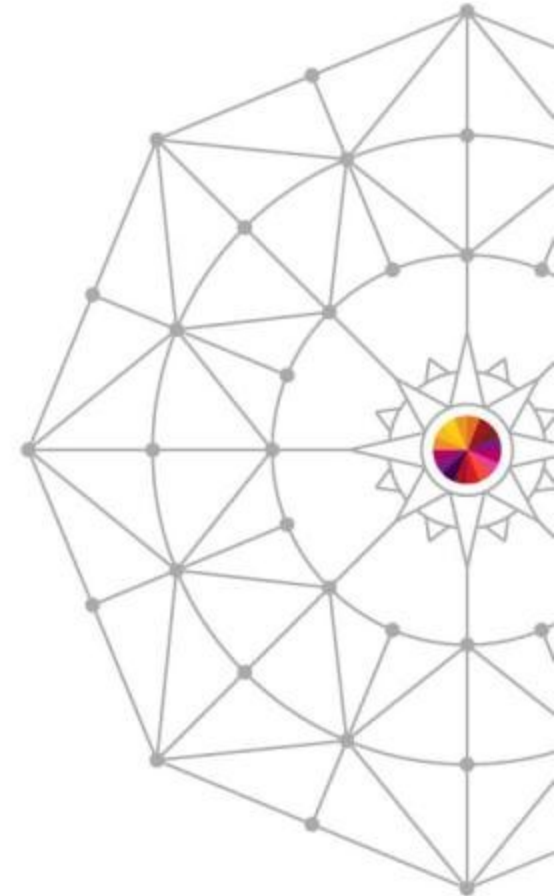


Migrating to DB2 11 for z/OS

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IBM

Thursday, March 13



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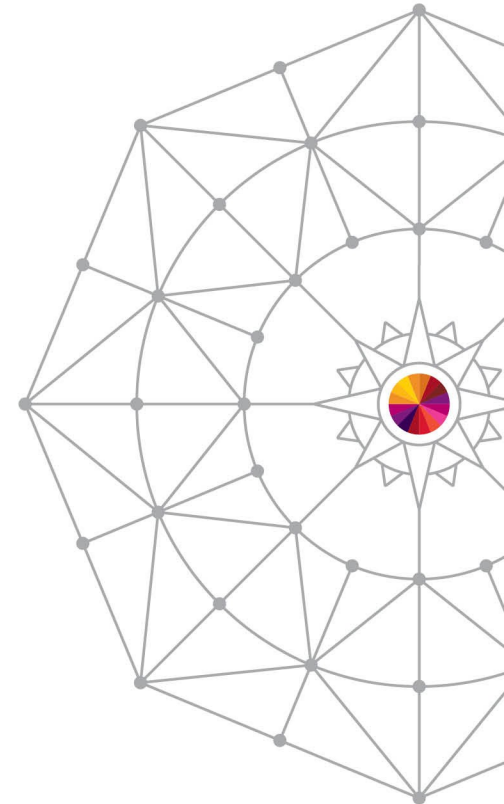
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Migration Agenda

- Hardware & Software Prerequisites
- Pre-migration planning
- Incompatibilities after migrating to V11
- The Migration Process
 - New Release Migration Planning
 - Migration to Conversion Mode (Running DSNTIJTC)
 - Enable New-Function-Mode (Running DSNTIJEN)
 - Catalog Restructure
- Fallback - Returning to a prior release



DB2 11 for z/OS

Hardware & Software Prerequisites



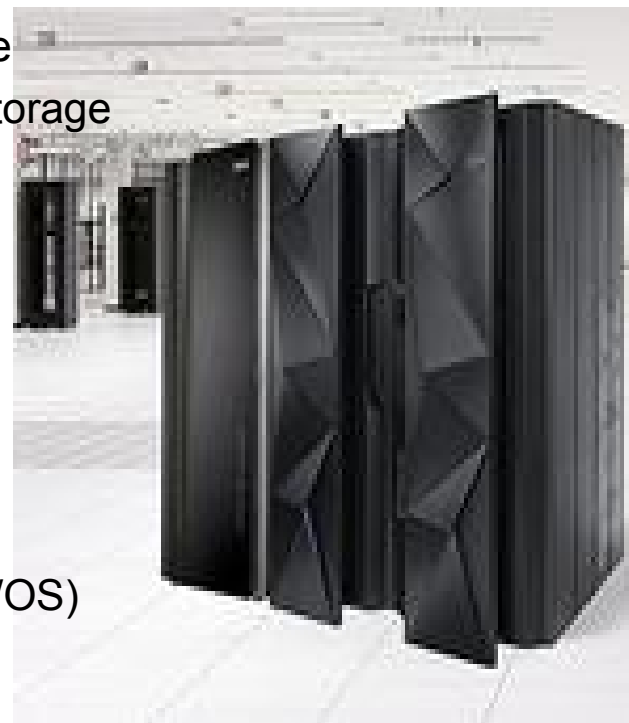
Prerequisites – Hardware & Operating System

➤ Processor requirements:

- EC12, z196, z10 processors supporting z/Architecture
- DB2 11 for z/OS will probably require increased real storage for a workload compared to DB2 10 for z/OS
 - Binding packages last bound prior to V9

➤ Software Requirements:

- z/OS V1.13 Base Services (5694-A01) at minimum
- DFSMS V1 R13 – DB2 Catalog is SMS managed
- Language Environment Base Services
- z/OS Version 1 Release 13 Security Server (RACF)
- IRLM Version 2 Release 3 (Shipped with DB2 11 for z/OS)
- z/OS Unicode Services and appropriate conversion definitions are required.
- DB2 Connect 10.5 Fixpack 2 – See II14732
 - Any in service release (9.7)
 - Seamless migration DB2 Connect 9.7 FP6 or 10.1 FP2



DB2 11 for z/OS

Pre-migration planning



Run DSNTIJPM (DSNTIJPB) pre-migration job

➤ Check for situations needing attention before migration

- Take the actions recommended by the report headers

➤ Run DSNTIJPM or DSNTIJPB, to identify them:

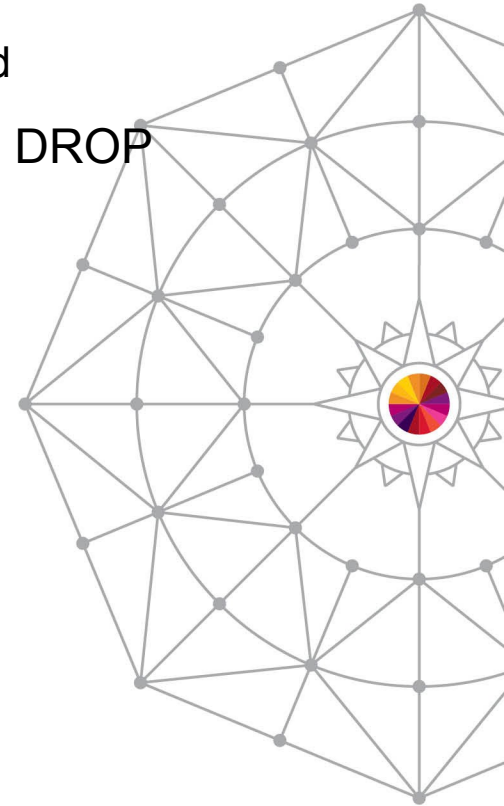
- DSNTIJPM ships with DB2 11 and should be run on previous releases to identify pre-migration catalog cleanup requirements.
 - DSNTIJPM may provide DDL or utility statements for the cleanup.
- DSNTIJPB is the same job and is shipped for DB2 V10 to maximize prepare time.



