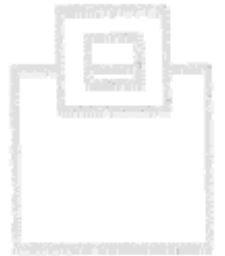


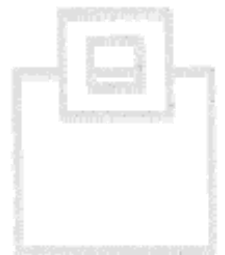
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# DB2 9 Package Stability:

*Migration, System and Daily Database Maintenance*



DB2-System Frühjahrsguide

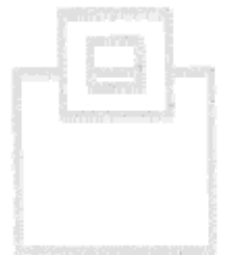
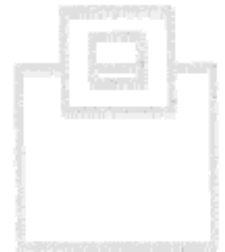
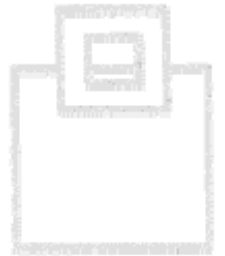
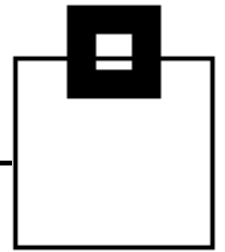


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# Agenda

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- What is “PACKAGE STABILITY” for?
- Why do I need it?
- What is it in detail and how does it affect...
  - DB2 subsystem
  - Access path
  - Workflow
- How can I use it for ...
  - DB2 Version Migration
  - DB2 System Maintenance
  - Daily Database Maintenance
- Summary



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# What is “Package Stability” for?

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Whenever your SQL or the data is changed you are requested to let the optimizer know

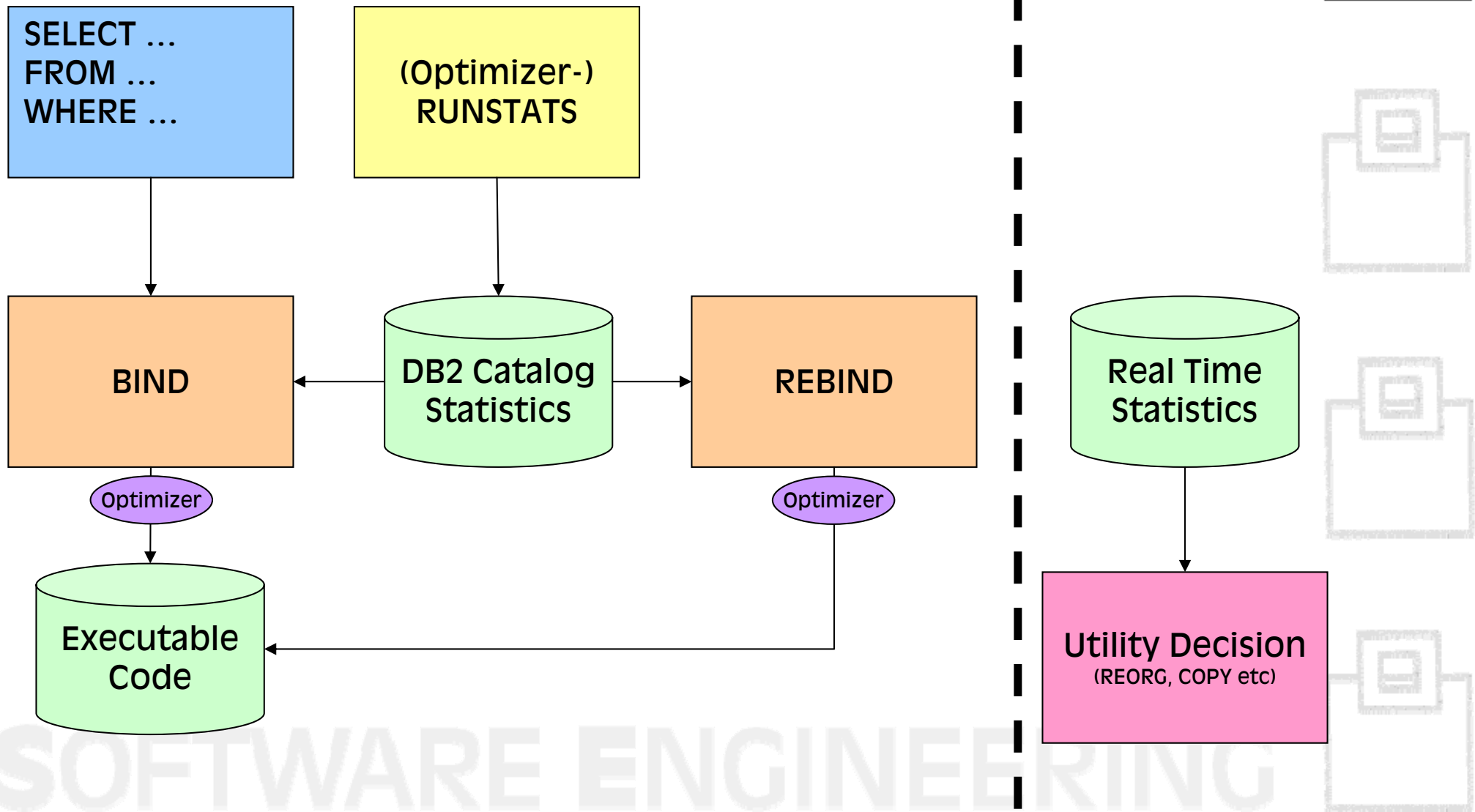
- Static SQL requires a BIND to create an access path
- New/Updated Statistics improve an access path
  - **(Daily) Database Maintenance requires REBINDs**

