member
  - New CATALOG section(s) for catalog related parameters
    - Single section format `<SECTION=CATALOG>`
    - Multiple section format `<SECTION=CATALOG imsid>`
      - Multiple IMS systems sharing one DFSDFxxx PROCLIB member
      - *imsid* suffix must be a four character IMS ID
  - CATALOG section parameters
    - CATALOG=N | Y
      - Catalog is disabled or enabled
      - If enabled, IMS automatically creates catalog DDIR & PDIRs at IMS startup
    - ALIAS=DFSC | xxxx *(no default value)*
      - Specifies any 1-4 alphanumeric value used as a Catalog database name prefix
      - Enables use of non-shared, Catalog databases within an IMSplex
        - Use in a data sharing environment where each IMS has its own Catalog database and all are registered in a single set of RECONs
        - At runtime, the alias Catalog database names are dynamically replaced with internal database names **DFSCD000** and **DFSCX000**
      - For standalone IMS system – use “DFSC” which is the standard Catalog database name prefix → **DFSCD000** and **DFSCX000**
IMS Catalog Enablement

• DFSDFxxx PROCLIB Member
  • CATALOG section parameters (continued)
    • Information used by Catalog Populate Utility to automatically allocate the Catalog database data sets
      • DATACLAS
        • Optional data class for SMS managed data sets
      • MGMTCLAS
        • Optional management class for SMS managed data sets
      • STORCLAS
        • Required storage class for SMS managed data sets
      • IXVOLSER
        • Volume serial number for primary and secondary catalog indices
        • Required for non-SMS managed data sets
      • SPACEALLOC
        • Free space % (0 to 9999) added to the IMS-computed size of the primary & secondary data set allocations
      • SMSVOLCT
        • Number of volumes (1-20) created by the Catalog Populate utility for SMS-managed
IMS Catalog Enablement

• DFSDFxxx PROCLIB Member
  • CATALOG section parameters (continued)
    • RETENTION=(MAX=2 | nnn) or RETENTION=(PERIOD=0 | nnn)
      • Specifies retention schedule for metadata in the IMS catalog
      • By default IMS keeps only two copies of the DBD or PSB in catalog
        • MAX=2 | nnn
          • Maximum number of versions of a DBD or PSB to be stored before they are replaced first-in first-out
      • PERIOD=0 | nnn
        • Maximum number of days a version of a DBD or PSB is to be stored before it can be replaced
        • Metadata versions older than the specified retention period are not automatically deleted, but available for removal when new version of metadata is added
        • Default value of “0” disables this feature
IMS Catalog Enablement

• Definition of the HALDB structure
  • Partitioning of the catalog is the users responsibility
    • Minimum of 1 partition is required
    • Last partition must be able to contain the highest-key PSB record
  • Catalog HALDB uses the high-key selection method
    • No use of Partition Selection Exit allowed
• Catalog Database Definition
  • For systems that use DBRC
    • Catalog database can be defined to the RECONs with the DBRC utility and commands
  • For systems that do not use DBRC
    • Catalog database must be defined to the Catalog Partition Definition data set using the Catalog Partition Definition Data Set utility, DFS3UCD0
  • If an ALIAS is used in the CATALOG sections of the DFSDFxxx member, each alias Catalog database must be defined
IMS Catalog Enablement

- Using DBRC DSPURX00 utility and commands to define the Catalog database to the RECONs

```plaintext
//DEFCAT EXEC PGM=DSPURX00
//STEPLIB DD DSN=IMS.SDFSRESL,DISP=SHR
//SYSPRINT DD SYSOUT=* 
//IMS DD DSN=IMS.DBDLIB,DISP=SHR
//SYSIN DD *
INIT.DB DBD(DFSCD000) TYPHALDB SHARELVL(3)
INIT.PART DBD(DFSCD000) PART(DFSCD01) -
   DSNPREFX(dsnprefix.DFSCD000) -
   BLOCKSZE(4096) -
   KEYSTRNG(X'FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFfffffff')
INIT.DB DBD(DFSCX000) TYPHALDB SHARELVL(3)
INIT.PART DBD(DFSCX000) PART(DFSCX01) -
   DSNPREFX(dsnprefix.DFSCX000) -
   KEYSTRNG(X'FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFfffffff') /
```

