

Db2 12 for z/OS Update

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Db2 for z/OS
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December 5, 2019



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Agenda

- Review recent Db2 12 for z/OS enhancements
 - Function levels – V12R1M503 and beyond
 - M503, M504, M505, M506
 - Non-function level specific enhancements
- Discuss customer experiences
 - Recommendations for your migration
- Other questions that arise...

Function levels (1)

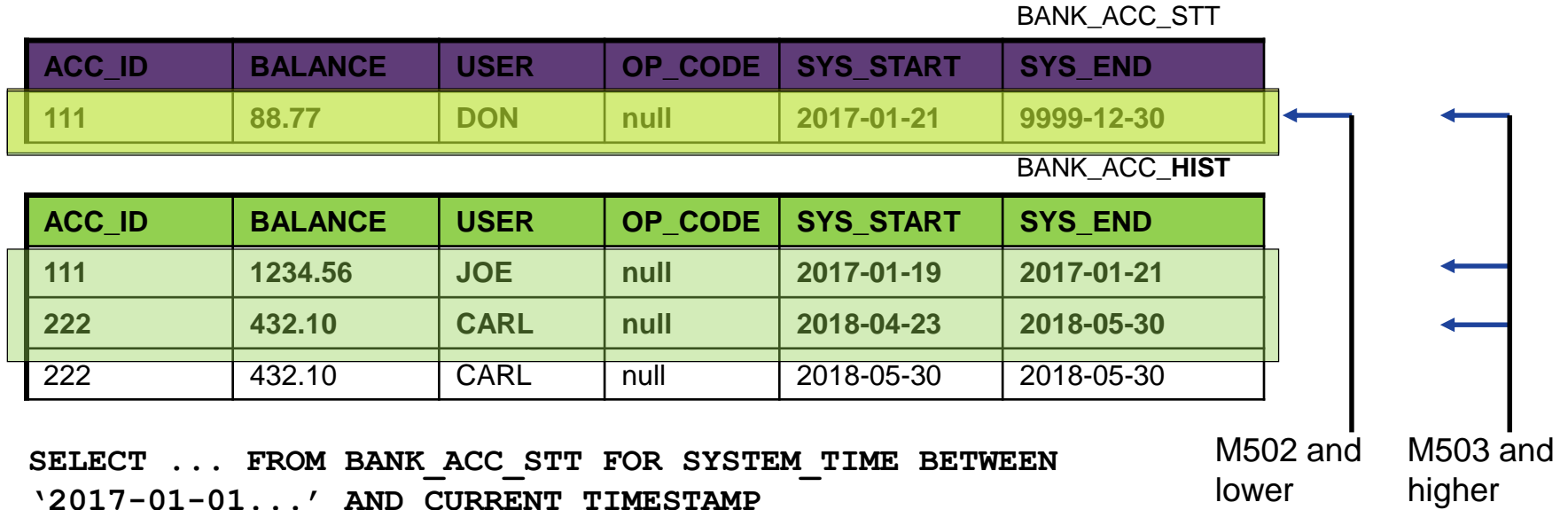
— V12R1M503 (PH00506)

- Code level required for Db2ZAI
 - Only function level V12R1M500 required for Db2ZAI
- Function level V12R1M503 supports temporal enhancements
 - System time temporal: temporal query correction
 - System time temporal: replication enhancements