However, if the optimizer itself changes you should let him re-think about the decision it has already made

- New DB2 versions open up optimizer enhancements
  - **DB2 Version Migration requires a global REBIND**
- Applying an optimizer APAR improves access paths
  - **DB2 System Maintenance requires (global) REBINDs**

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# What is "Package Stability" for?



# Why do I need it?

---

- In some cases a REBIND can also lead to an access path degradation, due to:
    - Wrong costs assumptions when comparing two possible APs
- ... as of ...
- Too optimistic estimates for range predicates with host variables or parameter markers used
  - No correlation statistics
  - No awareness of skewed data
  - No clue about the amount of rows to be processed

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# Why do I need it?

---

## How to secure access paths?

### Options:

1. No REBINDs at all – no exploitation of enhancements already paid for
2. Try and error – consider time/resources to play around
3. Pre-Check the results – most controllable and most efficient



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# Why do I need it?

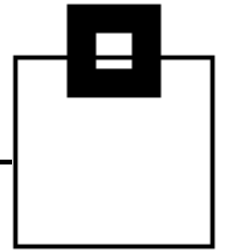
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>> *To rebind or not to rebind, "when?" is the question: Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous access paths, Or to take arms against a sea of troubles, And by rebinding, end them? To die: to sleep; No more; and by a sleep to say we end the heart-ache and the thousand natural shocks that old plans are their to. 'Tis a consummation devoutly to be wished to die, to sleep. To sleep: perchance to dream: aye, there's the rub; For in that sleep of death what dream may come when plans have shuffled off this mortal coil, must give us pause: There's the respect that makes calamity of so long life for old plans and packages.<<*

by Roger Miller

## Why do I need it?

---



No REBINDs at all is NOT the solution!

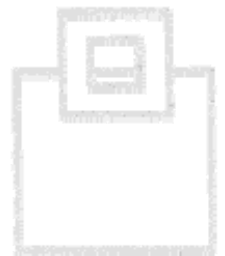


Make sure you do

- Global REBINDs after DB2 version migration
- Global REBINDs after DB2 system maintenance
- Practice the 3Rs – REORG → RUNSTATS → REBIND

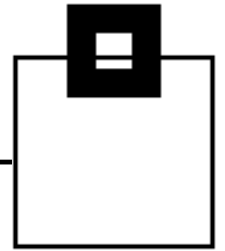


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# Why do I need it?

