DB2 Utilities changes you should know

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Please be aware that the actual programming techniques, algorithms and all numerical parameters used in examples given in this presentation are subject to change at some future date either by a new version of DB2, a new release, a Small Programming Enhancement (SPE) or a Programming Temporary Fix (PTF).

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Many thanks to IBM SVL for their ongoing support for Gold Consultants. Anything I say about DB2 12 might change... see manuals at GA
Agenda

- Introduction
- Performance
- DBA Changes
- Utilities
- Temporal change
- Archive Transparency
- SQL changes
- Optimizer
- Security
- System Changes
- Data Sharing

General...
The miracles of using zIIP's!

- zIIPs: System z Integrated Information Processor
- Why should you care?
  - Pay IBM for GP CP only

- DB2 11 / 12: even more more zIIP exploitation
  - zIIP usage expanded
  - Utility and system tasks

BUT WARNING: Calling for help

- If the zIIP processors are over-committed...
  - The zIIP processor can request help from the GP CPs
  - This time will be recorded as IIPCP time in RMF or SMF30 record

**IMPORTANT:** with defaults, and with HIPERDISPATCH=YES, may wait for up to 3.2 milliseconds before receiving help from standard processors

**IMPORTANT:** you can “FORCE” the zIIP eligible workload to be executed on the zIIP engine. Same for zAAP on zIIP

- Review IIPHONORPRIORITY settings
- **WARNING:** may cause increased wait for CPU
**DB2 11 Template**

- **TEMPLATE** enhancements - NFM
  - Additional operands added to **TEMPLATE DSNTYPE** keyword:
    - LARGE -- LARGE FORMAT is requested (greater than 65535 tracks)
    - EXTREQ -- EXTENDED FORMAT is required
    - EXTPREF -- EXTENDED FORMAT is preferred
    - BASIC -- BASIC FORMAT is requested (no more than 65535 tracks)

- Added **EATTR** keyword to request data sets with "extended attributes"

- **TEMPLATE** control statement modified to use either UTC time or LOCAL time in the expansion of **TEMPLATE DSN** date/time variables
  - New ZPARM option, **TEMPLATE_TIME**
    - LOCAL -- use local time in the expansion of date/time DSN variables
    - UTC -- use Coordinated Universal Time in the expansion of date/time DSN variables. DEFAULT
  - Override with new **TEMPLATE** variable **TIME**
  - Retrofitted to DB2 10: PI29707

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**DB2 11 Externalize Real Time Statistics**

- New option in ACCESS DATABASE command
  - **ACCESS DB() SP() MODE(STATS)**
    - Forces RTS to be externalized
    - Can be useful to make right (utility) decisions
    - Be careful for performance impact when using wildcards
      - Command is executed in parallel internally
    - Command does not have Data Sharing Scope available
    - Retrofitted into DB2 10 via PM80779

- RTS changes:
  - Tables now in separate tablespaces
  - Two new SYSTABLESPACESTATS columns:
    - **UPDATESIZE** (BIGINT): bytes added / removed via UPDATE operations since creation, REORG, or LOAD REPLACE
    - **LASTDATACHANGE** (TIMESTAMP): last update time for this row in RTS
**DB2 11 DSNACCOX Improvements**

- **DATASPACERATIO**
  - For small objects, default DATASPACERATIO of 2 is too large
    - Changed default to -1 which will turn off this criteria
    - Will not effect users which had changed the value
  - Check only objects with **DBET** state that needs REORG and/or COPY

- Improve performance by evaluating fewer objects and return less false positive recommendations.
  - Parse the CRITERIA input parameter, and if possible, apply the CRITERIA as a "where" clause when DSNACCOX queries RTS tables.
  - Call DSNACCOX with CRITERIA set to "DBNAME=<database name>" to get the CRITERIA to be applied early for better performance

- **DB2 12 will further enhance DSNACCOX** (e.g. do not REORG new created TS)

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**DB2 11 Parallelism**

- Utilities use (too much) parallelism
  - Allow users to cap the number of parallel tasks that utilities start
  - Prevent utilities from consuming too much CPU