V12R1M503

— System time temporal: temporal query correction

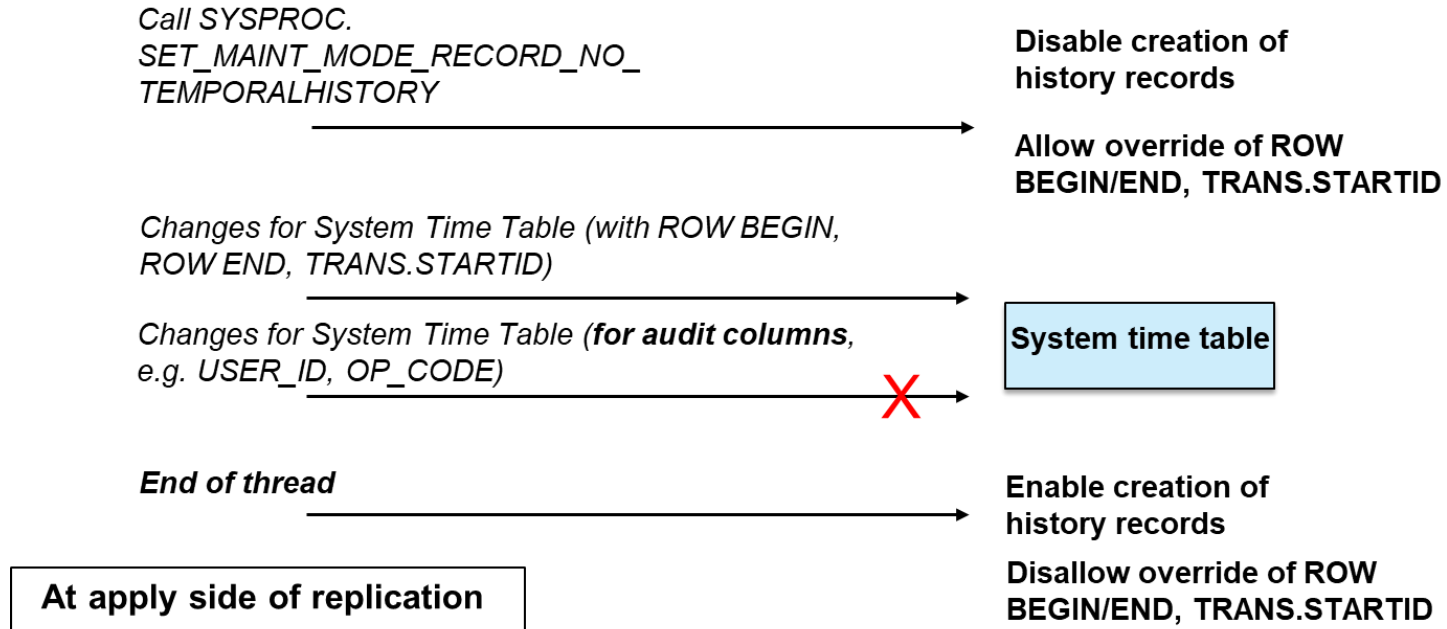
- Rows with NULLs for DATA CHANGE OPERATION in history table now included in result set
- Applies to system time temporal tables and history tables defined with ON DELETE ADD EXTRA ROW
 - Incompatible change – use IFCID 376 to identify affected queries



V12R1M503

— System time temporal: replication enhancements

- FL V12R1M502 or lower limited support for replication of system time temporal tables



— System time temporal: replication enhancements

- FL V12R1M503: new global variable `SYSIBMADM.REPLICATION_OVERRIDE` on apply side
 - Default: 'N'
- If set to 'Y'
 - Override ROW BEGIN, ROW END, TRANSACTION START ID and generated expressions
 - No history records created
- Allows complete replication of system time temporal tables (including history tables)
- Can be switched (back and forth) while thread is running
- Intended for replication products
- On apply side: `APPLCOMPAT(V12R1M503)` required for packages leveraging this feature

Function levels (2)

— V12R1M504 (PH07672)

- Deprecated objects
- Huffman compression
- New BIFs pass-through to IDAA

V12R1M504

— Deprecated objects

e.g. CREATE TABLESPACE	issued by application with APPLCOMPAT < V12R1M504	issued by application with APPLCOMPAT >= V12R1M504
SEGSIZE n	Segmented Table Space	UTS – PBG
SEGSIZE 0 & NUMPARTS p	Classic Partitioned Table Space	UTS – PBR
SEGSIZE n & MAXPARTITIONS p	UTS – PBG	UTS – PBG
SEGSIZE n & NUMPARTS p	UTS – PBR	UTS – PBR

V12R1M504

— Deprecated objects

- Classic partitioned and segmented table spaces can no longer be created by a program (e.g. DSNTEP2) whose package has APPLCOMPAT \geq V12R1M504
- Consideration: multi-table segmented table space
 - Reorg to convert it to multiple UTS PBG will come in future
 - If such an object mistakenly dropped, can re-create if APPLCOMPAT (or CURRENT APPLICATION COMPATIBILITY) $<$ V12R1M504
- No longer do-able with APPLCOMPAT \geq V12R1M504:
 - CREATE TABLE referencing an empty classic partitioned or any segmented/simple table space
 - CREATE/ALTER TABLE ... ORGANIZE BY HASH
 - CREATE SYNONYM [plan to use CREATE ALIAS instead]