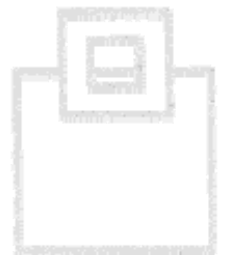
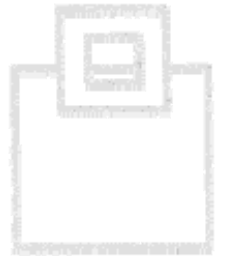
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## *Can Package Stability help?*

Package Stability is an access path backup!

To easy fallback in case of a performance regression.



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# What is it in detail?

---

**Package Stability** is a new feature of DB2 9 to create backups of static SQLs access paths that allow access path recovery capabilities

- Requires PK52523
- Already available in DB2 9 CM (conversion mode)
- The backup is created when a REBIND is done
- The restore is controlled by a REBIND as well
- The feature can be controlled subsystem wide or individually at the package level

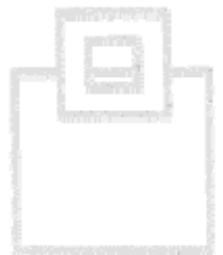
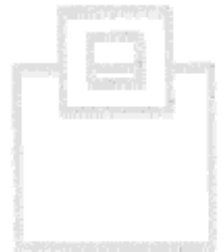
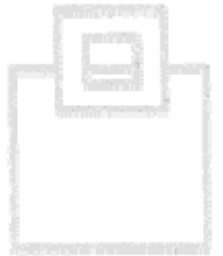
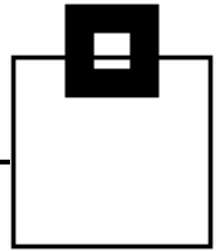
SOFTWARE ENGINEERING

# What is it in detail?

---

- **Package Stability can backup**
  - Regular packages
  - Non-native SQL procedures
  - External procedures
  - Trigger packages

, but not PLANS!!!



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# What is it in detail?

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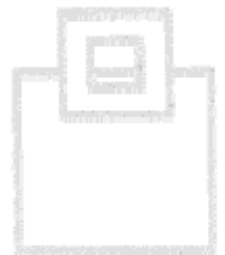
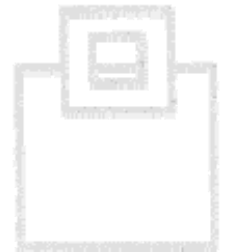
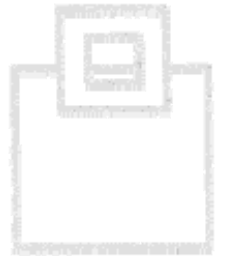
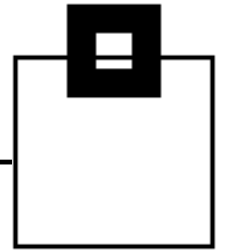
- **Package Stability copies**

- Metadata for all copies (e.g. SYSPKSYSTEM)
- Dependencies of all copies (SYSPACKDEP)
- Access paths (SPT01)
  
- SYSPACKAGE always reflects the current access path

Backups double or even triple the size of SPT01\*.  
REBIND overhead is about 30%.

\*Consider to apply usermod

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# What is it in detail?

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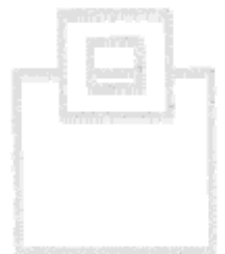
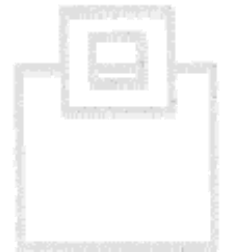
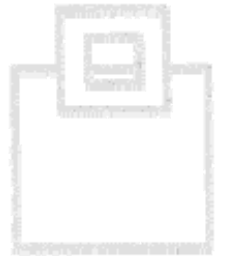
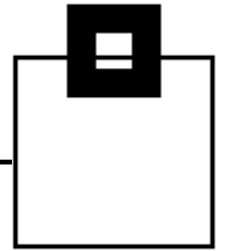
- Default REBIND processing is controlled through ZPARM PLANMGMT in macro DSN6SPRM
- Specific REBIND processing is controlled through REBIND parameter PLANMGMT
- Two options are available
  - BASIC
  - EXTENDED
- Running a REBIND with PLANMGMT deletes a prior copy

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# What is it in detail?