Important preparation

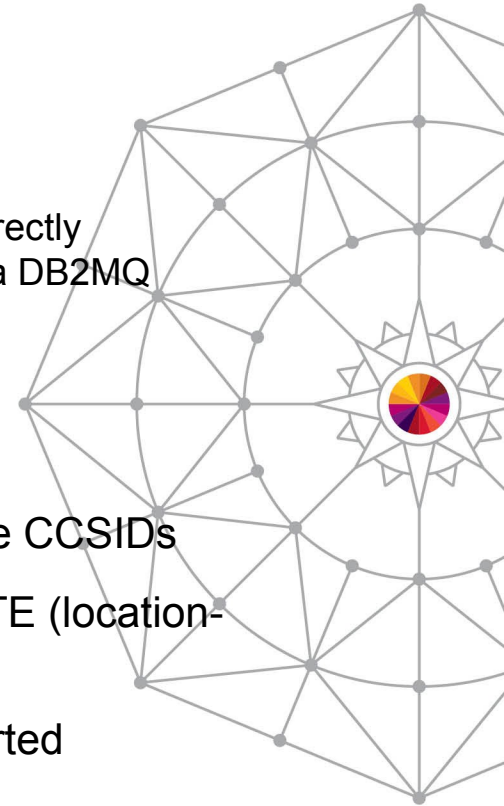
- Old plans and packages bound prior to V9 → REBIND
 - Previous or Original PLANMGMT copies prior to V9 cannot be used
- Views, MQTs, and Table functions with Period Specification → DROP
 - These created in V10 are not supported.
 - Period Specification must be on base table.
- IBM InfoSphere Data Replication (IIDR) 10.2.1 (Extended LRSN)

- V8 Plan table format will be accepted
- Plans containing DBRMs → packages
- ACQUIRE(ALLOCATE) only applies to DBRMs in plan → packages, ACQUIRE(USE)



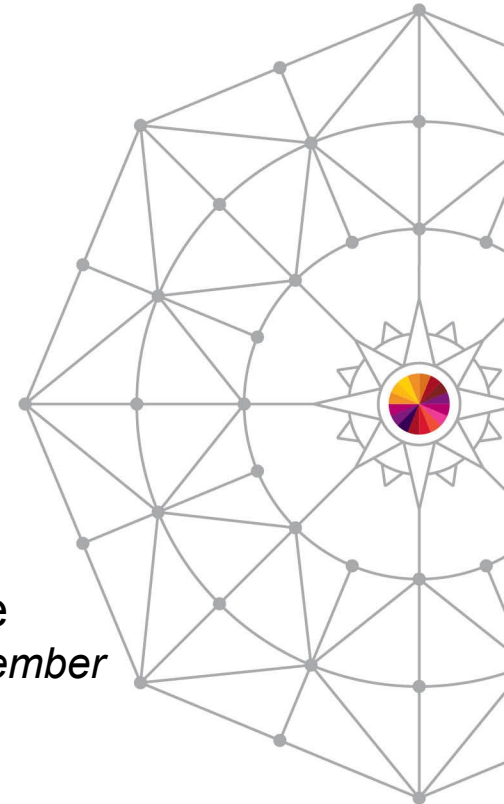
Items deprecated in earlier versions - NOW eliminated

- Password protection for active log and archive log data sets
- DSNH CLIST NEWFUN values of V8 and V9 – Use V10 or V11
- Some DB2 supplied routines
 - SYSPROC.DSNAEXP – Use the EXPLAIN Privilege and issue EXPLAIN directly
 - AMI-based DB2 MQ functions – Use the MQI-based functions in schema DB2MQ
See APAR PK37290 for guidance
 - DB2MQ1C.*
 - DB2MQ2C.*
 - DB2MQ1N.*
 - DB2MQ2N.*
- CHARSET application programming default value (KATAKANA) – use CCSIDs
- BIND PACKAGE options ENABLE and DISABLE (REMOTE) REMOTE (location-name,...,<luname>,...) -- specific names cannot be specified.
- Sysplex Query Parallelism – Single member parallelism is still supported
- DSN1CHKR – There are no longer any links in the catalog or directory

