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The DB2 for z/OS Catalog Gets a Makeover

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Monday, February 28, 2011: 4:30 PM-5:30 PM
Session 8789



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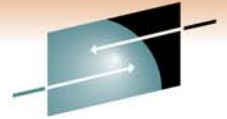


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Why?



Most Significant Catalog Changes in 27 Years

- **Database 2 (DB2 Version 1) to DB2 10 for z/OS**
 - Increased the number of table spaces
 - 11 table spaces to 90
 - Increased the number of tables
 - 25 tables to 137
 - Links to no links
 - Now uses a new table space structure (UTS in DB2 9)
 - LOBs (DB2 V6)
 - Reordered Row Format
 - Row level locking
 - Unicode
 - All DB2 10 Catalog/Directory objects are DB2 managed

To Appreciate Today's Changes....

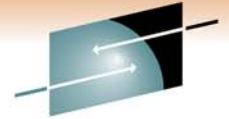
- DB2 10 for z/OS
- Available since October, 2010
 - Upgrade paths available from
 - DB2 Version 8 New Function Mode (NFM)
 - *DB2 V8 End of Service (EoS) is April 2012*
 - DB2 9 NFM

We Have to Start Here....

- Database 2 – DB2 Version 1

How the DB2 Catalog has Changed

| DB2 Version | Table Spaces | Tables | Added |
|-------------|--------------|--------|-------|
| V1 | 11 | 25 | |
| V3 | 11 | 43 | 5 |
| V4 | 11 | 46 | 3 |
| V5 | 12 | 54 | 8 |
| V6 | 15 | 65 | 9 |
| V7 | 20 | 84 | 19 |
| V8 | 21 | 87 | 2 |
| V9 | 32 | 108 | 19 |
| V10 | 90 | 137 | 29 |



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All of Those Fun Pointers



Prior to DB2 10

- Which table spaces used links
 - SYSDBASE, SYSPLAN, SYSDBAUT, SYSVIEW, SYSGROUP and DBD01
 - These table spaces used page level locking because of the links
 - Using SYSDBASE as an example:
 - SYSCOLAUTH, SYSCOLUMNS, SYSFIELDS
 - SYSFORIGNKEYS, SYSINDEXES, SYSINDEXPART
 - SYSKEYS, SYSRELS, SYSSYNONYMS,
 - SYSTABAUTH, SYSTABLEPART, SYSTABLES,
 - SYSTABLESPACE
 - A change to any of the above tables could lock all of the tables

*What do we mean by links or pointers?
Next slide...*

All of Those Pointers... Shades of IMS



- Using SYSTABLES as an example
 - SELECT * against SYSTABLES returns NAME for first column the first
- DSN1PRNT shows something a little different
 - Output of data page in a SYSDBASE containing a SYSTABLES row *
 - 4-byte forward ring pointer to next SYSTABLES record or SYSTABLESPACE record
 - 4- byte backward ring pointer to the previous SYSTABLES record or SYSTABLESPACE record
 - 4-byte child pointer pointing to a SYSCOLUMNS record
 - 4-byte child pointer pointing to a SYSRELS record
 - 4-byte child pointer pointing to a SYSINDEXES record
 - 4-byte child pointer pointing to a SYSTABAUTH record
 - 4-byte child pointer pointing to a SYSSYNONYMS record.

* Examined using DSN1PRNT and the Diagnosis Guide and Reference (licensed materials)