- If using a catalog alias prefix, replace `DFSC` in the database and partition names for the catalog and the catalog secondary index with the four character ALIAS name prefix

- You might need to define multiple alias name databases to the RECONs
IMS Catalog Enablement

- Using the Catalog Partition Definition Data Set utility, DFS3UCD0, to define the Catalog database (for systems that do not use DBRC)

```plaintext
//S1 EXEC PGM=DFS3UCD0,REGION=0M
//STEPLIB DD DSN=IMS.SDFSRESL,DISP=SHR
//DFSRESLB DD DSN=IMS.SDFSRESL,DISP=SHR
//DFSHPDBC DD DSN=...,,DISP=
//SYSPRINT DD SYSOUT=* 
//IMS DD DSN=IMS.DBDLIB,DISP=SHR
//SYSIN DD *
  HALDB=(NAME=DFSCD000)
  PART=(NAME=DFSCD000, PART=partitionname,
          DSNPREFIX=dsnprefix,
          KEYSTRING=keystring)
  HALDB=(NAME=DFSCX000)
  PART=(NAME=DFSCX000, PART=partitionname,
          DSNPREFIX=dsnprefix,
          KEYSTHEX=FFFFFFFFFFFFFFFF) /*
```

- Catalog Partition Definition data set is populated with the information specified in the HALDB and PART control cards
  - RECON-like information for catalog database partition definition and structure
- The name DFSCD000 in the HALDB and PART statements contains the default catalog prefix **DFSC**. If your catalog uses an alias name prefix, substitute it in the JCL.
IMS Catalog Enablement

- After Catalog database is defined in Catalog Partition Definition Data Set
  - Identify unregistered Catalog database names
    - UNREGCATLG parameter in the DATABASE section of the DFSDFxxx member

```plaintext
/*****************************/
/* Database Section */
/*****************************/
<SECTION=DATABASE>
UNREGCATLG=(DFSCD000,DFSCX000) /* Unregistered IMS catalog DB */
/*****************************/
/* */
/*****************************/
```

- If using an alias name prefix, replace **DFSC** in the UNREGCATLG database names with the four character alias name prefix
- Limitations of using an unregistered Catalog database
  - NO IMS Data Sharing support
  - NO OLR support
  - NO partition definition change support
    - User must rebuild catalog partitions
  - Manual recovery required for unregistered Catalog databases
IMS Catalog Enablement

• After Catalog database is defined in Catalog Partition Definition Data Set
  • Create a new DFSMDA dynamic allocation member for the Catalog Partition Definition data set

```plaintext
//DYNALLOC JOB
//*
//STEP EXEC IMSDALOC
//SYSIN DD *
  DFSMDA TYPE=INITIAL
  DFSMDA TYPE=CATDBDEF, DSNAMEdsn
  DFSMDA TYPE=FINAL
END
/*
```

• `dsn` is the name of the Catalog Partition Definition data set
  • Catalog Partition Definition data set was allocated in the DFS3UCD0 utility on the DFSHDBSC DD
  • Dynamically allocate Catalog Partition Definition data set in any IMS job step
Start with 3 members in an ACBLIB
- Run the Catalog Populate Utility, **DFS3PU00**
- Created catalog members will contain timestamp TS0
- This is the same timestamp from the ACB member
### Catalog Populate Utility Report

