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2023 EMEA **Db2** Tech Conference

# **Db2 for z/OS Online Schema: Past, Present and Future**

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*Session A03*

# Agenda

- Immediate vs. deferred ALTERs
- Online schema up to V13
- What was promised – and delivered in V13
- A look to the future
- Summary

# Introduction

- Development focuses upon two main areas
  - Improving online schema mechanism for both immediate and pending ALTERs
    - Avoiding package invalidation or impact of package invalidation
    - Improving serialization with application threads
  - Delivering new online schema capability
    - Tablespace conversions
    - Unique indexes
    - Names
    - ...

# Immediate ALTERs

- Table schema changes typically take immediate effect
  - E.g. ALTER TABLE ADD COLUMN
- Relies on table and index versioning
  - Enhanced table version 0 support delivered in APARs in V12 to make tables self-describing in tablespaces

# Immediate ALTERs

- May require serialization that can prevent ability to break in on applications
  - Drain object
  - Serialise and invalidate cached dynamic statements
  - Static package execution lock, package invalidation
- Immediate ALTERs not compatible with deferred ALTERs
  - Zparm in V12 allows immediate ALTERs to be deferred

# Deferred ALTERs

- Larger granularity changes that require REORG for conversion
  - E.g. ALTER TABLESPACE MAXPARTITIONS 255
- Affected object placed in AREOR
  - No impact to existing applications
- Pending DDL change cached in SYSIBM.SYSPENDINGDDL
- DDL change materialized at next tablespace-level REORG
  - Only SHRLEVEL REFERENCE or CHANGE
- Pending DDL can be removed using ALTER TABLESPACE DROP PENDING CHANGES



# Static package handling

- Many changes affect information cached in a package
- Changing these attributes mean that the current package can no longer be used and must be invalidated
- Once invalidated, must be rebound or autobound by next execution
  - Autobind now uses APREUSE(WARN) as of PH15896
- Can result in significant impact due to transaction queuing

# Dynamic statement handling

- ALTER TABLE changes can have difficulty breaking in on dynamic workloads
- Sequence of events
  1. DDL acquires locks on catalog
  2. Invalidate statements in statement cache
  3. New PREPAREs must wait for catalog/database locks to be released
  4. DDL completes and commits, releasing locks
  5. New PREPAREs succeed



# Dynamic statement handling - improvements

- Sequence of events
  1. DDL acquires locks on catalog
  2. Invalidate statements in statement cache
    - Was serial, now all blocking statements are invalidated up front in PH00637 (V12)
  3. New PREPAREs must wait for catalog/database locks to be released
  4. DDL completes and commits, releasing locks
  5. New PREPAREs succeed
- Undetected deadlocks can still occur
  - DDL locks catalog; S2 invalidated, wait for S1 use count to go to zero; transaction holding up use count on S1 attempts to prepare S2

# Dynamic statement handling - improvements

- Effect of PH00637 improving dynamic statement cache invalidation

Before	stmts / uow	ddl total	ddl fail	sql total	sql fail	time (min)
	2	23	19	2522	407	10
	6	17	14	2360	461	10

After	stmts / uow	ddl total	ddl fail	sql total	sql fail	time (min)
	2	30	0	2440	600	10
	6	30	0	1720	600	10

# Online schema in V12

- Online conversion to PBR RPN
- Online migration of tables from multi-table simple or segmented tablespaces to separate PBGs
  - V12R1M508
  - Move a single table or set of tables in a single REORG
  - New DDL syntax (APPLCOMPAT controlled)
  - No change to REORG utility syntax



# Online schema in V12

- Multi-table conversion to PBG considerations
  - More open datasets
    - z/OS 2.5 decreases memory footprint for open datasets
  - More OBIDs used
    - Catalog queries provided to assist in planning
    - Cannot move a table to a different database

# Online schema situation prior to V13 GA

- Online conversion to UTS, either PBG or PBR, now possible
- Static package invalidation can have significant impact
  - Table dependency tracked at package level so entire package is invalidated and must be autobound or rebound
- ALTERs can still have difficulty breaking in on dynamic SQL workloads
- What next?