— Huffman compression

— Requirements

- z14 or beyond
- UTS only
- DSNZPARM keyword TS_COMPRESSION_TYPE:
 - FIXED_LENGTH (old style compression logic)
 - HUFFMAN (aka entropy encoding)
- Table space has COMPRESS YES attribute

— Next dictionary build (REORG, LOAD REPLACE or INSERT) generates Huffman dictionary

- Which compression logic is used, can be detected by value in header page field HPGZLD (formatted by DSN1PRNT):
 - L or F indicates fixed-length dictionary
 - H indicates Huffman dictionary

V12R1M504

— New BIFs pass-through to IDAA

- Passthrough-only expressions cannot run on Db2 for z/OS and are only supported by accelerator servers

— How it works

- Db2 only verifies that the data types of the parameters are valid for the functions
- The accelerator engine does all other function resolution processing and validation
- This feature is only for Db2 Analytics Accelerator V7
- 7.1.5 is required from IDAA side
- Required Db2 maintenance is listed in release notes

<http://www-01.ibm.com/support/docview.wss?uid=swg27050440>

V12R1M504

— New BIFs pass-through to IDAA

- CUME_DIST : Returns a cumulative distribution of a row within an OLAP window
- FIRST_VALUE : Returns the expression value for the first row in an OLAP window
- LAG : Returns the expression value for the row at offset rows before the current row
- LAST_VALUE : Returns the expression value for the last row in an OLAP window
- LEAD : Returns the expression value for the row at offset rows after the current row
- NTH_VALUE: Returns the expression value for the nth-row row in an OLAP window
- NTILE : Returns the quantile rank of a row
- PERCENT_RANK : Returns a relative percentile rank of a row within an OLAP window
- RATIO_TO_REPORT : Returns the ratio of an argument to the sum of the arguments in an OLAP partition
- REGEXP_COUNT : Returns a count of the number of times that a regular expression pattern is matched in a string
- REGEXP_INSTR : Returns the starting or ending position of the matched substring, depending on the value of the **return_option** argument
- REGEXP_LIKE : Returns an INTEGER value of 0 or 1 indicating if the regular expression pattern is found in a string
- REGEXP_REPLACE : Returns a modified version of the source string where occurrences of the regular expression pattern found in the source string are replaced with the specified replacement string

Function levels (3)

— V12R1M505 (PH09191)

- REBIND phase-in
- IDAA HTAP Phase 2
- BIF for Transparent Column Encryption
- Indexes for DECFLOAT columns
- Removal of trigger restrictions for Temporal and Transparent Archiving
- RUNSTATS sampling simplification

V12R1M505

— REBIND phase-in

— Problem statement

- DBA cannot bind packages that are in use, for example
 - Cannot reoptimize
 - Cannot change bind options
 - Cannot switch to previous access path in case of regression
- ‘in use’ means use count is > 0
 - Applies to RELEASE COMMIT until commit
 - Applies to RELEASE DEALLOCATE until thread termination

— Solution: REBIND phase-in

- Existing threads use current package copy
- DBA issues REBIND; Db2 creates new package copy
 - Db2 marks current copy ‘do not use’ in EDM pools
- New threads use new copy
 - Old copy deleted when no longer used

V12R1M505

- REBIND phase-in sequence of events
- Threads executing CURRENT package copy (copy ID n)
- REBIND
 - Create a next CURRENT copy of package with new copy ID (n+1)
 - Replicate old CURRENT copy (n) to PREVIOUS (copy ID 1) and ORIGINAL (copy ID 2) if needed
 - Move copy ID n to SYSPACKCOPY as **phased-out** copy
- New threads load and execute new CURRENT copy (n+1) once the REBIND completes

V12R1M505

— REBIND phase-in example

Thread 1 – copy ID 0



Thread 2 – copy ID 0



REBIND – copy ID 4: CURRENT



Thread 3 – copy ID 0



Thread 4 – copy ID 4



V12R1M505

— REBIND phase-in COPYID

COPYID column	in SYSIBM...	Remark
0, 4, 5, ... 16	SYSPACKAGE	CURRENT, used in wrap-around mode
1	SYSPACKCOPY	PREVIOUS
2	SYSPACKCOPY	ORIGINAL
3	-	reserved
0, 4, 5, ... 16	SYSPACKCOPY	Phased-out copies, until deleted