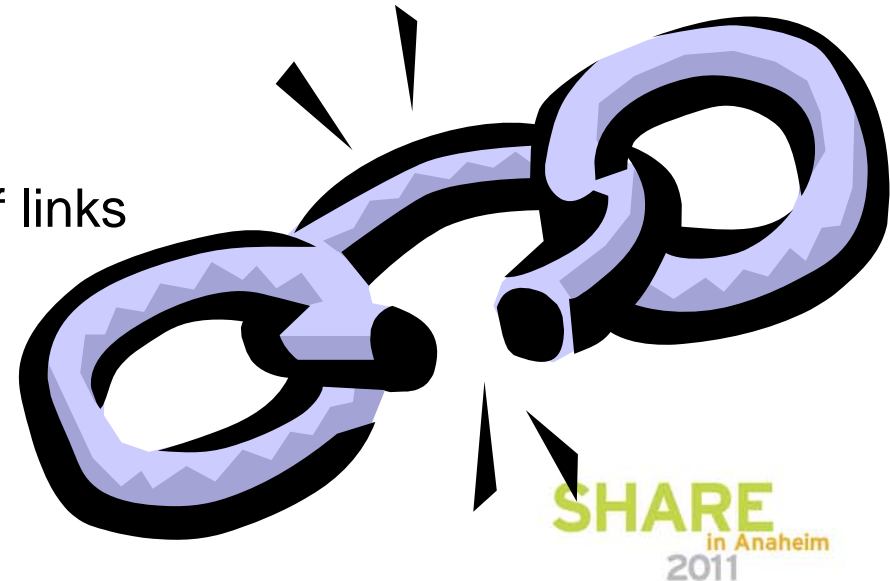
Have Links, Need Check

- DB2 Version 2 enhancement for catalog
 - DB2 link checker added
 - Stand-alone utility DSN1CHKR
 - The integrity of the DB2 directory and catalog table spaces can now be verified
- You'll still need to check links one more time
 - As part of the migration
 - Run DSN1CHRK against SYSDBASE, SYSPLAN, SYSDBAUT, SYSVIEW, and SYSGROUP
 - Run DSN1COPY with CHECK option against all catalog/directory table space
 - Run CHECK INDEX against all catalog/directory indexes
 - Run catalog queries in member DSNTESSQ in SDSNSAMP
 - *Use DSNTEP2 so you can retain results*
- Make sure stuff is correct before attempting to migrate it

DB2 10 Catalog...

- Processed during enabling new function mode (ENFM*)
 - SYSDBASE, SYSPLAN, SYSDBAUT, SYSVIEW, SYSGROUP and DBD01 (because of links)
 - Plus SPT01, SYSOBJ, and SYSPKAGE
 - Above table spaces are removed and their tables are moved to new partition by growth table spaces with these characteristics:
 - Row level locking
 - New row format
 - Partition-by-growth
 - Referential Integrity in place of links
 - One table per table space
 - DSSIZE 64 G
 - MAXPARTS 1

*Uses migration job DSNTIJEN



DB2 10 Catalog...



- Converting to ENFMx
 - V10EN8 / V10EN9
 - 7 Table Spaces dropped
 - SYSIBM.SYSVTREE / SYSVLTREE dropped (moved to SYSVIEW's BLOB)
 - 72 Table Spaces added
 - SYSPLUXA / SYSPLUXB