---

- Make sure you keep your REBIND options
  - Owner
  - Qualifier
  - DBPROTOCOL
  - ENABLE
  - DISABLE
  - PATH
  - PATHDEFAULT
  - IMMEDIATEWRITE

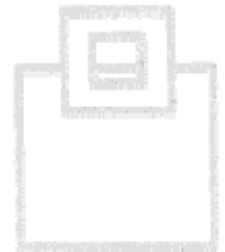
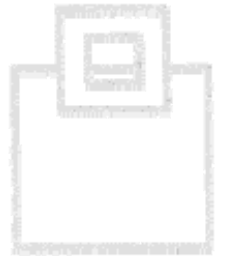
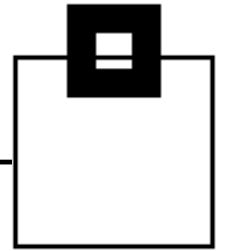


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# What is it in detail?

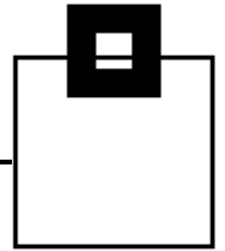
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- Restore of an access path backup via REBIND SWITCH
- Two options are available
  - PREVIOUS
  - ORIGINAL (only available when REBIND EXTENDED used)
- **Wildcards supported to process multiple packages**
  - If no copy exists, DB2 issues error message DSNT217I
- Cleanup possible by FREE using parameter PLANMGMTSCOPE
- Dependant alter or drop invalidates an access path backup



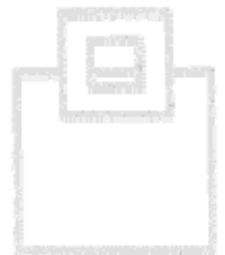
# What is it in detail?

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## Workflow:

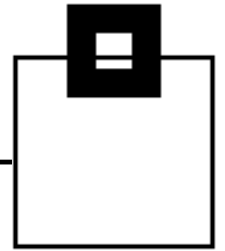
- You have to add **PLANMGMT(BASIC or EXTENDED)** to your **REBIND** to backup an access path while creating a new one
- **If you encounter a performance regression**
  - do a **REBIND SWITCH(PREVIOUS)** to activate your prior access path
  - do a **REBIND SWITCH(ORIGINAL)** to activate your initial access path
- Cleanup copies no more used via **FREE PLANMGMTSCOPE(INACTIVE)**



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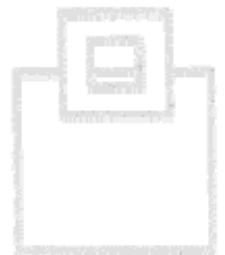
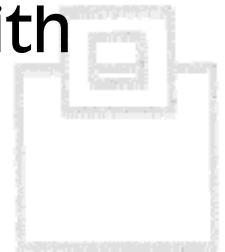
# What is it in detail?

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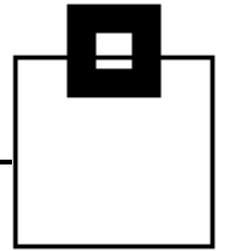


## Access Path:

- The situations described above don't change. You may still run into performance regression, but you have an option to recover to the prior access path
- You can create a baseline (2nd copy) and play around with an access path

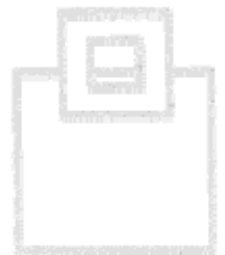
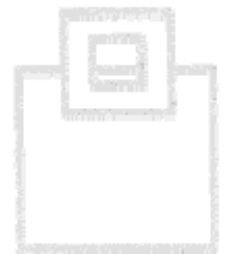
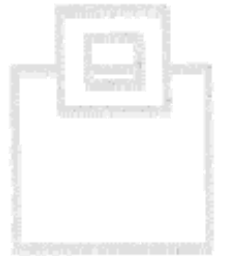


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How can I use it for ...