V12R1M505

- REBIND phase-in
- Current copy
 - 1 row in SYSPACKAGE, including COPYID column
 - Copy ID generated as 0, 4, 5, 6, ...16 then wrap back
 - 1 = PREVIOUS, 2 = ORIGINAL, 3 is reserved
- Phased-out copies
 - In SYSPACKCOPY (with COPYID other than 1, 2)
 - Cleaned up on subsequent REBIND
- EXPLAIN PACKAGE COPY *copy-id*
 - CURRENT: copy ID in SYSPACKAGE.COPYID column (0 or non-0)
 - Omit COPY clause: includes CURRENT, PREVIOUS, and ORIGINAL
 - Changed value in PLAN_TABLE.HINT_USED
- New copy ID field in IFCID 239 package accounting
 - Increased QPAC mapping size

V12R1M505

- REBIND SWITCH phase-in
- Threads are executing CURRENT copy ID (n)
- REBIND SWITCH:
 - Copy PREVIOUS or ORIGINAL to new CURRENT copy ID (n+1)
 - Copy n becomes **phased-out** copy
 - Replicate phased-out copy (n) into PREVIOUS and ORIGINAL if needed
- New threads can execute new CURRENT (n+1)

V12R1M505

- REBIND phase-in eligibility
- Phase-in occurs only when current copy is in use
- Initial support:
 - PLANMGMT(EXTENDED) APREUSE(NO)
 - PLANMGMT(EXTENDED) APREUSE(WARN|ERROR) APREUSESOURCE(CURRENT)
- Packages for native SQL routines or advanced triggers do not currently support REBIND phase-in
- REBIND phase-in is an always-on feature in M505
 - No APPLCOMPAT requirement

V12R1M505

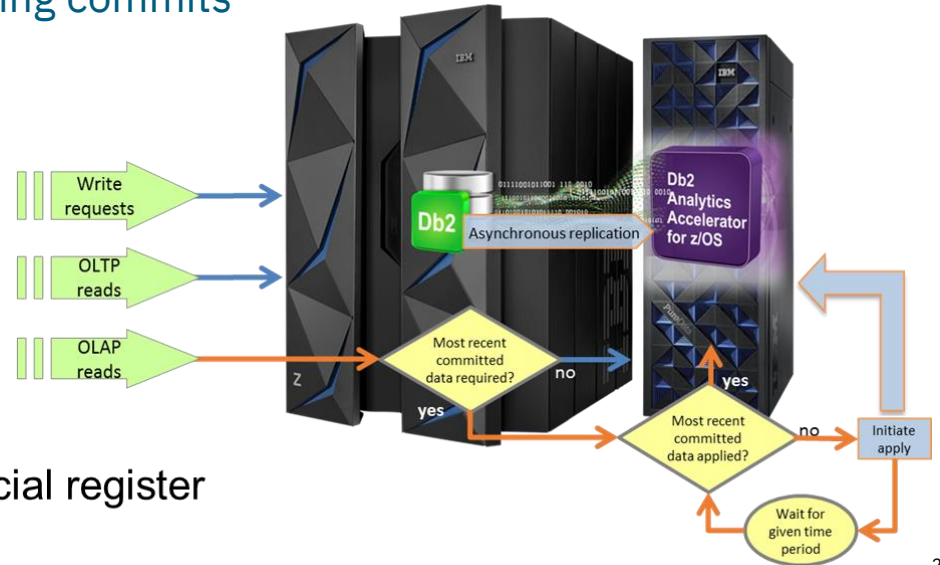
— FREE phased-out copy

— Phased-out copy clean up on REBIND

- Query package lock holders
- Compare oldest thread's package allocation time to the time a copy becomes phased-out
 - DSNT500I message with new reason code 00E30307 to show thread blocking FREE
- New IFCID 393 to indicate long running thread RELEASE(DEALLOCATE), uncommitted thread

V12R1M505

- IDAA HTAP Phase 2
- Data coherency between DB2 and Accelerator
- Don't worry about latency of committed data
Queries run when data available
- No longer need to explain to users why committed data not seen.
Data used by SELECT contains corresponding commits