- New ZPARM PARAMDEG_UTIL (0 – 32767, 0 = auto like before)
  - At individual utility level, cap concurrent subtasks with keyword PARALLEL n
    - **PARALLEL always overrides the specification of PARAMDEG_UTIL**
  - The ZPARM PARAMDEG_UTIL applied when using parallelism for:
    - COPY
    - RECOVER
    - UNLOAD
    - LOAD
    - REORG
    - REBUILD INDEX
    - CHECK INDEX
DB2 11 Deprecated Functions

- Deprecated in DB2 11
  - **REORG**
    - PARALLEL YES|NO (Superseded by LISTPARTS)
    - INDIFFRELIMIT
    - OFFPOSLIMIT
    - LEAFDISTLIMIT
    - UNLOAD ONLY
    - UNLOAD PAUSE
    - UNLOAD EXTERNAL
  - **COPY**
    - CHANGELIMIT

**Deprecated functions are no longer documented but still work**
Flashcopy Support – DB2 10

- Activated with **FLASHCOPY YES** or ZPARM
- Datasets recorded in SYSCOPY
- IDCAMS REPRO used if no Flash Copy hardware!!
- Enabled for most utilities:
  - COPY, RECOVER, REORG, LOAD, REBUILD INDEX, REORG INDEX
- Do not migrate these datasets with DFHSM
  - DB2 has no knowledge and will not recall
- DB2 12 will show DFSMS messages in utility log
- **Very interesting combination:**
  - SHRLEVEL CHANGE + FLASHCOPY CONSISTENT :-(
  - DB2 will create fuzzy flashcopy dataset
  - Then it will do backout on that dataset, result: CONSISTENT!
- Read manuals on restrictions
  - E.g. target can not be in FC relationship when doing RECOVER
  - Study and test carefully before using
    - Make a plan with your DFSMS experts

Recovery

Make a plan with your DFSMS experts
Materializing REORG – DB2 10

- Pending ALTERs:
  - Do (online) REORG
  - ALTER DROP ENDING

FOR UTS YOU CAN CHANGE:
- PAGESIZE
- DSSIZE
- SEGSIZE
- MEMBER CLUSTER

ALTER is stored in SYSIBM.SYSPENDINGDDL
No versioning or status set - No performance impact

DB2 11 PIT Recovery with Pending ALTER

- DB2 10 did not allow recover to point in time BEFORE the materializing REORG 😞

- DB2 11 (NFM) does allow this but the ALTER is not undone!
  - Forces the ALTER to happen again (so catalog and data match)
  - Insert new record in SYSPENDINGDDL after RECOVER is done
    - This record cannot be removed
    - Table becomes "hard" reorg pending REORP

- Restriction:
  - Works for UTS PBR (Including LOB and XML spaces)
  - No support for PBG yet (will come in DB2 12)
DB2 11 PIT Recovery with Pending ALTER

- The subsequent REORG SHRLEVEL REFERENCE is required
  - Must on be on ENTIRE table space
  - SHRLEVEL NONE is not supported
  - SHRLEVEL CHANGE is overruled by SHRLEVEL REFERENCE

- Where there were pending changes on LOB table space:
  - First REORG the LOB table space, then REORG the base table space

- REORP forces table to be inaccessible and REORG might take some time (and you spend already time in RECOVER...)

RECOVER BACKOUT – DB2 10

- BACKOUT keyword is added to the RECOVER utility
  - No Image Copies restore / Log Apply
  - Changes are backed out to the specified Point In Time (PIT)
  - Indexes must be marked COPY YES
  - Can only be done once for a given log range

- RECOVER TOLOGPOINT x'……' BACKOUT YES

UR1 - untouched
UR2 – backed out
UR3 – backed out
UR4 – untouched

LOG

PIT LOGPOINT

CURRENT LOGPOINT
**Faster catalog/directory recovery**
- DB2 11 Enables SYSLGRNX recording for these objects (in CM)
- RECOVER utility will not take advantage of the SYSLGRNX records until NFM

**VCAT name translation on RESTORE SYSTEM** for system cloning
- RESTORE SYSTEM utility to accept old and new VCAT aliases, and to switch to the new VCAT aliases during log apply processing!
  - Support log apply when RESTORE SYSTEM used for cloning purposes

**Improved recoverability with COPY-REORG concurrency**
- Allow COPY SHRLEVEL CHANGE to run at the same time as REORG SHRLEVEL CHANGE, until REORG is able to drain the claimers