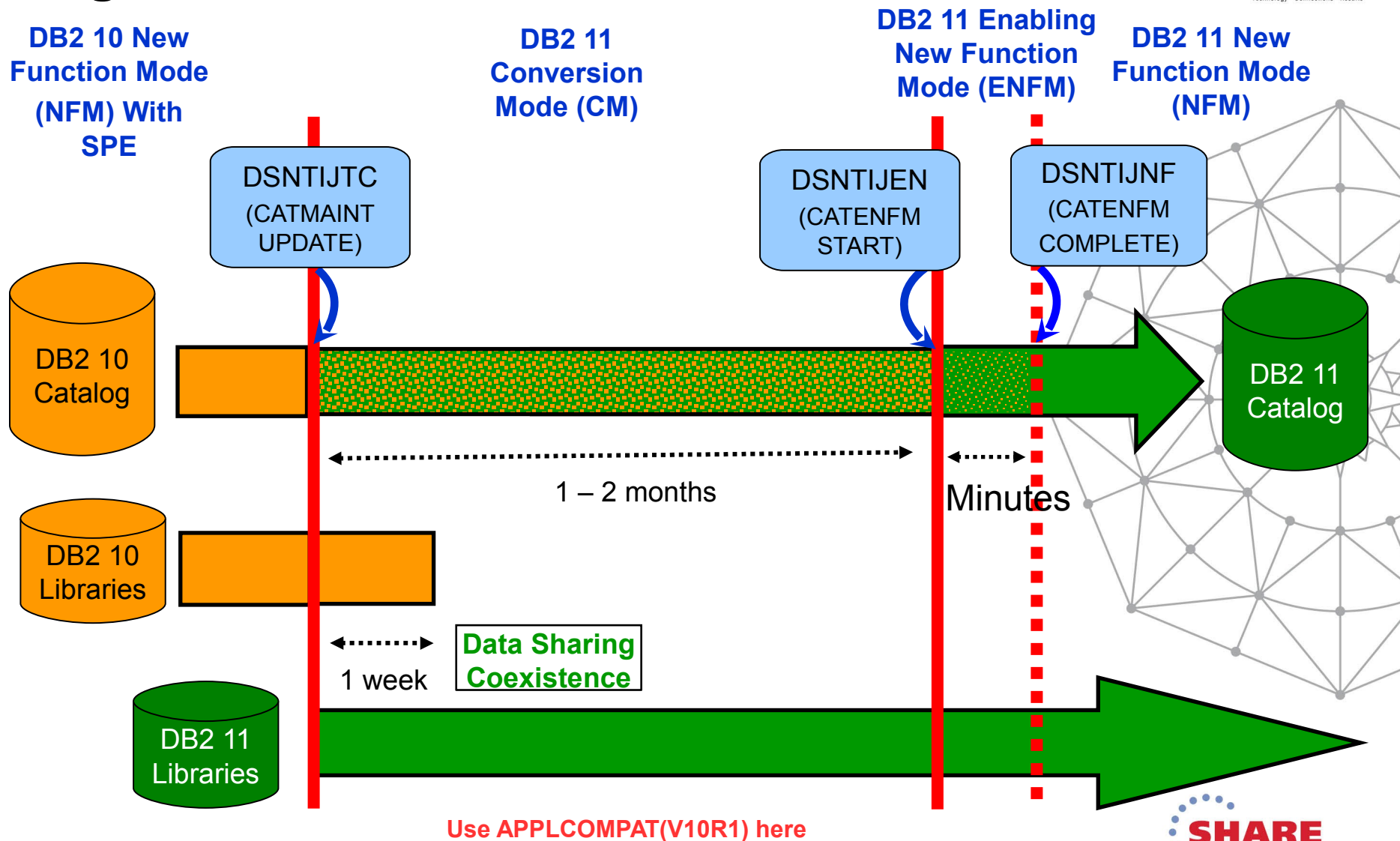


APPLCOMPAT – Application Compatibility

- Separates system migration from application migration
- APPLCOMPAT zParm provides default for BIND/REBIND
 - V10R1 for DB2 10 SQL behavior
 - V11R1 for DB2 11 SQL behavior
 - For install the default is V11R1
- BIND/REBIND option to override zParm default
- CURRENT APPLICATION COMPATIBILITY special register
 - For dynamic SQL
- Migration automatically sets V10R1 prior to NFM ... otherwise
 - DSNT225I -DSN BIND ERROR FOR PACKAGE *location.collid.member*
APPLCOMPAT(V11R1) OPTION IS NOT SUPPORTED
 - IFCID376 – Summary of V10 function usage
 - IFCID366 – Detail of V10 function usage, identifies packages
 - Expect changes necessary to avoid V10 usage to be made in NFM



Migration Overview DB2 10 → DB2 11



Use APPLCOMPAT(V10R1) here

Overview of Modes when migrating 10 → 11

CM Conversion Mode – The mode DB2 is in when DB2 11 is started for the first time after migrating direct from DB2 10. It will still be in CM when migration job DSNTIJTC has completed. Very little new function can be executed in CM. Data sharing systems can have DB2 10 and DB2 11 members in this mode.

ENFM Enabling New Function Mode - This mode is entered when job DSNTIJEN is first executed (CATENFM START). DB2 remains in this mode until all the enabling functions are completed. Data sharing systems can only have DB2 11 members in this mode.

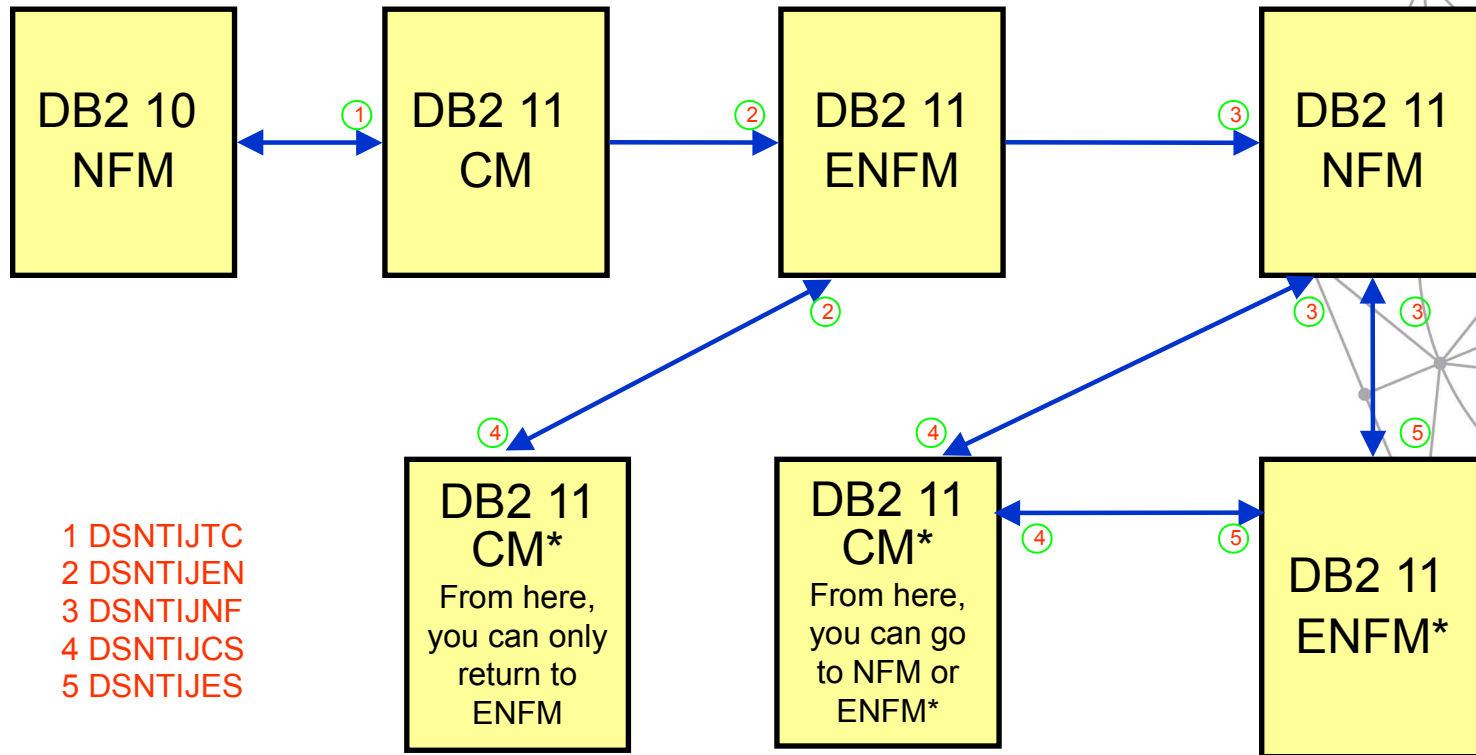
NFM New Function Mode - This mode is entered when job DSNTIJNF executed (CATENFM COMPLETE). This mode indicates that all catalog changes are complete and new function can be used.