LOBs for Routines from SYSOBJ

SYSDBASE

SYSTSFAU
 SYSTSTSP SYSTSCOL SYSTSTPT
 SYSTSTAB SYSTSFLD SYSTSREL
 SYSTSSYN SYSTSFOR SYSTSTAU
 SYSTSKEY SYSTSIXS SYSTSIPT

2 additional LOB spaces

SYSDBAUT

SYSTSDBA
 SYSTSDBU

SYSOBJ

SYSTSCON SYSTSTBC
 SYSTSAUX SYSTSDEP SYSTSPRM SYSTSTRG
 SYSTSDAT SYSTSKYC SYSTSRAU SYSTSENV
 SYSTSROU SYSTSSCM

3 additional LOB spaces

SYSGROUP

SYSTSSTG
 SYSTSVOL

SYSVIEWS

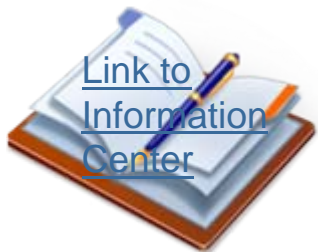
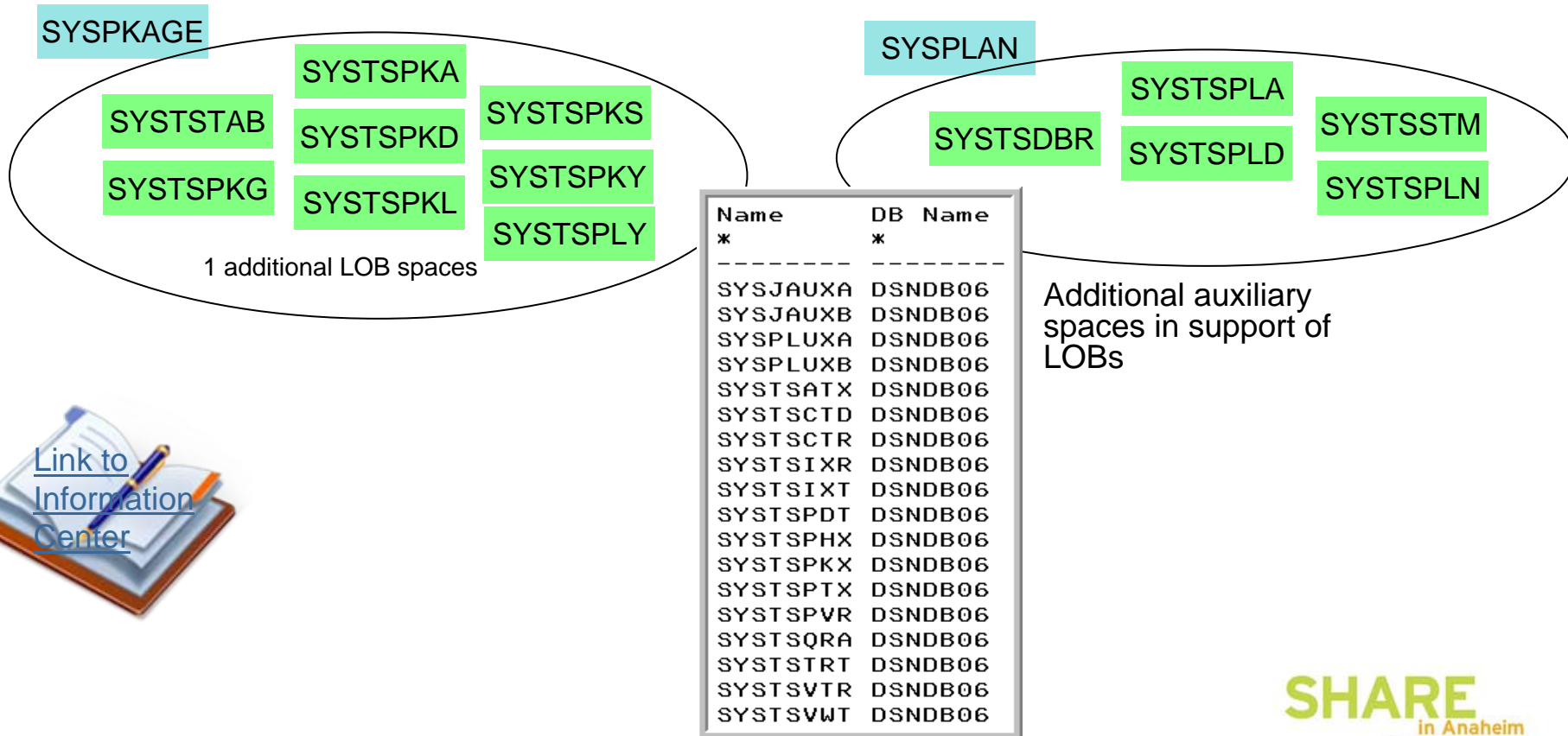
SYSTSVWD
 SYSTSVIEW

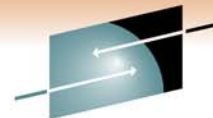
2 additional LOB spaces

Underlined items occur in a V9 to V10 migration

DB2 10 Catalog...

- Converting to ENFMx
 - V10EN8 / V10EN9





DB2 10 Catalog...

- Compare / Contrast

| DB2_VERSION_MODE | TS Count | Column Count |
|------------------|----------|--------------|
| V8NFM | 22 | 1281 |
| V10C8 | 30 | 1705 |
| V10EN | 95 | 2046 |
| V10NF | 95 | 2046 |

| DB2_VERSION_MODE | TS Count | Column Count |
|------------------|----------|--------------|
| V9NFM | 28 | 2003 |
| V10C9 | 30 | 2057 |
| V10EN | 95 | 2387 |
| V10NF | 95 | 2387 |

Based on tables that are "SYSIBM" tables
Does not include several "User" tables added post-migrations
-Like the tables in DSNXSR (DSNTIJNX)