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**REORG**
Part Level REORG NPSIs Handling – DB2 11

- Sort all keys of NPSI in same sort operation and rebuilding index from entire set of sorted keys
  - Based on the ratio of index keys in REORGed partitions

- ZPARM REORG_PART_SORT_NPSI (retrofitted to DB2 9 and 10 PM55051)
  - Possible options: AUTO / NO / YES
  - AUTO specifies that if sorting all keys of the non-partitioned secondary indexes improves the elapsed time and CPU performance then all keys are sorted
  - YES Always sorts all keys of the non-partitioned secondary indexes

- Keyword SORTNPSI keyword added to REORG TABLESPACE PART
  - Default for SORTNPSI is value of ZPARM REORG_PART_SORT_NPSI

- Processing of NPSIs:
  - Up to a 60% ET reduction!
  - All RIDs from parts are sorted once, instead complex NPSI update

REORG SWITCH Phase – DB2 11

- Speed up switch phase (up to 90%)
  - Faster DRAIN acquisition for part-level REORG in CM
    - Prevent new claims on all target partitions while waiting for drains
    - If REORG PART 1-10, prior to beginning drain on part 1 (out of 10), will set flag to prevent claims on any of the 10 parts involved in REORG.
    - Will then drain part 1, part 2 and so on till all 10 parts drained
  - Retrofitted into DB2 10: PI09303

- New DRAIN_ALLPARTS(NO/YES) keyword
  - Will drain all parts when obtaining drains (available in NFM only)
  - Eliminates claim-drain "deadlocks" for part-level REORG with NPSIs
    - Example: REORG 10 parts, got drains on all 10 but now need to drain NPI - Application is using part 50 and has claim on NPI - Application now needs access to part 5, already drained by REORG → DEADLOCK!
    - Temporarily drain entire table space until we get drain on NPI, then release all table space parts except those involved in REORG
  - Ensures REORG can break in SQL, eliminates DEADLOCK (at the cost of application performance)
DB2 11 Delete Empty PBG Partitions

- Ability for REORG to physically delete empty PBG partitions

- New ZPARM REORG_DROP_PBG_PARTS
  - DISABLE - keep DB2 10 behavior
  - ENABLE - Delete empty PBG partitions on table space level REORG
  - Removes empty trailing parts of PBG when REORG is run:
    - Restriction: not organized by hash
    - Includes LOB spaces and AUX Indexes
    - REORG XML PBG Table Spaces separately

- Cannot be specified on REORG statement 😎
  - If PBG created using NUMPARTS or ALTER ADD partition was used then REORG may prune to a lesser number of partitions

**Warning: No PIT recovery to prior to a pruning REORG**

- No facility to resurrect deleted partitions

DB2 12 makes it available as a new keyword

DB2 11 REORG Automated Mapping Table

- Automated Mapping Tables
- Support for mapping tables in PBGs
  - Increases mapping index max size from 64Gb to 16Tb
- Automatically create new DB2 11 format mapping table if required
  - If one exists, honor specs if correct, otherwise create new (in same DB)
  - If one does NOT exist use ZPARM REORG__MAPPING_DATABASE
    - Defaults to Implicit Database
  - REORG Keyword MAPPINGDATABASE database-name
    - Overrides the ZPARM value
- Created under INSTALL SYSADM ID to prevent auth issues
  - Gotcha... DSNDB04!!
- Dropped at end of REORG
- NFM requires new format mapping table
  - Old & new format supported in CM, ENFM
  - Convert mapping tables during CM or plan to use automatically created tables
DB2 11 REORG Without Sorting Data

- More REORGs are performed for reasons other than to regain clustering of data, yet no ability to avoid costly re-clustering

- SORTDATA NO prevents sorting of data and cuts down on DASD needs (but data is unloaded via clustering index which is costly)

- DB2 11 supports SORTDATA NO with SHRLEVEL CHANGE - NFM

- New RECLUSTER YES/NO option on SORTDATA NO
  - RECLUSTER NO – Do not unload data through clustering index and do not sort data records in clustering order
  - Default is RECLUSTER YES for release compatibility