ENFM* This is the same as ENFM but the * indicates that at one time DB2 was at DB2 11 NFM. Objects that were created when the system was at NFM can still be accessed but no new objects can be created. When the system is in ENFM* it can not fallback to DB2 10 or coexist with a DB2 10 system.

CM* This is the same as CM but the * indicates that at one time DB2 was at a higher level. Objects that were created at the higher level can still be accessed. When DB2 is in CM* it can not fallback to DB2 10 or coexist with a DB2 10 system.

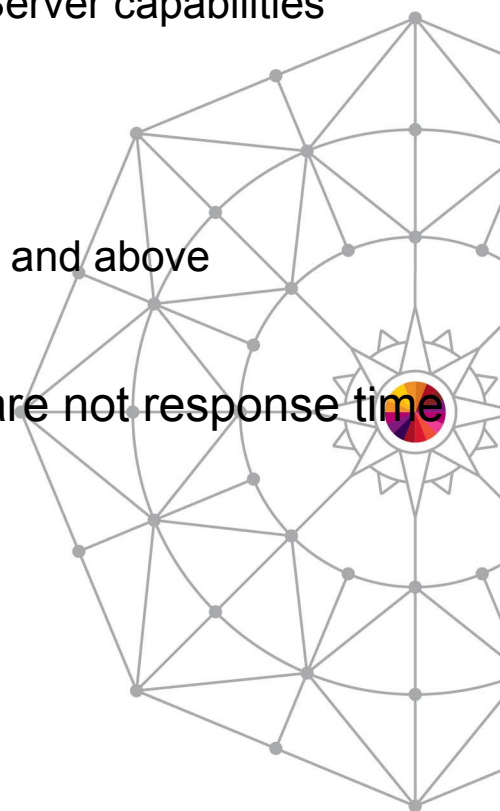
Migration and Fallback Paths

- With DB2 11, you can always drop back to the previous stage
- Cannot fallback to DB2 10 after entry to DB2 11 (ENFM), but can return to DB2 11 (CM*)



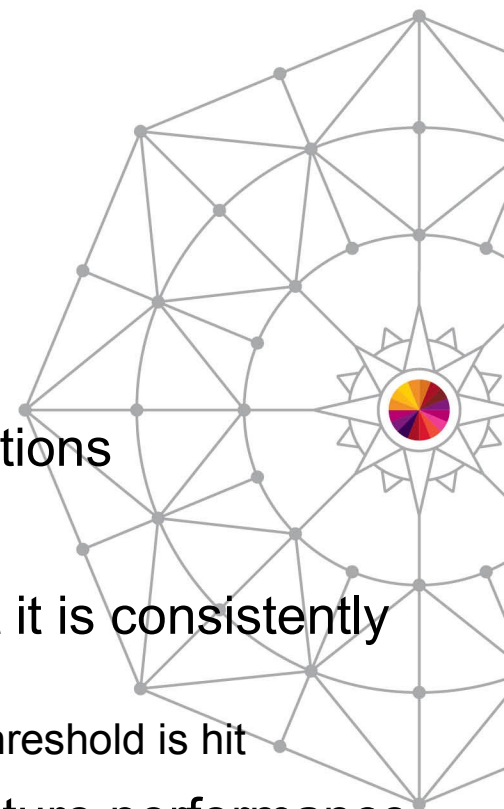
Performance Enhancements - no REBIND needed (CM)

- DDF performance improvements
 - Reduced SRB scheduling on tcp/ip receive using new CommServer capabilities
 - Improved autocommit OLTP performance
 - DRDA package based continuous block fetch
- xProcs above the bar
 - 31-bit Vstor relief enabled by RMODE 64 support in z/OS 1.13 and above
 - Enables other internal performance improvements
- zIIP enablement for all SRB-mode DB2 system agents that are not response time critical
- Avoid cross-memory overhead for writing log records
- Data decompression performance improvement
- INSERT performance
 - Latch contention reduction for classes 6, 14, 19
 - CPU reduction for Insert column processing and log record creation
 - Data sharing LRSN spin avoidance
 - Page fix/free avoidance in GBP write



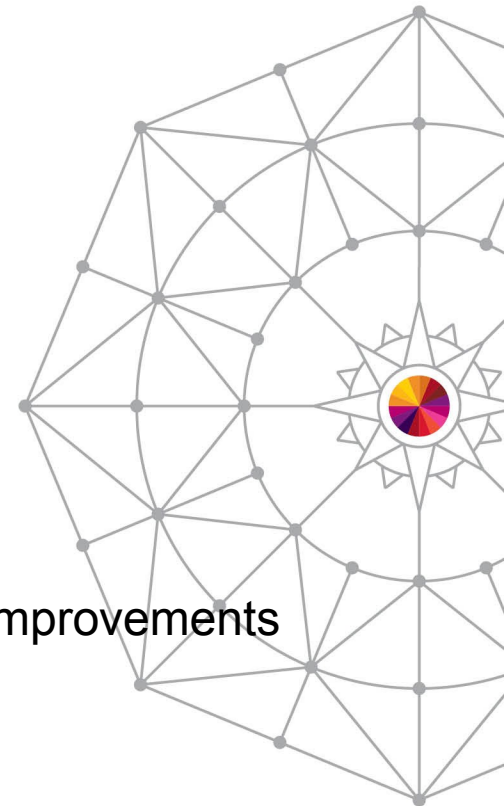
Performance Enhancements - no REBIND needed (CM)

- Automatic index pseudo delete cleanup
 - For fine-tuning, DBA work would be required
- ODBC/JDBC type2 performance improvements
 - Stored procedure invocation
- Java stored procedure multi-threading improvements
- Sort performance improvements
- DPSI performance improvements for merge
- Performance improvements with large number of partitions
- XML performance improvements
- Optimize RELEASE(DEALLOCATE) execution so that it is consistently better performing than RELEASE(COMMIT)
 - Monitor # parent locks and cleanup internal structures when threshold is hit
- IFI 306 filtering capabilities to improve Replication capture performance
- Utilities performance improvements



Performance Enhancements – no REBIND needed (CM)

- ACCESS DATABASE command performance
- DGTG performance improvements
 - Avoid incremental binds for reduced CPU overhead
- P-procs for LIKE predicates against Unicode tables
- Improved performance for ROLLBACK TO SAVEPOINT
- zEC12 exploitation:
 - Pageable 1M frames for buffer pool control structures
 - 2G page frame size
 - 1M page frames for DB2 code.
 - Requires z/OS 2.1 or above and zEC12 Flash Express
- Latch contention reduction and other high n-way scalability improvements
- Data sharing performance improvements
 - LRSN spin reduction with extended LRSNs
 - Castout performance
 - GBP write-around
 - Index split performance