This V9 system had several of "User" tables, tools-tables, DB2 stored procedure-tables

| | Table Space Count | Column Count |
|----------------------|-------------------|--------------|
| V8 NFM | 22 | 1281 |
| + | 8 | 424 |
| - | 0 | 0 |
| V10 CM8 | 30 | 1705 |
| + | 72 | 349 |
| - | 7 | 8 |
| V10 ENFM8 | 95 | 2046 |
| + | 0 | 0 |
| - | 0 | 0 |
| V10 NFM | 95 | 2046 |
| Overall Delta | 73 | 765 |

| | Table Space Count | Column Count |
|----------------------|-------------------|--------------|
| V9 NFM | 28 | 2003 |
| + | 2 | 54 |
| - | 0 | 0 |
| V10 CM9 | 30 | 2057 |
| + | 72 | 338 |
| - | 7 | 9 |
| V10 ENFM9 | 95 | 2387 |
| + | 0 | 0 |
| - | 0 | 0 |
| V10 NFM | 95 | 2387 |
| Overall Delta | 67 | 384 |

DB2 10 Catalog...

- Migrating to CM
 - V10CM8 or V10CM9
 - 8 or 2 Table Spaces Added
 - *SYSCONTX* *Trusted Context Definitions*
 - *SYSPLUXA* *Aux Space with BLOB for SYSRoutines.TEXT*
 - *SYSROLES* *Roles Definitions*
 - *SYSRTSTS* *Real Time Statistics*
 - *SYSTARG* *Extended Index Definitions*
 - *SYSTSASC* *ASCII SYSDUMMYA*
 - *SYSTSUNI* *Unicode SYSDUMMYU*
 - *SYSXML* *XML Definitions*
 - *(Node IDs, Schema IDs, etc.)*
 - No Table Spaces Dropped

Underlined items occur in a V9 to V10 migration

DB2 10 Catalog...



• Migrating to CMx

- V10CM8 / V10CM9
 - SYSCOPY
 - *Logging information (V9)*
 - SYSCOLUMNS
 - Hash information
 - XML Type Modifier
 - SYSINDEXES / HIST
 - *DATAREPEATFACTOR (V9)*
 - *Compression*
 - *Index on Expression*
 - Hash
 - SYSTABLEPART
 - Hash
 - SYSTABLES
 - Hash
 - Versioning / Temporal
 - Columns for Roles added throughout
 - RELEASE Created throughout

- SYSTABLESPACE
 - Hash
 - Member Cluster
 - *Clone (V9)*
 - *PBG (V9)*
- SYSDATABASE
 - *Implicit (V9)*
- LOCATIONS
 - *Trusted Context*
- SYSSTOGROUP
 - *SMS (V9)*
- SYSCOLDIST / HIST
 - *Histograms (V9)*
- SYSJAVAPATHS
- SYSDATATYPES
 - Inline LOBs
- SYSDEPENDENCIES
- SYSENVIRONMENT
- SYSROUTINES
 - *NSPs (V9)*
 - Inline routines
 - SECURE
- SYSROUTINESTEXT

- SYSTRIGGERS
 - *SQL PL*
 - SECURE
- SYSPACKAGE
 - Temporal
 - APR
 - Plan Management
 - Extended Ind.
 - Concurrent Access
 - LASTUSED
- SYSPLAN
 - Concurrent Access
- SYSPACKSTMT
 - Statement ID
 - Text
- RTS
- SYSDUMMYE
- SYSDUMMYA
- SYSDUMMYU
- SYSUSERAUTH
 - New Authorities
- SYSXMLRELS
- SYSXMLSTRINGS

Summary of catalog changes
Underlined items occur in a V9 to V10 migration

DB2 10 Catalog...

- Converting to ENFMx
 - V10EN8 / V10EN9
 - SYSROUTINES_TREE
 - BLOB on SYSROUTINES
 - Real Time Statistics are moved into the Catalog
 - SYSINDEXSPACESTATS
 - *TOTALENTRIES* now *BIGINT*
 - Various new stats
 - SYSTABLESPACESTATS
 - *TOTALROWS* and *SPACE* now *BIGINT*
 - Various new stats
 - SYSAUDITPOLICIES
 - SYSAUDITALERTS / _OUT
 - SYSAUTOTIMEWINDOWS
 - SYSCONTROLS / _DESC
 - SYSPENDINGDDL
 - SYSPENDINGOBJECTS
 - SYSPACKCOPY
 - SYSQUERY
 - SYSQUERYPLAN
 - SYSQUERYOPTS
 - SYSTABLES_PROFILES
 - SYSXMLTYPMOD
 - Several places where text or control info is included as CLOB or BLOB

DB2 10 Catalog...