**Catalog DFSCD000**  
**Partition DFSCD01**  

**Number of Segments Inserted into the Catalog**  
**Inserted Average**

<table>
<thead>
<tr>
<th>SC</th>
<th>Segment</th>
<th>Segments</th>
<th>DSG</th>
<th>Parent</th>
<th>Segs/Parent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HEADER</td>
<td>4228</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DBD</td>
<td>2530</td>
<td>A</td>
<td>HEADER</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>CAPXDBD</td>
<td>7</td>
<td>D</td>
<td>DBD</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>DSET</td>
<td>2599</td>
<td>D</td>
<td>DBD</td>
<td>1.0</td>
</tr>
<tr>
<td>7</td>
<td>AREA</td>
<td>139</td>
<td>D</td>
<td>DBD</td>
<td>0.1</td>
</tr>
<tr>
<td>9</td>
<td>SEGM</td>
<td>16337</td>
<td>B</td>
<td>DBD</td>
<td>6.5</td>
</tr>
<tr>
<td>10</td>
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<td>1</td>
<td>D</td>
<td>SEGM</td>
<td>0.0</td>
</tr>
<tr>
<td>12</td>
<td>FLD</td>
<td>16426</td>
<td>C</td>
<td>SEGM</td>
<td>1.0</td>
</tr>
<tr>
<td>14</td>
<td>MAR</td>
<td>16426</td>
<td>C</td>
<td>FLD</td>
<td>1.0</td>
</tr>
<tr>
<td>17</td>
<td>LCHILD</td>
<td>2687</td>
<td>B</td>
<td>SEGM</td>
<td>0.2</td>
</tr>
<tr>
<td>20</td>
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<td>134</td>
<td>B</td>
<td>LCHILD</td>
<td>0.0</td>
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<tr>
<td>33</td>
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<td>1840</td>
<td>A</td>
<td>HEADER</td>
<td>0.4</td>
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<tr>
<td>35</td>
<td>PCB</td>
<td>9190</td>
<td>B</td>
<td>PSB</td>
<td>5.0</td>
</tr>
<tr>
<td>37</td>
<td>SS</td>
<td>75274</td>
<td>B</td>
<td>PCB</td>
<td>8.2</td>
</tr>
<tr>
<td>39</td>
<td>SF</td>
<td>1105</td>
<td>B</td>
<td>SS</td>
<td>0.0</td>
</tr>
<tr>
<td>41</td>
<td>DBDXREF</td>
<td>8886</td>
<td>D</td>
<td>PSB</td>
<td>4.8</td>
</tr>
</tbody>
</table>

**Segment within existing header duplicates not inserted**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBD</td>
<td>71</td>
</tr>
<tr>
<td>PSB</td>
<td>72</td>
</tr>
</tbody>
</table>

**Estimated Space Requirement to Hold Inserted Segments**

<table>
<thead>
<tr>
<th>DSG</th>
<th>BLKSIZE</th>
<th>BLOCKS</th>
<th>RECORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4096</td>
<td>596</td>
<td>L</td>
</tr>
<tr>
<td>B</td>
<td>4096</td>
<td>9343</td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td>4096</td>
<td>8214</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4096</td>
<td>236</td>
<td></td>
</tr>
</tbody>
</table>

**Secondary Index Records**

<table>
<thead>
<tr>
<th>Index</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFGSCX000</td>
<td>8886</td>
</tr>
</tbody>
</table>
Adding IMS Catalog Metadata

- **New ACB Generation - DFS3UACB**
  - Replaces existing ACBGEN Utility, DFSUACB0 (if IMS catalog enabled)
  - Generate ACBLIB member and populate/create catalog metadata in a **single job step**
  - **Phase 1 - ACBGEN**
    - DBDLIB and PSBLIB members used as input
    - Validation is unchanged
    - ACB member is written to ACBLIB with new ACBGEN timestamp
  - **Phase 2 – IMS catalog update**
    - Generated ACB is decoded, converted to catalog segments, loaded into the catalog
    - DBD and PSB metadata created and inserted
    - Corresponding ACB member timestamp saved as timestamp in catalog DBD and PSB segments
      - ensures validity and consistency of ACBLIB and catalog

- **New ACBGEN, DFS3UACB, and new Catalog Populate, DFS3PU00, utilities are the only updaters of the IMS catalog**
  - IMS online and IMS batch regions will never update catalog data
  - IMS online and IMS batch regions will only retrieve data from the catalog
IMS Catalog Additions: New ACBGEN

- New integrated ACBGEN process includes updates to the IMS catalog
- DFSDFxxx PROCLIB member has the catalog information
- DFSMDA member used to dynamically allocate the catalog datasets
ACBLIB and Catalog After New ACBGEN

- User makes a change to DB3 and runs ACBGEN
  1. Creates updated DB3 ACB member with new timestamp
  2. Creates new DB3 member in the catalog with the new timestamp
Catalog Member Timestamps