APREUSE Comparison of ERROR and WARN

➤ APREUSE(ERROR) – available in V10

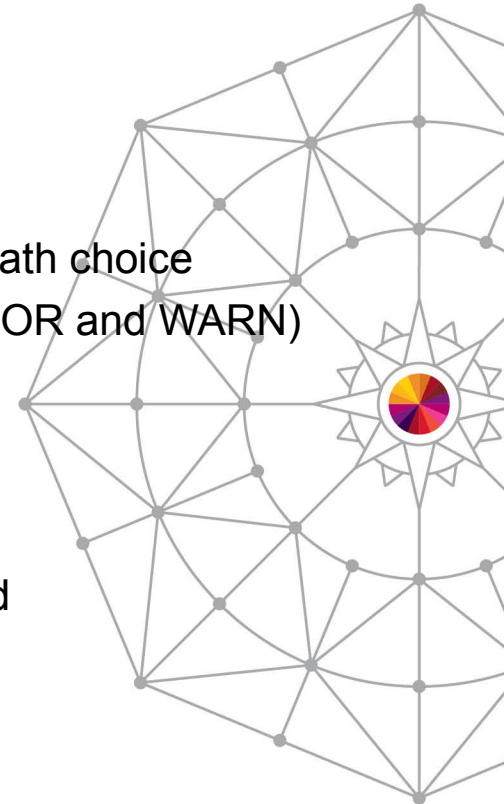
- Effectively operates at the package level

➤ APREUSE(WARN) – new in V11

- Effectively operates at the statement level
- Upon failure of reuse, Optimizer will generate a new access path choice
- PLAN_TABLE output will represent a valid plan (for both ERROR and WARN)

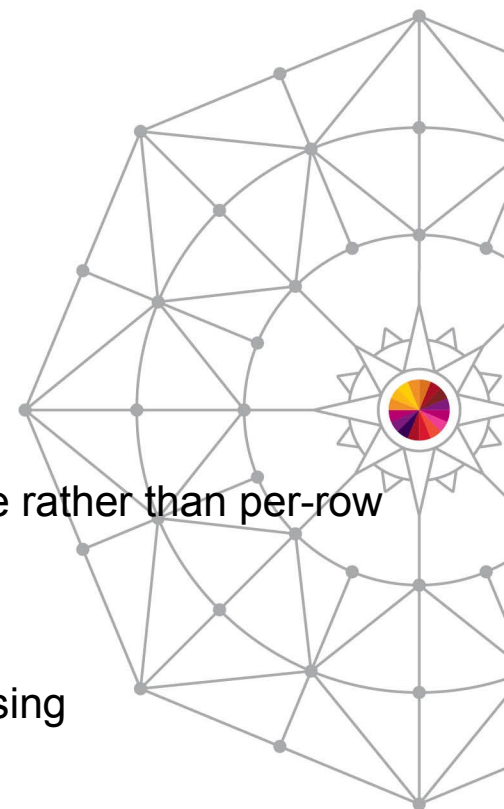
➤ Example

- With APREUSE(WARN)
 - Access paths kept on all statements that took the hint
 - Fresh access paths for statements on which the hint failed
 - All packages rebound successfully
- With APREUSE(ERROR)
 - Access paths kept for all packages that took all hints
 - Package REBIND failure where a hint failed
 - Larger number of queries affected



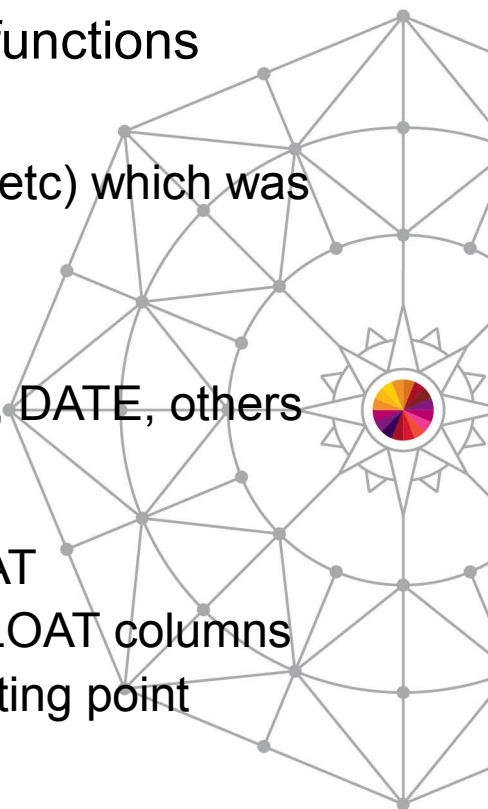
Performance Enhancements requiring REBIND (CM with or without REUSE)

- Most In-memory techniques
 - In-memory, reusable workfile
 - Sparse index (limited hash join support)
 - Non-correlated subquery using MXDTCACH
 - Correlated subquery caching
- Non correlated subquery with mismatched length
- Select list do-once
 - Non column expressions in the select list can be executed once rather than per-row
- Column processing improvements
 - Xproc (generated machine code) for output column processing
 - Optimized machine instructions for input/output column processing



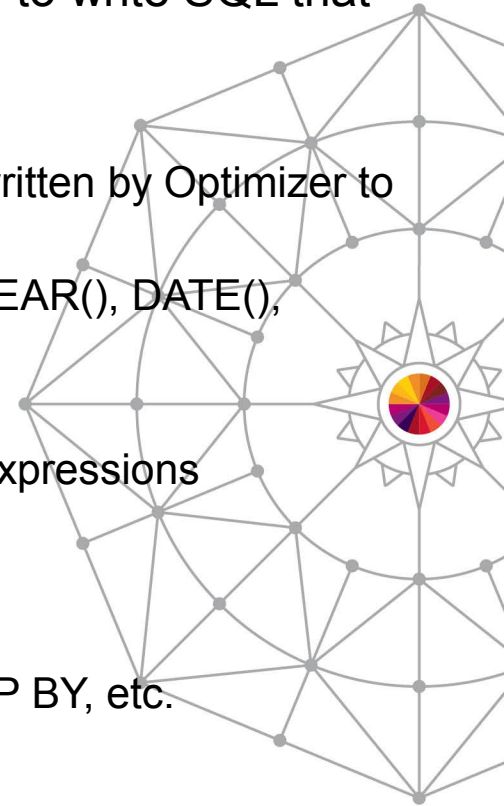
Performance Enhancements requiring REBIND (CM with or without REUSE)