- Convert to NFM
 - V10NFM
 - No additional changes noted
 - This is where more SYSIBM user tables would be created
 - *Database DSNXSR (DSNTIJNX – V8)*
 - *Resource Limit facility*
 - *Profiles*
 - *Explain tables*
 - *Etc...*

DB2 10 Catalog...

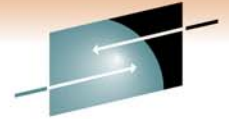
- V10 catalog restructure provides greater concurrency for catalog operations
 - Concurrent binds
- V8 migrations will include new Catalog table spaces for
 - Real-Time Statistics
 - New page size for SYSOBJ
 - XML
 - Trusted Context
 - Extended Index definitions
- V8 and V9 migrations see many table space changes for the catalog restructure
- Several LOB columns
 - Using Inline LOBs

DB2 10 Catalog...



- Summary
 - 55 spaces are UTS Partition By Growth
 - All are Unicode, except
 - SYSCOPY
 - SYSEBCDC
 - SYSTSASC
 - All are row level locking, except the following (page level):
 - SYSEBCDC
 - *Contains SYSDUMMY1 & SYSDUMMYE*
 - SYSSEQ
 - *Has MAXROWS set to 1*
 - 68 are RRF
 - 18 LOB Columns
 - 6 use Inline LOBs

| TABLERNAME | COLNAME | INLINE_LENGTH |
|-------------|------------|---------------|
| SYSPACKSTMT | STATEMENT | 15360 |
| SYSPACKSTMT | STMTBLOB | 7168 |
| SYSCTRLS | RULETEXT | 16000 |
| SYSCTRLS | DESCRIPTOR | 12000 |
| SYSQUERY | STMTTEXT | 2048 |
| SYSVIEWS | PARSETREE | 27670 |

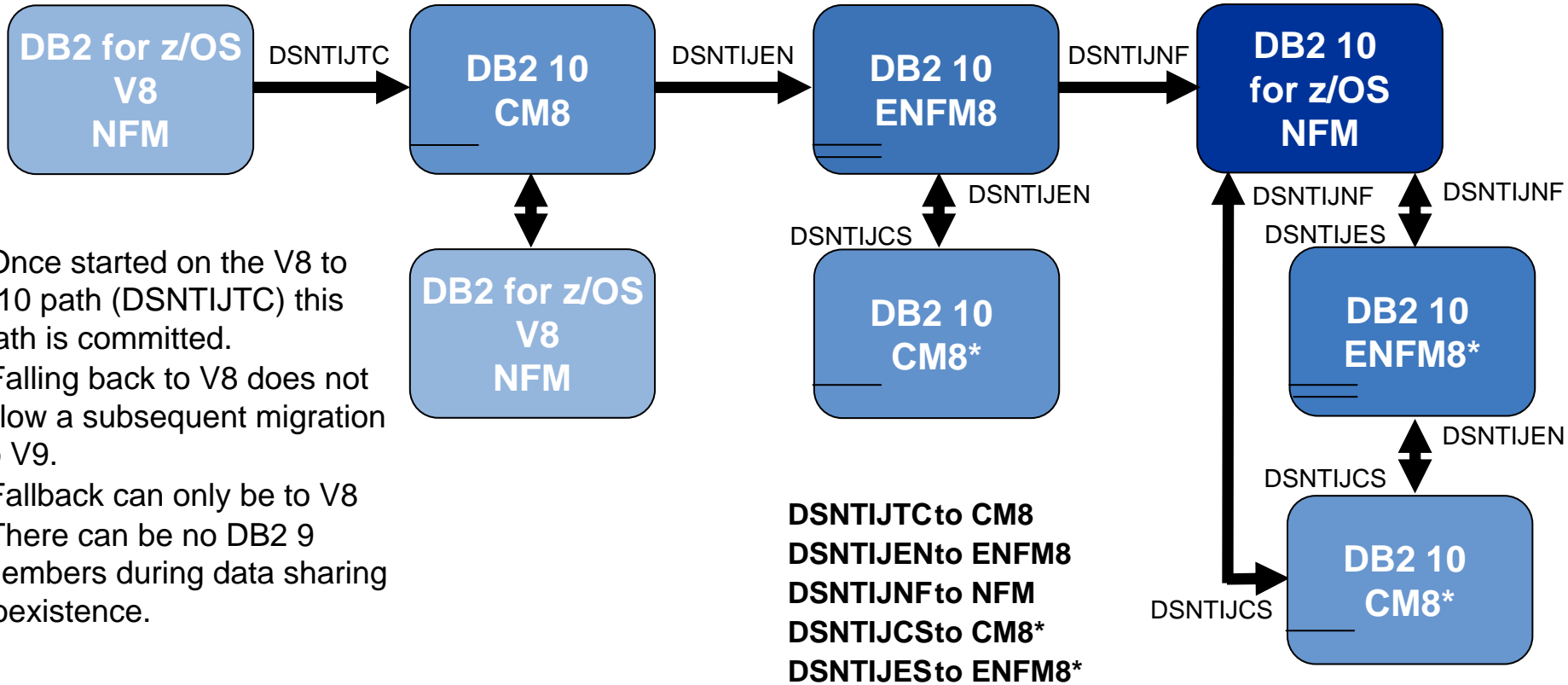
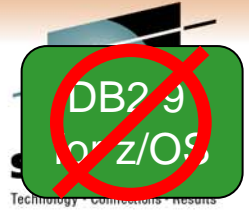