- DB2 Version Migration
- DB2 System Maintenance
- Daily Database Maintenance



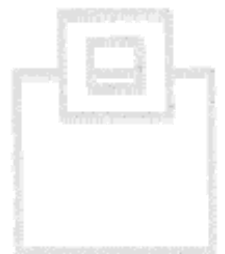
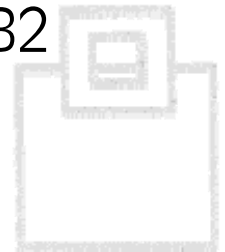
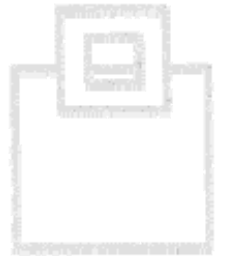
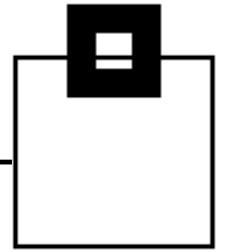
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# DB2 Version Migration

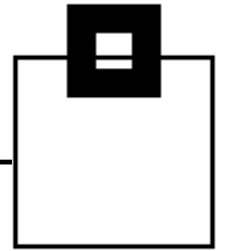
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DB2 9 has started the process of moving the plan and package static statement storage above the bar

- Depending on the statement 5% - 90% moves
- To achieve the VSCR in the below-the-bar storage for the CT and PT, you need to rebind your plans and packages in DB2 9 to move the relevant sections to 64-bit addressing

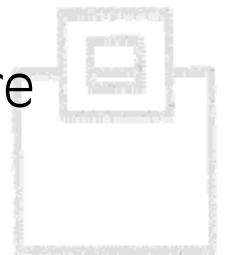


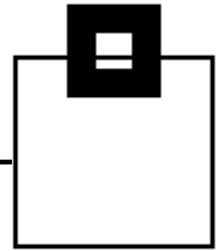
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## You want to exploit new features you paid for?

- **Note:** The DISTINCT and GROUP By enhancements are available in conversion mode. REBIND is required to obtain a sort avoidance benefit.
- **Note:** The dynamic prefetch functionality is available in conversion mode after a REBIND.
- **Note:** The global query optimization functionality is available in conversion mode and requires a REBIND.
- **Note:** The enhanced page-range screening functionality is available in conversion mode and requires REBIND.
- **Note:** Generalized sparse indexes and in-memory data caching are available in conversion mode after a REBIND.
- **Note:** Dynamic index ANDing for a star join query is available in conversion mode and requires a REBIND.
- **Note:** The histogram statistics over a range of column values are available in new-function mode with a REBIND required.





## DB2 9 for z/OS Performance Topics



„DB2 9 for z/OS is an exciting new version, with many improvements in performance and little regression“

Use the functions that provide reduced CPU time

Discover improved scalability and availability

Reduce TCO with more zIIP eligibility

DB2 9 for z/OS is an exciting new version, with many improvements in performance and little regression. DB2 V9 improves availability and security, as well as adds greatly to SQL and XML functions. Optimization improvements include more SQL functions to optimize, improved statistics for the optimizer, better optimization techniques, and a new approach to providing information for tuning. V8 SQL procedures were not eligible to run on the IBM System z9 Integrated Information Processor (zIIP), but changing to use the native SQL procedures on DB2 V9 makes the work eligible for zIIP processing. The performance of varying length data can improve substantially if there are large numbers of varying length columns. Several improvements in disk access can reduce the time for sequential disk access and improve data rates.

The key DB2 9 for z/OS performance improvements include reduced CPU time in many utilities, deep synergy with IBM System z hardware and z/OS software, improved performance and scalability for inserts and LOBs, improved SQL optimization, zIIP processing for remote native SQL

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SOFT

# DB2 Version Migration

... so there are strong reasons to exploit the new features and REBIND, but as the REBIND can be surprising...