- RID overflow to workfile handled for Data Manager set functions
 - DB2 10 added RID overflow to workfile
 - DB2 11 adds support for set functions (COUNT, MAX, MIN etc) which was excluded in DB2 10
- Performance improvements for common operators
 - MOVE, CAST, output hostvar processing, CASE, SUBSTR, DATE, others
- DECFLOAT data type performance improvements
 - Up to 23% CPU reduction for conversion to/from DECFLOAT
 - Approx. 50% CPU reduction in INSERT, FETCH for DECFLOAT columns
 - Helped further by zEC12 hw improvements for decimal floating point



Performance Enhancements requiring REBIND (CM without REUSE)

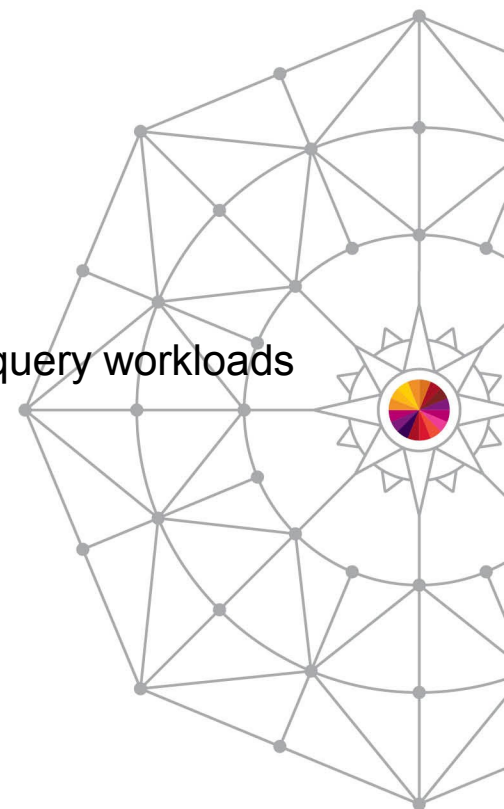
- Query transformation improvements – less expertise required to write SQL that performs well
 - Enhanced query rewrite to improve predicate indexability
 - new situations where non-indexable predicates can be rewritten by Optimizer to be indexable
 - Convert some common stage 2 predicates to indexable (YEAR(), DATE(), SUBSTR(col,1,x), value BETWEEN COL1 AND COL2)
 - Improved indexability for OR COL IS NULL predicates
 - Push complex predicates inside materialized views/table expressions
 - Enhanced pruning of "always true" and "always false" predicates
- Enhanced duplicate removal
 - Lots of queries require duplicate removal: e.g. DISTINCT, GROUP BY, etc.
 - Duplicate elimination via sorting can be expensive
 - New techniques: Index duplicate removal, early out
 - Will not show in Explain table, need to look at IXSCAN_SKIP_DUPS column in DSN_DETCOST_TABLE to determine if sort avoided



Performance Enhancements requiring REBIND (CM without REUSE)

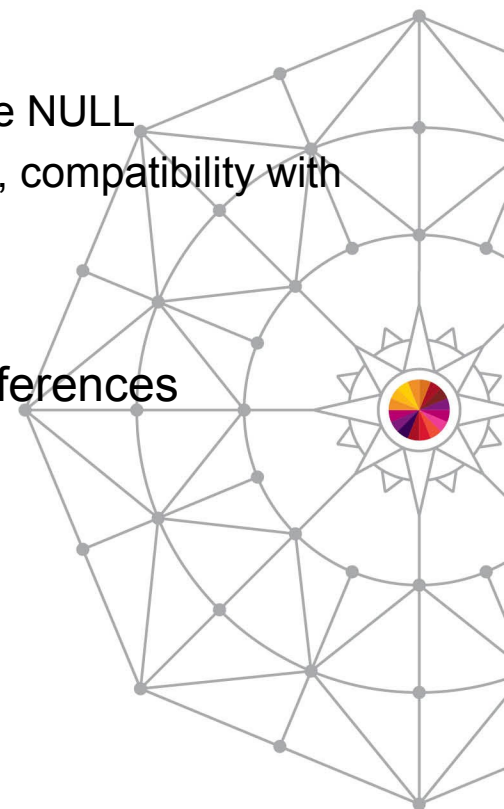
- DPSI and page range performance improvements
 - Page range screening for join/correlation predicates
 - Parallelism optimization for DPSI access

- Optimizer CPU and I/O cost balancing improvements
 - Measured results: 3% to >30% performance improvement for query workloads



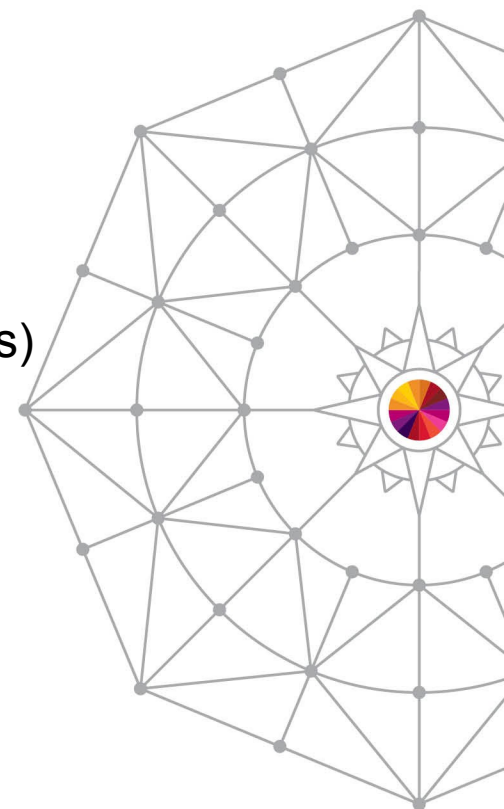
Performance Enhancements - DBA or application effort required (NFM)

- Suppress-null indexes
 - Index entries not created when all values for indexed columns are NULL
 - Reduced index size, improved insert/update/delete performance, compatibility with other DBMSes
 - Improved utility CREATE INDEX performance
- New PCTFREE FOR UPDATE attribute to reduce indirect references
- DGTT performance improvements
 - Non logged DGTTs
- Global variables
 - Easier, more efficient sharing of data between SQL statements



Performance Enhancements - DBA or application effort required (NFM)

- Optimizer externalization of missing/conflicting statistics
 - Identify missing statistics during bind/prepare/explain
 - DBA or tooling to convert output to RUNSTATS input
- Extended optimization - selectivity overrides (filter factor hints)
 - Improve optimizer's ability to find the cheapest access path
 - Collect filter factors for predicates in a Selectivity Profile
 - Selectivity Profile is populated via BIND QUERY
- Open data set limit raised to 200K



Optional Enhancements need NFM + DBA effort

- DSNTIJCB – Optional – Convert BSDS for extended 10-byte RBAs
 - STOP DB2 MODE(QUIESCE)

- DSNTIJCV – Optional – Convert Catalog and Directory table and index spaces to extended 10-byte RBA format
 - Reorg all Catalog and Directory table spaces SHRLEVEL CHANGE



Preparing your current DB2 for Migration to V11 CM

- Apply the Fallback SPE APAR, **PM31841** and any prerequisite fixes
 - **Your DB2 V10 system *MUST* be at the proper service level**
 - **See Info APARs II14660**
- Non-Data Sharing
 - Current DB2 10 must be started with the SPE applied, or migration to DB2 11 will terminate.
- Data Sharing
 - Before migrating a member to DB2 11, all other started DB2 10 members must have the fallback SPE applied.
 - The fallback SPE must be on all active DB2 10 group members for DB2 11 to start.