- Application request is made to read DB3
  1. IMS determines active DB3 member has timestamp TS0
  2. Internal DL/I call issued to retrieve member DB3 from IMS catalog
  3. IMS retrieves metadata from catalog member DB3 with timestamp TS0
Catalog Member Timestamps

- Initiate OLC to switch from ACBLIBA to ACBLIBB
  - Activates DB3 ACB with timestamp TS1
- Application request is made to read DB3
  1. Internal DL/I call issued to retrieve member DB3 from IMS catalog
  2. IMS determines active DB3 member has timestamp TS1
  3. IMS retrieves metadata catalog member DB3 with timestamp TS1

---

**Diagram:**
- **Active**
  - ACBLIBB
    - DB1 TS0
    - DB2 TS0
    - **DB3 TS1**
- **Inactive**
  - ACBLIBA
    - DB1 TS0
    - DB2 TS0
    - DB3 TS0
- **IMS**
- **DMB pool**
- **Catalog**
  - DB1 TS0
  - DB2 TS0
  - **DB3 TS0**
  - **DB3 TS1**
- **IMS DB**
Multiple IMSes, Cloned ACBLIBs, Shared Catalog

Shared CATALOG DB
Shared DFSDFxxx
ALIAS=DFSC

DFSDFO00 Member:
<SECTION=CATALOG>
CATALOG=Y
ALIAS=DFSC
Multiple IMSes, Shared ACBLIBs, each IMS has it’s own Catalog

Non-Shared CATALOG DBs
Shared DFSDFxxx
Separate `<SECTION=CATALOG imsid>`
ALIAS=xxxx

DFSDF000 Member:
`<SECTION=CATALOGIMS1>`
CATALOG=Y
ALIAS=CAT1
`<SECTION=CATALOGIMS2>`
CATALOG=Y
ALIAS=CAT2
`<SECTION=CATALOGIMS3>`
CATALOG=Y
ALIAS=CAT3
`<SECTION=CATALOGIMS4>`
CATALOG=Y
ALIAS=CAT4
Multiple IMSes, Shared ACBLIBs, each IMS has its own Catalog

Non-Shared CATALOG DBs
Non-Shared DFSDFxxx
ALIAS=xxxx

DFSF001 Member:
<SECTION=CATALOG>
CATALOG=Y
ALIAS=CAT1

DFSF002 Member:
<SECTION=CATALOG>
CATALOG=Y
ALIAS=CAT2

DFSF003 Member:
<SECTION=CATALOG>
CATALOG=Y
ALIAS=CAT3

DFSF004 Member:
<SECTION=CATALOG>
CATALOG=Y
ALIAS=CAT4
Application Programming with IMS Catalog

- IMS catalog PSBs resident for application programs
  - DFSCP000 - High-level assembler and COBOL applications
  - DFSCP002 - PL/I applications
  - DFSCP003 - PASCAL applications

- PCBs included to support different catalog processing models:
  - DFSCAT00 - Primary PCB to access all data in the catalog database
  - DFSCATSX – Used access the catalog database via the catalog 2nd index
  - DFSCATX0 – Used to access the catalog 2nd index as a database

- All catalog processing is performed with PROCOPT=G

- New “GUR” DL/I call to access Catalog DB records
  - Application programs can use the GUR call
NEW “GUR” DL/I Call

- Get Unique Record
  - Retrieves an XML formatted Catalog database “record”
  - Restricted to use with the IMS Catalog database
- Functions like a GU followed by a series of GNP calls
  - Less overhead than issuing GU & GNP to retrieve all the metadata for a catalog member
- Returns the entire database DBD or PSB record in one call
  - Using an AIB token, the call can be continued if the I/O area is too small for the entire catalog database record
- Data returned in XML format
  - The XML schemas are included in the IMS.ADFSSMPL data set:
    - DFS3XDBD.xsd (for DBD records)
    - DFS3XPSB.xsd (for PSB records)
- Support added for DFSDDLT0 and IMS REXX
IMS Catalog Benefits

- Trusted, online source for IMS metadata
- Direct access to IMS metadata in the catalog
- Leveraged by the Universal Database Drivers
- No need for “local” Java metadata classes
Summary

• IMS Catalog
  • Contains information about IMS database resources, program resources, and relevant application metadata
  • Populate Utility and new ACBGEN
    • Used to populate and maintain the catalog metadata
  • The IMS Catalog: The Next Step in Simplification and Enterprise Integration

• IMS Enterprise Suite Explorer for Development
  • Generates DBD/PSB source used to populate the catalog
  • Enables IMS metadata discovery from the IMS Catalog
  • IMS Enterprise Suite Explorer: The new face of IMS
Two IMS White Papers!!