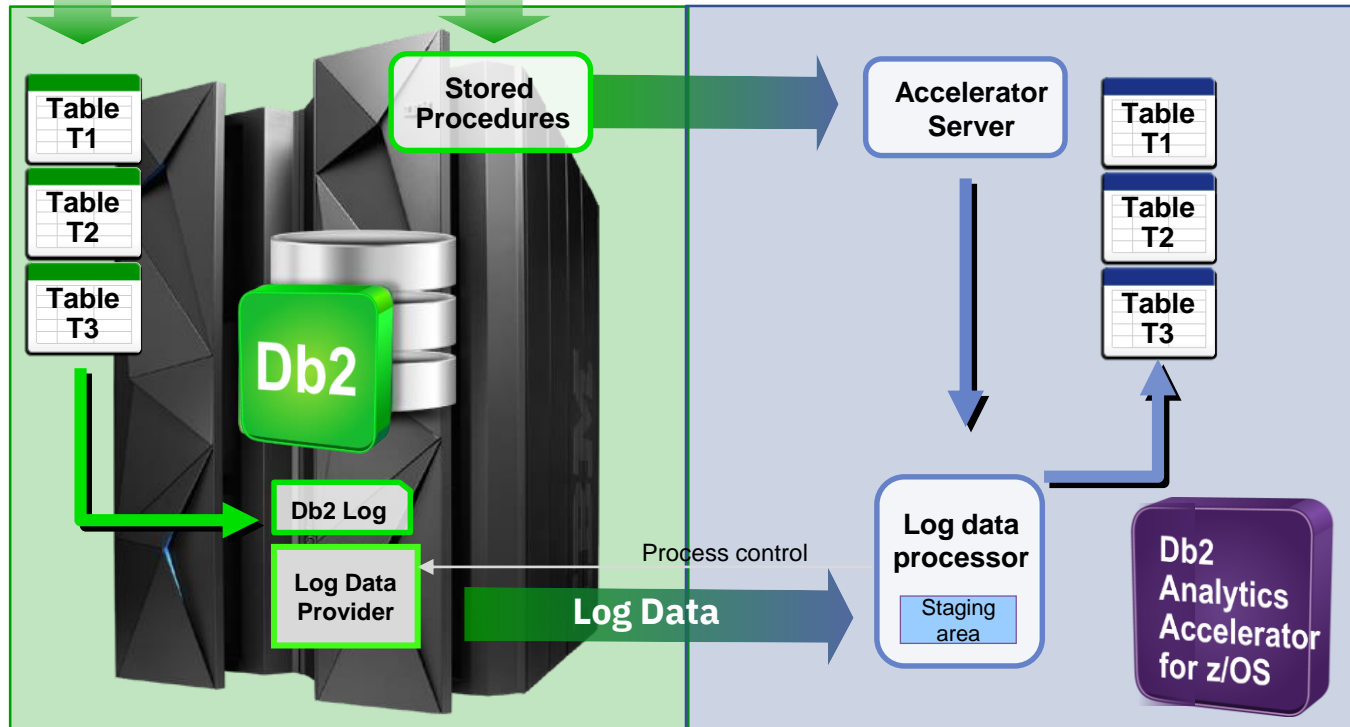
zParm + Bind option + Special register
WAITFORDATA > 0.0

V12R1M505

— IDAA Integrated synchronization

Applications executing
I/U/D Statements on replicated tables

Accelerator Users enabling
tables for replication



- BIF for Transparent Column Encryption

- **ENCRYPT_DATAKEY (data string, keylabel, algorithm)** allows
 - Column-based encryption of security-sensitive data
 - String and numeric datatypes are supported
 - Resulting datatype is VARBINARY for any non-LOB and BLOB for any LOB input value
 - Schema change required for cipher text column
 - Use of ICSF protected keys and RACF keylabel protection
 - Primary authid requires permit for keylabel defined in CSFKEYS class
 - AES256D|R – 256-bit AES CBC mode encryption algorithm
 - 'D' – fixed initialization vector to generate a cipher text
 - 'R' – random initialization vector to generate a cipher text

- **DECRYPT_DATAKEY_BIGINT ... _CHAR ... _INTEGER ...**
 - Datatype dependent BIFs: DECRYPT_DATAKEY_xxxx (encrypted data)