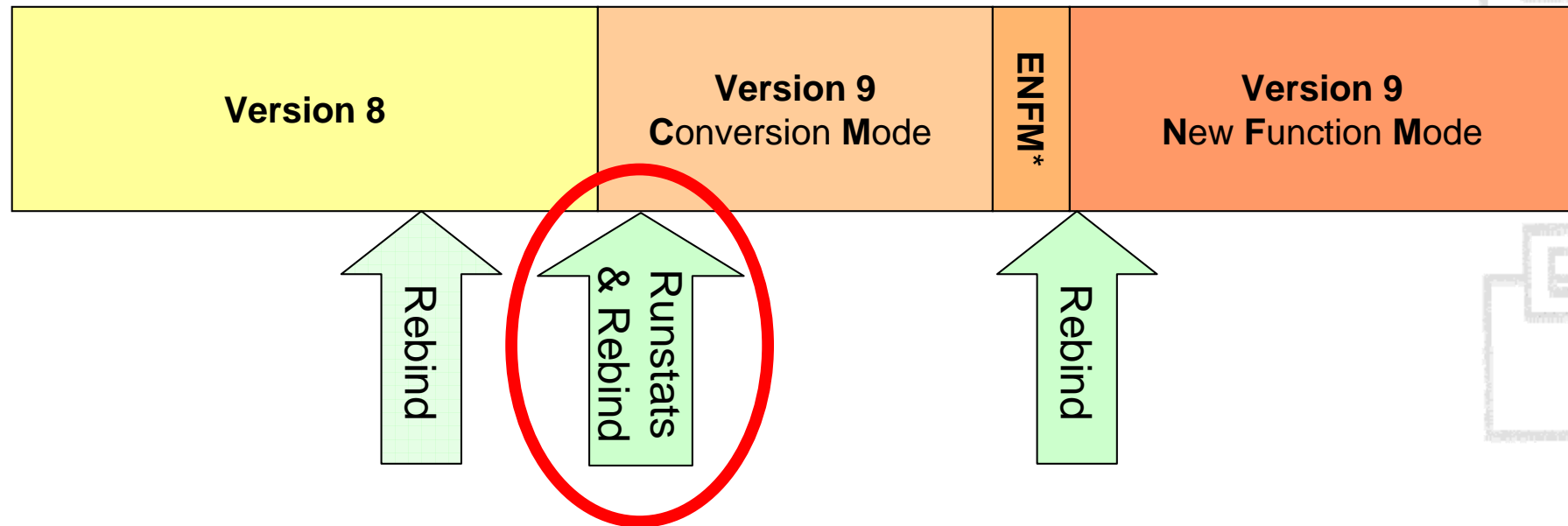
How to get the „many improvements in performance“ of this „exciting new version“ only, without the „little regressions“?



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# DB2 Version Migration

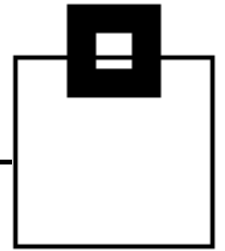
Path to a safe exploitation of DB2 enhancements using package stability:



\* **ENFM**: Enabling **New Function Mode**

# DB2 Version Migration

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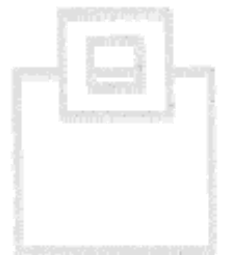
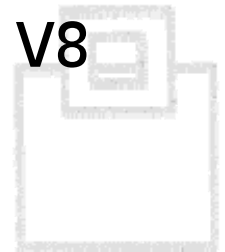
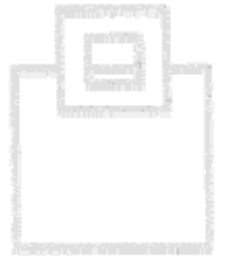
- Preparation:

- Make sure you have plan table data for all your access paths

**REBIND EXPLAIN(YES)**

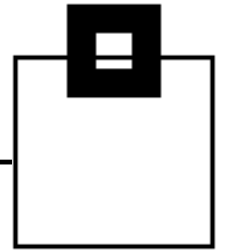
- Make sure you have APAR PK52522 applied to your DB2 V8
- SET DB2 9 ZPARM PLANMGMT to EXTENDED\*

\* Watch out for the 64GB limit or apply  
**usermod**



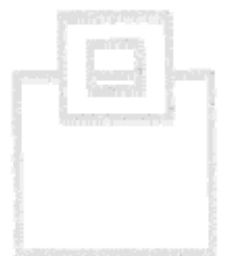
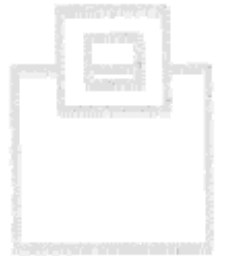
# DB2 Version Migration

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- Migration:

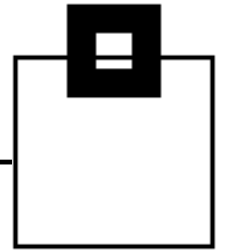
- Get DB2 9 CM stable
- Set ZPARM STATSCCLUS to ENHANCED (this is default)
  - this opens up the new clusterratio calculation
  - this opens up data repetition factor calculation (DRF)
- Run extended RUNSTATS
- Execute global REBINDs
  - Current access path is DB2 9
  - Previous access path is a prior DB2 9 access path or V8
  - Original access path will remain your V8 access path



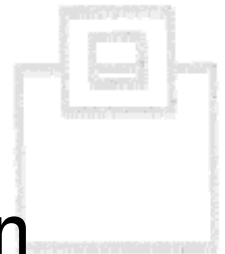
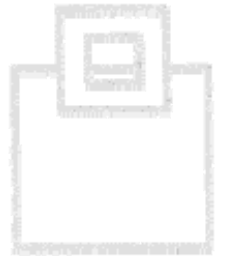
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# DB2 Version Migration

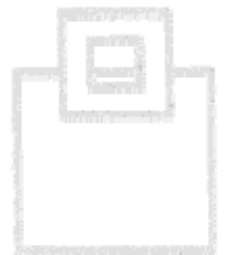
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- Fallback:
  - Do a REBIND PACKAGE ... SWITCH(ORIGINAL)
  
- Cleanup:
  - Do a FREE PACKAGE ... PLANMGMTSCOPE(INACTIVE)

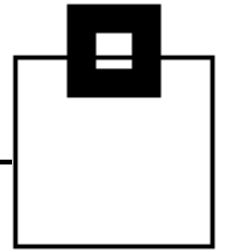


If you are satisfied with the resulting access paths move on to NFM



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# DB2 Version Migration



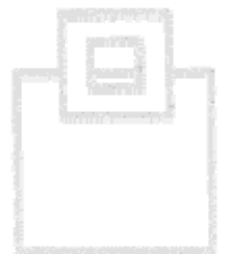
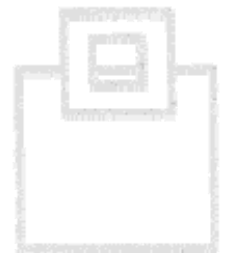
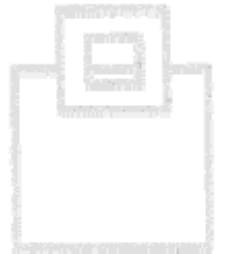
- Results:

- V7 → V8 2005, no distribution stats

- Improved: 4 %
- Degraded: 6,1 %
- Unchanged: 79,9 %
- Changed: 10 %

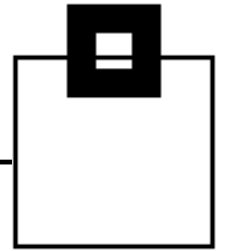
- V7 → V8 2008, distribution stats on everything