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- SHARE blog
- IBM Destination z

**YouTube**
- IBM System z
- Destination z

**Tumblr**
- IBM Mainframe50

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THANK YOU
BONUS SLIDES
SSA Command Code “O”: Qualify by Position

- New SSA command code “O”
  - Non-key field definitions not required in the DBD
    - Allows fields defined in database metadata to be used
  - Search by position and length vs. field name
    - 4 byte position, hex value
    - 4 byte length, hex value
  - Valid for HDAM, HIDAM, PHDAM, PHIDAM and DEBD databases
  - Valid for GU, GHU, GN, GNP, GHNP, ISRT calls
  - Plays well with other command codes
  - “GE” status code returned if field not found
  - Support for DFSDDLT0 and IMS REXX
  - Performance will be the same as non-key field search
SSA with command code, position and length

- SSA with “O” command code, position and length

### Database Segments

<table>
<thead>
<tr>
<th>Field</th>
<th>Pos</th>
<th>Len</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASTNAME</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

### Field Pos Len

<table>
<thead>
<tr>
<th>Field</th>
<th>Pos</th>
<th>Len</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASTNAME</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>FIRSTNAME</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>EXTENSION</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>ZIPCODE</td>
<td>31</td>
<td>7</td>
</tr>
</tbody>
</table>

GU TELEBOOK*-O--(LASTNAME=LAST2)
GU TELEBOOK*-O--(0000000010000000A=LAST3)
GU TELEBOOK*-O--(0000000B0000000A=FIRST1)

‘bb‘ Status Code: segments returned successfully

(Position is relative to 1 vs. zero)
SSA Command Code “O”: Qualify by Position

• Support for IMS Universal Drivers
  • Allows users to issue queries qualified on non-searchable fields and have a field’s position and length generated automatically in the qualified SSA

• SQL
  • Universal Drivers will detect a non-searchable field in the where clause based on database metadata and will internally convert the SSAList qualification

• DLI
  • Universal Drivers will detect a non-searchable field in the SSAList based on database metadata and will internally convert the SSAList qualification

IMS12
APAR PM69378
PTF UK81917
IMS Universal Driver Additional Enhancements

- Variable length segment support
  - VL segments contain a two byte length (LL) field that identify size of the segment instance
  - Universal Drivers are now sensitive to the LL field of a VL segment and will manage the IO area of the segment instance on all CRUD calls

<table>
<thead>
<tr>
<th>FIELD=PERSONAL_INFO (VLOB min length=82 max length=112)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INNER FIELD=LENGTH (2 bytes)</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>112</td>
</tr>
<tr>
<td>82</td>
</tr>
</tbody>
</table>
Mapping Support

- A Map is metadata that describes how a field, or set of fields, are mapped for a particular segment instance
- Various mapping cases are captured in the metadata
  - defines the set of fields to be used for each case
- Maps can be defined in the IMS catalog
- Example:
  - Insurance segment mapped multiple ways depending on value of a ‘Policy Type’ field

<table>
<thead>
<tr>
<th>Policy Type</th>
<th>Property Type</th>
<th>Rooms</th>
<th>Value</th>
<th>Address</th>
<th>Make</th>
<th>Model</th>
<th>Year</th>
<th>Value</th>
<th>Color</th>
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</thead>
<tbody>
<tr>
<td>M</td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
<td>Ford</td>
<td>Escort</td>
<td>1989</td>
<td>2K</td>
<td>Red</td>
</tr>
<tr>
<td>H</td>
<td>Single Family</td>
<td>5</td>
<td>500K</td>
<td>555 Disk Drive Way, 95141</td>
<td>-</td>
<td>-</td>
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</tr>
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