V12R1M505

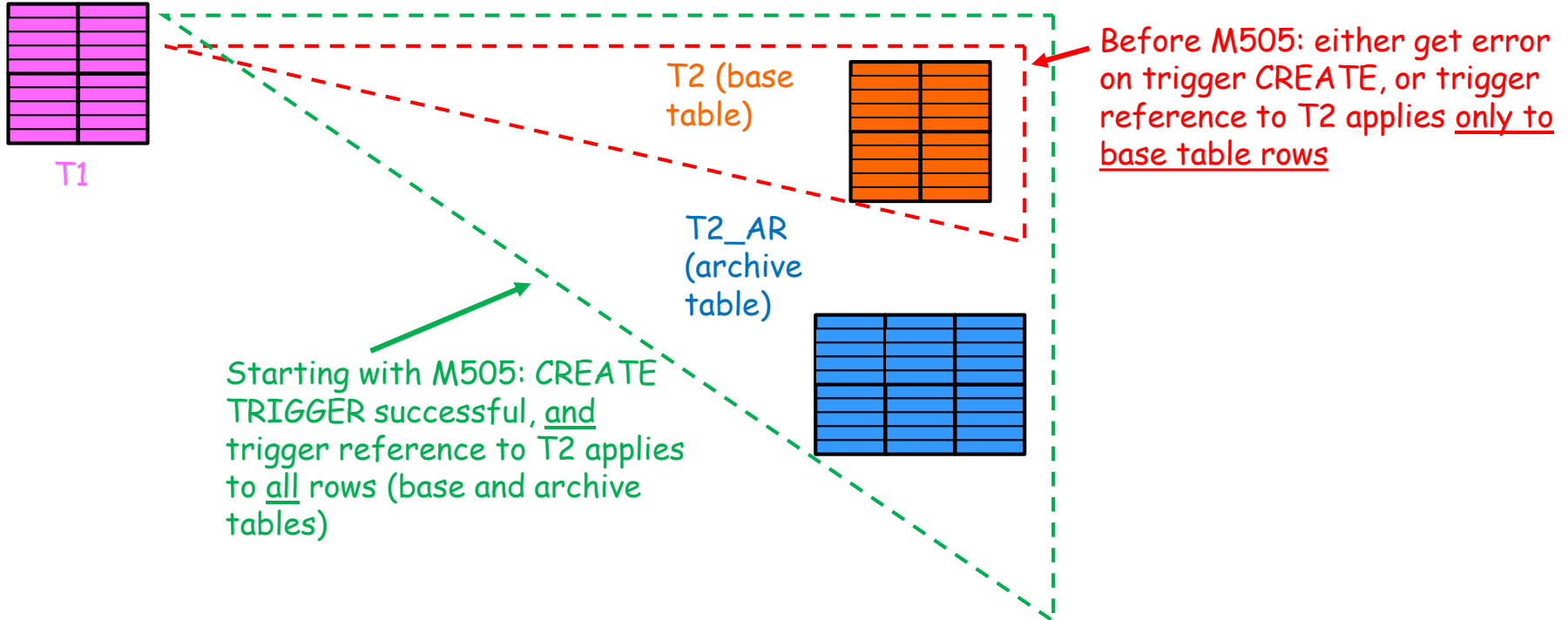
- Indexes for DECFLOAT columns
- DECFLOAT columns can now:
 - be part of an **index** (unique or non-unique)
 - be specified in a **unique constraint**
 - be specified in a **primary key constraint**
- Other restrictions remain
 - DECFLOAT columns can neither be specified in referential constraints nor be part of a partitioning key
 - No support for DECFLOAT columns in INCLUDE indexes nor in indexes on expression
- Note: **implicit casting** to DECFLOAT data type is still stage 2 in Db2 12, regardless of index support