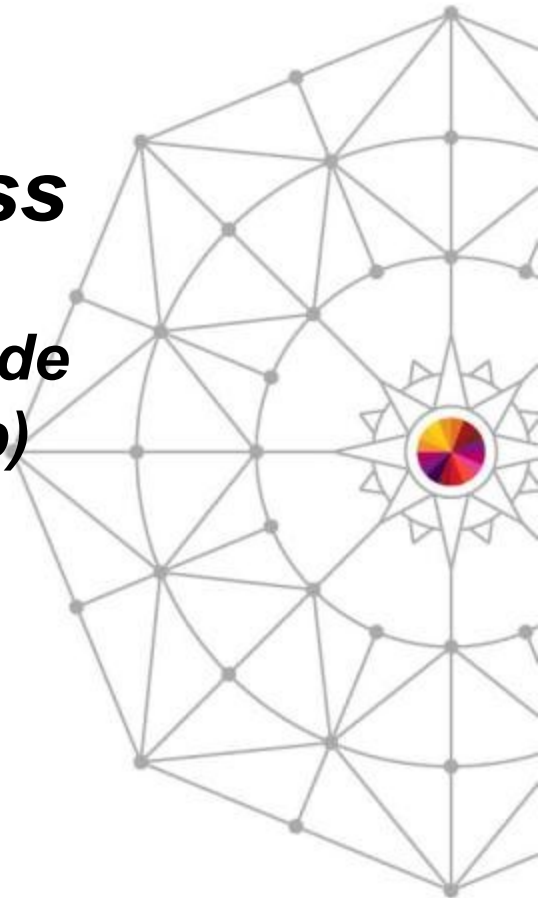


Important – Apply SPE to ALL Data Sharing Members Before Starting Migration!