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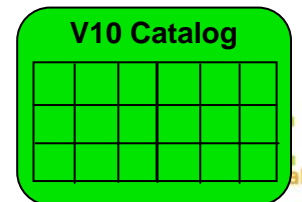
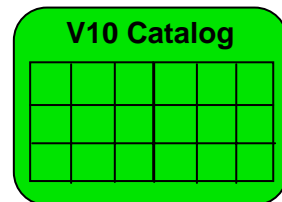
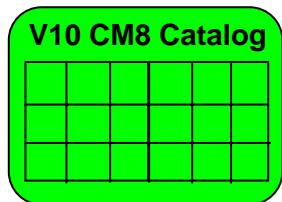
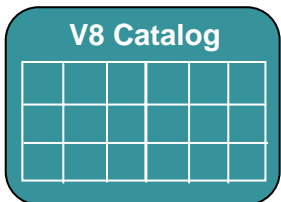
A Little More on that Migration Stuff...



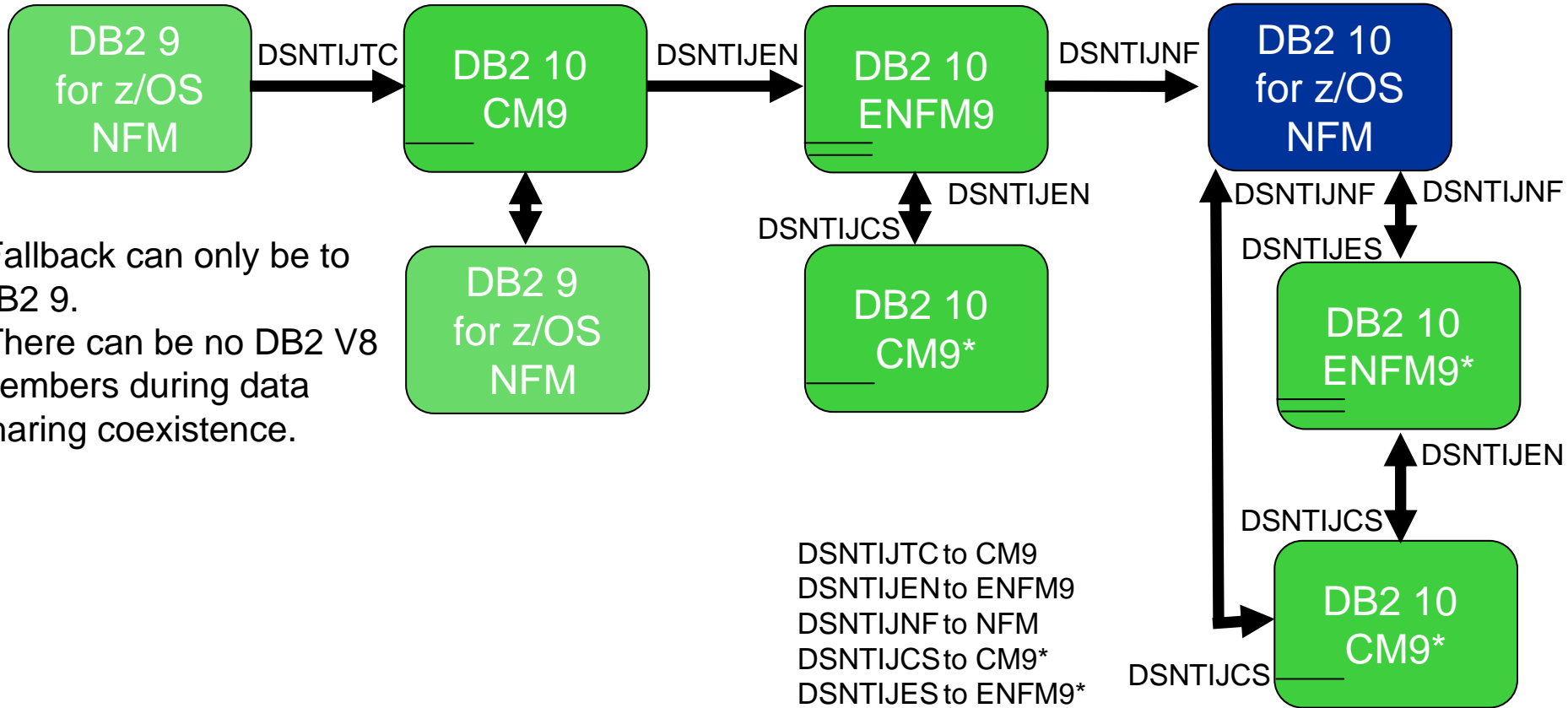
DB2 10 for z/OS Migration Modes from V8



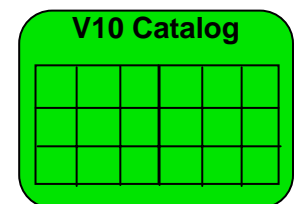
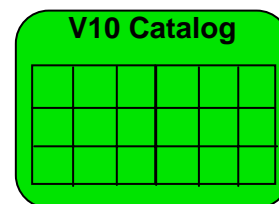
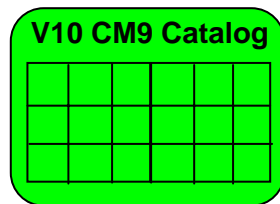
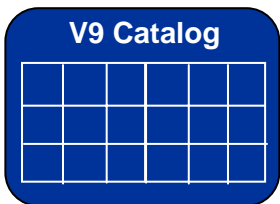
- Once started on the V8 to V10 path (DSNTIJTC) this path is committed.
- Falling back to V8 does not allow a subsequent migration to V9.
- Fallback can only be to V8
- There can be no DB2 9 members during data sharing coexistence.



DB2 10 for z/OS Migration Modes from V9



- Fallback can only be to DB2 9.
- There can be no DB2 V8 members during data sharing coexistence.



DB2 10 Modes

- CMx Considerations (1)

- Address Incompatibilities before migration
- Fall back SPE must be on all members (and restarted)