V12R1M505

- Removal of trigger restrictions for Temporal and Transparent Archiving
- Problem: WHEN clause of trigger could not be applied to data in history table (system-time temporal) or archive table
 - In more technical terms: WHEN clause of trigger could not reference...
 - ...table for which row versioning has been enabled, if trigger package bound with SYSTIMESENSITIVE(YES)
 - ...archive-enabled table, if trigger package bound with ARCHIVESENSITIVE(YES)
 - Trigger packages could be bound or rebound with SYSTIMESENSITIVE(NO) or ARCHIVESENSITIVE(NO), but that means no trigger access to data in history or archive table
- Db2 12 function level M505 removes these restrictions when trigger package bound with APPLCOMPAT(V12R1M505)
 - APPLCOMPAT value can be specified for advanced trigger, will be picked up from ZPARM parameter APPLCOMPAT for basic trigger

V12R1M505

- Removal of trigger restrictions for Temporal and Transparent Archiving
- Suppose via a trigger you want Db2 to do something when table T1 is updated and a certain thing is true for table T2, and suppose that T2 is an archive-enabled table



Function levels (4)

— V12R1M506

- DROP TABLE: automatic drop of explicit table spaces
- SQL syntax compatibility for scalar functions

V12R1M506

- DROP TABLE: automatic drop of explicit table spaces
- Explicitly created table spaces are dropped as part of DROP TABLE processing
 - True for universal table spaces and LOB table spaces
 - For such table spaces, DROP TABLE no longer fails with -669, reason code 1

— SQL Syntax compatibility for scalar functions

Current name	Alternate name
COVARIANCE or COVAR	COVAR_POP
CHARACTER_LENGTH	CHAR_LENGTH
CLOB	TO_CLOB
HASH_MD5, HASH_SHA1, HASH_SHA256	HASH with different integer constants as second argument
LEFT	STRLEFT
POSSTR	STRPOS
POWER	POW
RAND	RANDOM
RIGHT	STRRIGHT
TIMESTAMP_FORMAT or TO_DATE	TO_TIMESTAMP

Non-function level specific enhancements

- SSL-only DDF access (PH08188)
- To ensure only secure socket layer (SSL) access to Db2 via DDF (DRDA or REST clients):
 - Set secure port (SECPORT or SPORT) to same value as SQL Port (DRDA port)
 - In data sharing environment, set secure port equal to alias port for each location alias
 - Applies to static alias (defined in BSDS) or dynamic alias
- New timestamp string formats (via fix for APAR PH03263):

`yyyy-mm-dd⊖hh:mm:ss`

What is new is this dash - before, if you wanted colons in the time part, there had to be a blank (versus a dash) between the date and time parts of the timestamp string

`yyyy-mm-dd⊖hh:mm:ss+th:tm` (timestamp with time zone)

Non-function level specific enhancements

- Db2 Native REST
 - Versioning for services
 - New commands
- Db2ZAI
- Db2aaS and IBM CloudPak for Data
- z14 (and z15) zHyperLink support for log writes
- z14 (and z15) zHyperLink read support retrofit to Db2 11
- z14 (and z15) asynchronous GBP cross-invalidation
- Simplified application compatibility for IBM Data Server Drivers and Db2 12 function levels

Customer experiences... and recommendations

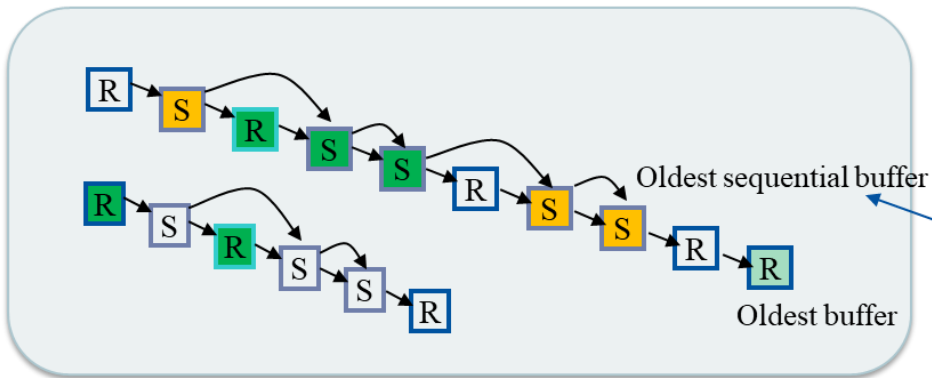
- Db2 12 uptake is cresting
- Vast majority of feedback and experience is positive
- There are a few ‘gotchas’ to watch out for
- Db2 Data Server Driver (Db2 Connect) and APPLCOMPAT
 - PH08482
- Is it on by default? Some examples:
 - Contiguous buffer pools – PGSTEAL (NONE)
 - V12R1M100
 - FRAMESIZE 2GB uses 4K frames !
 - Index Fast Traverse Block (FTB)
 - V12R1M100
 - Insert algorithm 2 (Fast Insert) – UTS with MEMBER CLUSTER
 - V12R1M500
 - Dynamic Plan Stability
 - V12R1M500
 - REBIND phase-in
 - V12R1M505