 Partition-level inline image copy

- Create partition-level inline image copies if using TEMPLATE with &PA or &PART
  - Separate output dataset created for each partition
    - Pre DB2 11 used single output dataset for ALL partitions
  - No new option or keyword needed on REORG

- Faster partition-level recovery from inline image copy
  - Example RECOVER of single partition of a 20 partition table space
    - Elapse Time reduced by 28%
    - CPU Time reduced by 49%
Improved REORG LISTDEF processing

- New DB2 11 REORG LIST option LISTPARTS n (NFM)
  - Limit # of partitions to be processed in a single REORG using LISTDEF
  - Overrides ZPARM REORG_LIST_PROCESSING
  - Takes the place of (deprecated) PARALLEL YES/NO on REORG LIST
  - Perfect if you cannot shadow all partition in a single REORG

- Example (2 partitions at the time in parallel)

```
LISTDEF PLEVELREORG
  INCLUDE TABLESPACE DBB.TSS PARTLEVEL 3
  INCLUDE TABLESPACE DBB.TSS PARTLEVEL 4
  INCLUDE TABLESPACE DBB.TSS PARTLEVEL 8
  INCLUDE TABLESPACE DBB.TSS PARTLEVEL 17
REORG TABLESPACE LIST PLEVELREORG LISTPARTS 2
```

REBALANCE enhancements

- REORG REBALANCE has been redesigned (CM)

- Improved REORG REBALANCE logic to better handle table space/partitions with skewed data distribution
  - DB2 10 REORG can fail due to 'insufficient data to rebalance'
  - New message DSNU2906I issued to provide a rebalance summary

- New SORTCLUSTER keyword to sort data in clustering as well as partitioning order
  - NO – data records not explicitly sorted into clustering order
  - YES – specifies that the data records are to be explicitly sorted into clustering order as needed
  - If you don't specify SORTCLUSTER you get DB2 10 behavior
    - Can be left in Advisory Reorg Pending (AREO*)
    - With SORTCLUSTER you do not get AREO* anymore


**REBALANCE enhancements**

- Improve compression dictionary handling (CM)
  - REORG REBALANCE will now build a **single** compression dictionary for all target partitions
  - If you are satisfied with the existing compression ratio make sure to use **KEEPDICTIONARY**

- Support REORG REBALANCE **SHRLEVEL CHANGE** (NFM)
  - Retrofitted back to DB2 10: PI11839

- REORG support of **Online ALTER LIMITKEY** (NFM)
  - For PBR UTS table spaces and classic partitioned table spaces with table controlled partitioning
  - REORG TABLESPACE REBALANCE is not allowed when it is running on partitions with pending alter limit key changes
    - Will fail with return code 8 and new error message DSNU2917I

**Improved REORG serviceability**

- SYSLGRNX read **performance** degrades over time
  - Size of database objects grow with increasing number of partitions

- SYSLGRNX is a **single point of failure** in DB2
  - More and more function are made independent from it

- New Keyword LOGRANGES for REORG SHRLEVEL CHANGE
  - **YES** - Use SYSLGRNX information (Default)
  - **NO** - REORG should not use SYSLGRNX information for the LOG phase but scan the log
    - In data sharing, can result in the merging of all logs from all members!
REORG default changes to match best practices

- **DRAIN WRITERS ➔ DRAIN ALL**
  - DRAIN ALL will become the default instead of DRAIN WRITERS
    - DRAIN ALL avoids the possible deadlock issue and guarantees break-in
  - This is applicable to both REORG TABLESPACE and REORG INDEX

- Padding changed (gotcha!)
  - Keyword changed **NOPAD (YES/NO)**
    - DISCARD ➔ DISCARD NOPAD YES
    - UNLOAD EXTERNAL ➔ UNLOAD EXTERNAL NOPAD YES
  - DB2 10 unloaded/discarded data was by default padded unless NOPAD was specified
  - Specify NOPAD NO to request padded data (© double NO!!)