- Catalog is tailored
- Data Sharing group
 - V8 & CM8
 - V9 & CM9
- Test, test, test
- Fallback possible (CM8 to V8 OR CM9 to V9)
 - CM8 fall back to V8 CANNOT subsequently migrate to CM9
 - Fallback from CMx* not allowed
- Backup and Recover catalog objects in the specified order of the “migrate from” version.
 - Add new objects per:

http://publib.boulder.ibm.com/infocenter/dzichelp/v2r2/topic/com.ibm.db2z10.doc.inst/db2z_modifydsntijic.htm

| | |
|--|----------|
| V8 to V10CM8 New Table Spaces | |
| | 8 |
| TSNAME | |
| SYSCONTX | |
| SYSPLUXA | |
| SYSROLES | |
| SYSRTSTS | |
| SYSTARG | |
| SYSTSASC | |
| SYSTSUNI | |
| SYSXML | |

| | |
|--|----------|
| V9 to V10CM8 New Table Spaces | |
| | 2 |
| TSNAME | |
| SYSTSASC | |
| SYSTSUNI | |

DB2 10 Modes

- CM8 Considerations
 - RUNSTATS
 - Collects DATAREPEATFACTOR added in V9
 - New Cluster Ratio formula
- CMx Considerations (2)
 - REBIND
 - Re-enable XPROCs
 - Find additional incompatibilities
 - Potential virtual storage and performance improvements