Contiguous buffer pools

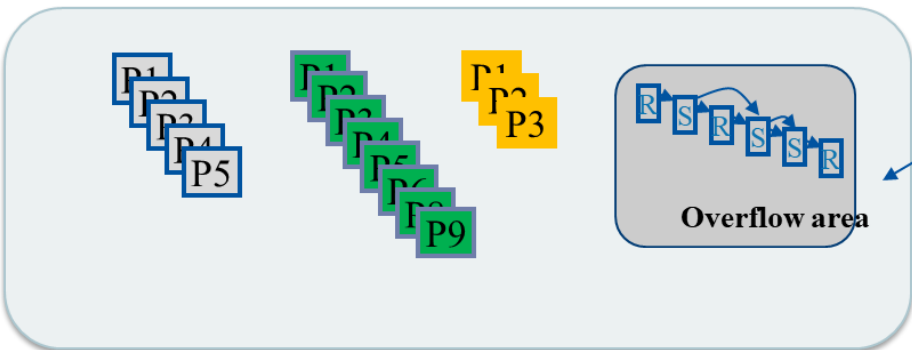
- Page steal algorithm : PGSTEAL = LRU, FIFO, NONE
- PGSTEAL(NONE) in Db2 10 and 11
 - Pre-loaded into buffer pools at the first access
 - Db2 still maintains hash and LRU chains
- PGSTEAL(NONE) in Db2 12: In-memory contiguous buffer pool
 - Pre-loaded into buffer pool at the first access
 - No more chain maintenance
 - Up to 6400 buffers are allocated to handle overflow
 - Eliminate impact of processor cache miss with large buffer pools
 - With 70% getpages in PGSTEAL(NONE), 8% CPU reduction is observed

Contiguous buffer pools

Db2 11
PGSTEAL(NONE),
PGSTEAL(LRU)



Db2 12
PGSTEAL(NONE)



Close the gap to static SQL

Several factors may cause access path changes

RUNSTATS

Db2 PTFs

New Db2 code level

DDL

ZPARM change

Bufferpool change

Sometimes with performance degradation for dynamic SQL...



Source: www.dreamstime.com

- Db2 12: introducing **Dynamic Plan Stability**
 - **Fix access plans** for cached dynamic SQL statements and **persist stabilized access plans to catalog** (as access plans for static SQL have long been persisted to directory)

Dynamic plan stability

— ZPARM **CACHEDYN_STABILIZATION**:

- “BOTH”: allow capture to and load from SYSIBM.SYSDYNQRY (Db2 catalog table)
- “CAPTURE”: capture only
- “LOAD”: load only
- “NONE”: no stabilization active

— For background monitoring of DSC:

- **Activate IFCID(318) to collect execution metrics**

— Required authorization

- SYSADM, SQLADM, SYSCTRL, SYSOPR or system DBADM

Migrate first, then exploit 'on by default'

- Ensure Db2 12 migration successful before taking advantage of these features
 - Turn them off
- Test in non-production
 - Thoroughly
- Implement one at a time in production

Knowledge Center links

— KC anchor point:

- https://www.ibm.com/support/knowledgecenter/en/SSEPEK_12.0.0/wnew/src/tpc/db2z_12_wnew.html

— Additional links:

- Enhancements by FL:
 - https://www.ibm.com/support/knowledgecenter/en/SSEPEK_12.0.0/wnew/src/tpc/db2z_db2functionlevels.html
- Enhancements independent of FL:
 - https://www.ibm.com/support/knowledgecenter/en/SSEPEK_12.0.0/wnew/src/tpc/db2z_minorenancementsinapars.html
- Db2 12 for z/OS Performance redbook
 - <http://www.redbooks.ibm.com/redbooks/pdfs/sg248404.pdf>

Thank you

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