RUNSTATS
DB2 11 RUNSTATS Enhancements

- More zIIP offload for RUNSTATS distribution statistics
  - Up to 80% zIIP-eligible
  - Column Group Distribution stats collection

- zIIP offload for inline statistics
  - Added COLGROUP to inline stats
  - Up to additional 30% offload to zIIP (compared to DB2 10)

- Enhance inline statistics for RUNSTATS avoidance
  - Inline statistics collection on NPSIs during REORG with SORTNPSI
  - Inline histogram statistics
  - Inline distribution statistics

- Obtain current RTS statistics prior to calling DSNACCOX
  - -ACCESS DATABASE ... MODE(STATS) option to externalize RTS statistics

Statistics Enhancements

- New \texttt{RESET ACCESSPATH} option on RUNSTATS
  - Resets the \texttt{access ALL} path statistics
  - Cannot be executed on LOB or XML table spaces
    - Will get message DSNU076I and RC=08

\textbf{CAREFUL: Stats now look as if RUNSTATS was never done!!}
DB2 11 – Optimizer Input to RUNSTATS

**Controlled by ZPARM STATFDBK_SCOPE**

- **Optimizer**
  - Missing stats? Conflicting stats?
  - In memory recommendations

- **Real-time Statistics (RTS)**
- **Statistics in Catalog Tables**
  - SYSTABLE-SPACESTATS
  - SYSINDEX-SPACESTATS

- **STATSINT**
  - DSNZPARM - minutes

- **SYSSTAT-FEEDBACK**
- **RUNSTATS**

**Statistics Feedback**

- **Access path selection for EXPLAIN**
  - Externalized to new EXPLAIN table **DSN_STAT_FEEDBACK** (see DSNTESE)
  - SYSTABLES STATS_FEEDBACK does not control these recommendations
  - Statement level recommendations written **synchronously** with EXPLAIN
  - User managed clean up needed (RUNSTATS does not remove)
  - Does not apply to VOLATILE, DGTT, or CGTT

- **Not seeing expected feedback in SYSSTATFEEDBACK?**
  - Make sure it has been externalized
    - **STATSINT** interval
    - **ACCESS DB() SPACENAM() MODE(STATS)** will force externalize

- **OPTINTS, APREUSE, APCOMPARE**
  - Recommendations become limited (not a full optimize anymore)

- **Not directly consumable by RUNSTATS (will change in DB2 12)**

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DB2 11 – Optimizer Input to RUNSTATS Using EXPLAIN

Use common sense when considering feedback

LOAD
DB2 11 LOAD Enhancements

- Crossloader support for XML data

- Now exploits FETCH CONTINUE for processing large LOBs & XML data in Crossloader
  - Reduce storage requirement and no more >32K (msg DSNU1178I) errors

- zIIP offload for LOAD REPLACE PART clearing of NPSIs
  - 100% offload to zIIP for LOAD REPLACE with dummy input

- LOAD... PARALLEL using single input dataset:
  - DB2 10 majority of time is spent during data conversion from external to internal format in a single task
  - DB2 11 can run data conversion in parallel
    - Recommend LOAD SHRLEVEL... PARALLEL(0) for best performance
    - LOAD SHRLEVEL NONE PARALLEL up 50% Elapse Time reduction
    - LOAD SHARELEVEL CHANGE PARALLEL up 80% Elapse Time reduction

DB2 11 addition: LOAD RESUME BACKOUT YES

- LOAD RESUME BACKOUT YES option
  - Avoid leaving table in RECP on load failure – PI08421

- LOAD RESUME BACKOUT YES support for DISCARDS
  - Only back out if DISCARDS limit is hit rather than on first discarded record – PI54658
LOB and XML columns can now be UNLOADed or LOADed
- To/from the same data set
- With other non-LOB/XML columns
  - Via spanned records
- Performance of reading from/writing to single sequential file is faster
  - Than using separate files or partition data set members
  - Utilities will not have to use open/close for each LOB
- When unloading LOB/XML columns to a sequential file
  - LOBs and XML documents will be written at the end of the record
    - In their column definition order

UNLOAD TABLESPACE DB1.TS1 SPANNED YES FROM TABLE TAB1

- Field spec list with CLOB and XML data at end
If CHECK used to find inconsistencies then:
- Pending status is set
  - RI violations set CHKP
  - Missing LOBS set AUXW

New ZPARM CHECK_SETCHKP controls behavior:
- NO (the default) only sets RC=4
- NO does NOT set pending status
- YES, behavior like V9
QUESTIONS?

Goodbye for now!

DB2 SYMPOSIUM

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