DB2 11 for z/OS

The Migration Process

***Migration to Conversion Mode
(Running the DSNTIJTC job)***



Migration to Conversion Mode

- Recommend starting DB2 11 the first time with ACCESS(MAINT)
 - To avoid -904 with reason code 00C900A6 until DSNTIJTC is complete
- Run the **DSNTIJTC** job to migrate:
 - From DB2 10 for z/OS to DB2 11 for z/OS Conversion Mode (**CM**)
 - Authorization check (INSTALL SYSADM)
 - Verify Catalog is at correct level for migration
 - New release DDL
 - Additional Catalog updates
 - Update Directory header page and BSDS/SCA with new release information

```
DSNU000I 035 11:03:00.77 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = CATMAINT
DSNU1044I 035 11:03:00.87 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I 035 11:03:00.95 DSNUGUTC - CATMAINT UPDATE
DSNU750I 035 11:03:01.05 DSNUECM0 - CATMAINT UPDATE PHASE 1 STARTED
DSNU777I 035 11:03:01.05 DSNUECM0 - CATMAINT UPDATE STATUS - VERIFYING CATALOG IS AT CORRECT LEVEL FOR MIGRATION.
DSNU777I 035 11:03:01.07 DSNUECM0 - CATMAINT UPDATE STATUS - BEGINNING MIGRATION SQL PROCESSING PHASE.
DSNU777I 035 11:03:11.45 DSNUECM0 - CATMAINT UPDATE STATUS - UPDATING DIRECTORY WITH NEW RELEASE MARKER.
DSNU752I 035 11:03:11.46 DSNUECM0 - CATMAINT UPDATE PHASE 1 COMPLETED
DSNU010I 035 11:03:11.57 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Scan of SYSOBDS, SYSSEQUENCES, SYSTABSTATS

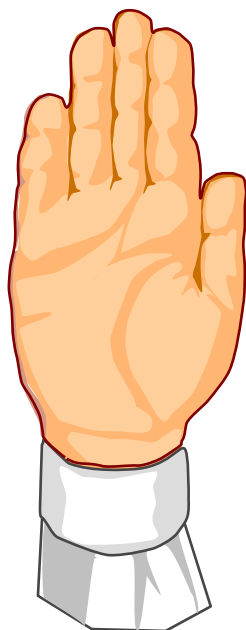
DB2 11 for z/OS

The Migration Process

Enabling New-Function-Mode



ENFM and NFM Considerations



Attention: You cannot return to the previous release (DB2 10) once you enter ENFM.

Do NOT move to ENFM until you are certain that you will not need to return.

HOWEVER

The code base for DB2 11 ENFM and NFM is the same as for CM.

You can return to CM* from ENFM or NFM if necessary.



Moving to Enabling New Function Mode

- DSNTIJEN job:
 - CATENFM START places DB2 in Enabling New Function Mode.
 - Data sharing groups must only have DB2 11 CM members.
- ENFM will handle the “**Catalog Restructure**” changes
- Some existing catalog and directory table spaces will be dropped and the tables will be moved to the new SMS-controlled table spaces.
 - DB2-defined indexes on these tables in the catalog and directory will also become SMS-controlled.
 - User-defined catalog indexes also become SMS-controlled.
- New columns will be added.
- A number of new Indexes will also be created



DB2 11 for z/OS

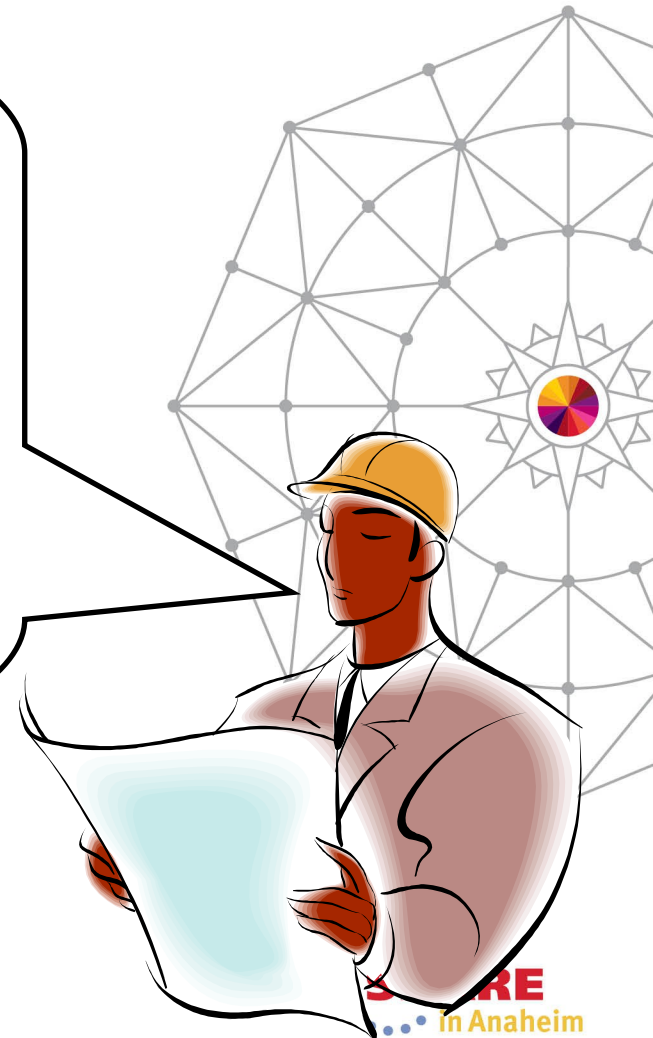
The Migration Process

“Catalog Restructure”



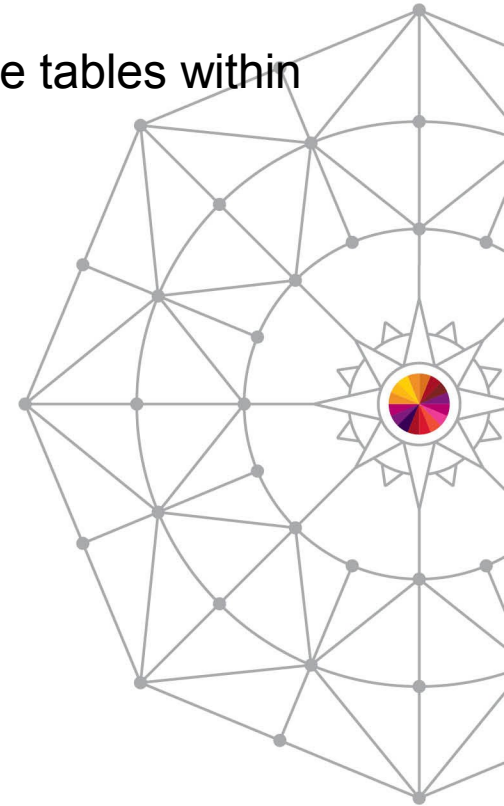
Catalog Restructure enhancement summary

- DB2 (SMS) managed catalog and directory data sets
- Reduce catalog contention
 - Change to row-level locking
- Convert some catalog and directory table spaces to partition-by-growth (PBG)
 - With MAXPARTS = 1
 - New Row Format



Catalog Restructure Table Spaces

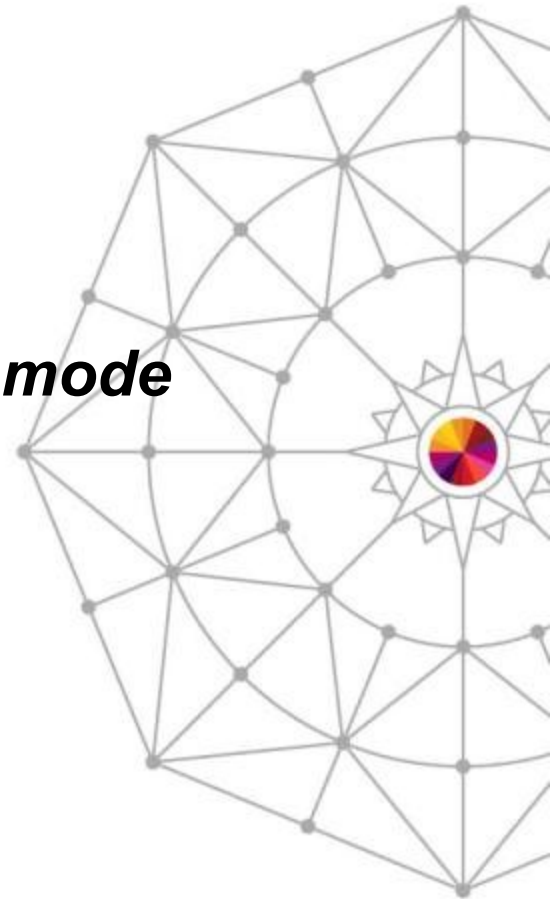
- SYSLGRNX becomes a PBG table space
- SYSCOPY, SYSRTSTS, and SYSSTR will be removed and the tables within each will be moved to new PBG table spaces
- SYSTSIXS and SYSTSTAB are also processed in ENFM.
 - Row level locking
 - New row format
 - Partition-by-growth
 - One table per table space
 - DSSIZE 64G
 - MAXPARTS 1
 - SMS-controlled



DB2 11 for z/OS

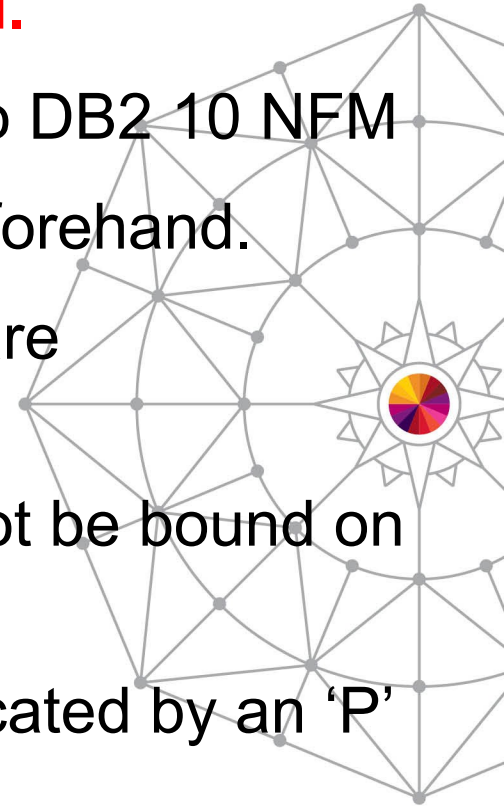
Fallback

Returning to a prior release or mode



Returning to a previous release from DB2 11

- **Fallback is only supported from DB2 11 CM.**
- Migrate to DB2 11 CM then you can fallback to DB2 10 NFM
- Fallback SPE (PM31841) **must** be applied beforehand.
- Packages bound (or rebound) in DB2 11 CM are automatically rebound in DB2 10 NFM.
- DBRMs created by the V11 Precompiler cannot be bound on V10
- Objects with functional dependencies are indicated by an 'P' in the IBMREQD catalog columns.
 - Frozen on return to DB2 10.



Questions and Answers

Thank
You