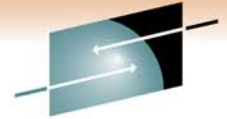
DB2 10 Modes

- ENFMx Considerations

- This is running the same code as CMx
- Catalog conversion takes place
- All members of a data sharing group must be at the CMx level before converting to ENFMx
- Can revert to CMx from ENFMx
- Beyond CMx, Backup and Recover objects V10 specified order

- NFM Considerations

- Can revert to ENFMx* or CMx*
 - Must be the same ENFM or CM mode as previous executed
 - *CM8 / CM9*
 - *ENFM8 / ENFM9*
- REORG TABLESPACE for LOBs SHRLEVEL NONE no longer supported.
 - As of NFM, these jobs will complete with an RC=0, but will not do anything



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DB2 Managed Catalog & Directory Table Spaces



Catalog Must be DB2 (DFSMS*) Managed



- Catalog must be DB2 managed
 - BEFORE moving to DB2 10 conversion mode (CM)
 - Before upgrading or a new installation
- DFSMS is a set of IBM software products that automatically manages your data (*see slide xx*)
- With DB2 10 DFSMS will manage and control
 - All new catalog changes
 - All conversions to universal table spaces
 - All new catalog and directory indexes and table spaces
- All the new indexes and table spaces being added in DB2 10 will also use Extended Addressability (EA).

* Data Facility Storage Management System

Catalog Must be DB2 Managed



- Migration job DSNTIJSS
 - Provides DFSMS classes for customers currently not using DFSMS
 - Environment created by DSNTIJSS only for the DB2 catalog and DB2 directory objects
 - No other DB2 data sets are covered
 - DSNTIJSS must be completed before the installation/migration jobs DSNTIJTC or DSNTIJEN are executed.
- No conversion step to SMS is required
 - Data sets are converted when related table space is next reorganized

Storage Definitions

- Installation/migration panel DSNTIPA2
 - Panel contains SMS data classes, management classes, and storage classes needed for DB2 10 catalog, directory, and their indexes
 - *Similar to what's currently available on the DB2 9 panel DSNTIPA3*
- DB2 10 DSNZPARM parameters for
 - Catalog and directory
 - CATDDACL, CATDMGCL, and CATDSTCL on the DSN6SPRM macro
 - Catalog and directory indexes
 - CATXDAACL, CATXMGCL, and CATXSTCL also on the DSN6SPRM macro

Storage Definitions

- Storage administrator should provide data classes, management classes, storage classes, and Automatic Class Selection (ACS) routines
- SMS must be configured to allocate all DB2 catalog and directory data sets in extended format using extended addressability (EA)

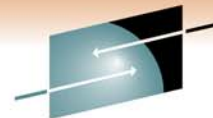
What Makes Up DFSMS*?

- **DFSMSdfp** (Data Facility Product), the biggest and only non-optional component on this list, provides the data, storage, program, and device management. It includes the following subcomponents: Extended Remote Copy (XRC), Peer-to-Peer Remote Copy (PPRC), Network File System (NFS), FlashCopy, SnapShot, and Concurrent Copy.
- **DFSMSdss** (Data Set Services) is the high-speed data mover used, among other things, to copy data from disk to disk or disk to tape.
- **DFSMShsm** (Hierarchical Storage Manager) quickly and automatically assists in moving data to less costly devices.
- **DFSMSrmm** (Removable Media Manager) helps deal with removable media.
- **DFSMSstvs** (Transactional VSAM Services) covers data integrity for shared VSAM by batch and CICS.

* Data Facility Storage Management System

References

- **DB2 10 for z/OS Migration**
 - IBM Migration Planning Workshop
 - Paul Bartak, Senior Certified Executive IT Specialist, DB2 Advisor
- **The DB2 Catalog Gets a Makeover**
 - December 2010 / January 2011 issue of z/Journal Magazine
 - <http://www.mainframezone.com/it-management/the-db2-catalog-gets-a-makeover>
- **My DB2 for z/OS Blog**
 - <http://it.toolbox.com/blogs/db2zos/>



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धन्यवाद

Hindi

多謝

Traditional Chinese

ขอบคุณ

Thai

Спасибо

Russian

Gracias

Spanish

Thank You

English

شكراً

Arabic

Merci

French

Obrigado

Brazilian Portuguese

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