# Online schema in V13 at GA

- Online conversion from PBG to PBR
  - RPN only
  - No LOB or XML cols
  - No automatic conversion of NPSIs to Pis
  - No stacking of other deferred alters – delivered via APAR post-GA
    - E.g. DSSIZE

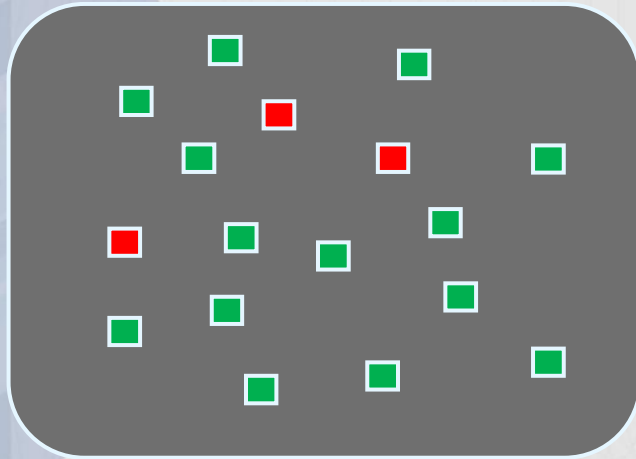
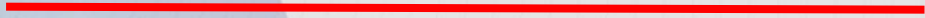
```
ALTER TABLE SCR001.TB01 ALTER PARTITIONING TO  
PARTITION BY RANGE (ACCT_NUM)  
( PARTITION 1 ENDING AT (199),  
PARTITION 2 ENDING AT (299),  
PARTITION 3 ENDING AT (399),  
PARTITION 4 ENDING AT (MAXVALUE) );
```

# Online schema in V13 at GA

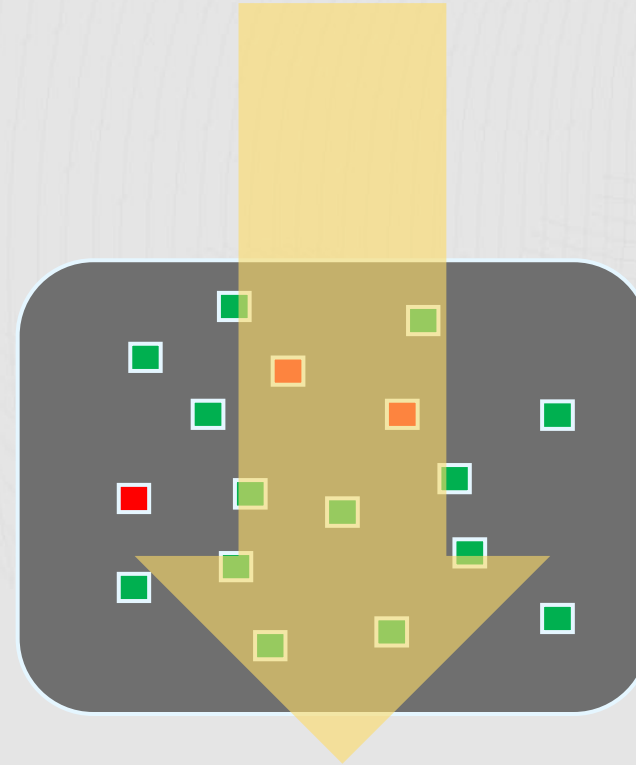
- Improved serialization for ALTER TABLE DATA CAPTURE CHANGES
  - Remove quiesce of packages and dynamic statements
- Position for improvements in static package invalidations
  - Allow tracking table dependencies at statement level
  - V13R1M502 – Allow invalidation of statements
  - No change to package invalidation processing

# Function Level 504 – October 2023

## Minimize and even eliminate impact from package invalidation



Synchronous autobind  
APREUSE



Incremental bind  
Asynchronous autobind  
Phase-in  
APREUSE

# Looking to the future

- Online conversion from PBR to PBG
  - Potentially stack with PBG-PBR conversion in a single REORG to open up new schema possibilities
  - Repartitioning
  - Removal of partitions
  - Removal of 40 byte limitkey truncations

# Looking to the future

- Other potential (Aha) ideas
  - Alter add hidden ROWID column
  - Online creation of any index
  - Simplified/improved management of implicit objects
  - Online alter of tablespace name
  - Online change of STOGROUP
  - ...

# Summary

- Providing complete schema flexibility whilst minimizing or eliminating any impact to business workloads is a key focus area for development
- Open, or vote for, Aha ideas to influence prioritization of future roadmap
- Become a member of the Db2 Customer Advisory Council and join sponsor user programs to influence design and quality of new features



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Please fill out your session evaluation!