- Improved: 13,2 %
- Degraded: 0,9 %
- Unchanged: 79,9 %
- Changed: 6 %



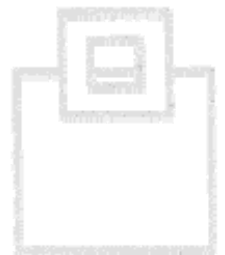
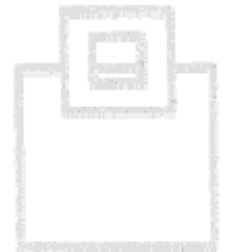
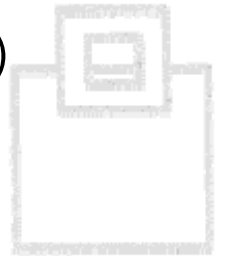
SOFTWARE ENGINEERING

# DB2 Version Migration

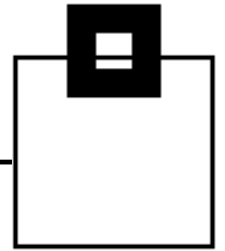


- Results:

- V8 → V9 2008 (critical online application, well tuned in V8)
  - Improved: 4,9 %
  - Degraded: 1,3 %
  - Unchanged: 70,6 %
  - Changed: 23,2 % (not categorized)
- V8 → V9 2008 (uncritical application, batch)
  - Improved: 4,2 %
  - Degraded: 5,8 %
  - Unchanged: 82 %
  - Changed: 8 %



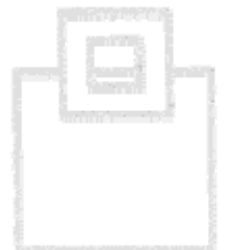
SOFTWARE ENGINEERING

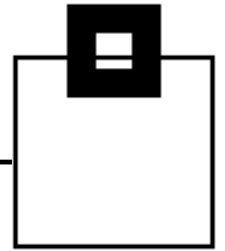


- Results:

- New access path patterns of DB2 9 – Using a different index

- Comparing DB2 V7 and V8, the latter showed a tendency to use smaller indexes (no. of pages)
- In general DB2 9 shows the same tendency, but ..
- In a lot of cases DB2 9 changed access paths in the way to prefer a bigger index to avoid a physical sort (similar to V7)



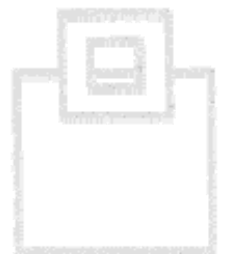
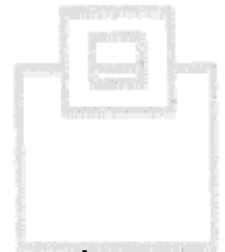


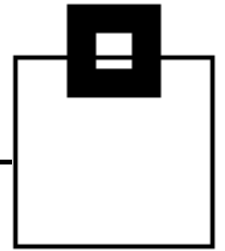
- Results:

- New access path patterns of DB2 9 – Bad stats:

- With DB2 V8 we saw many bad access paths caused by bad statistics. For example, missing statistics for a new index lead to a tablespace scan, even if another index was used before

- With DB2 9 Indexes with 0 pages seem to be always used



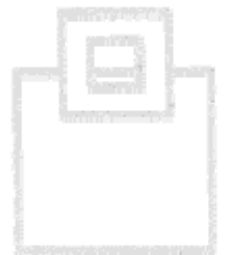
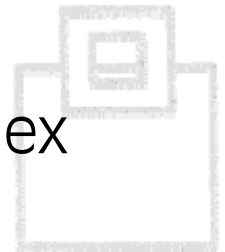
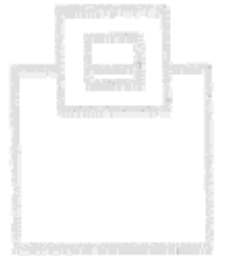


- Results:

- New access path patterns of DB2 9 – Small tables

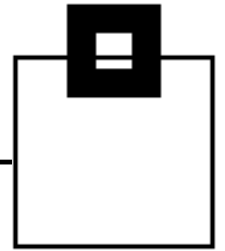
- With DB2 V8 a lot of matching or non matching index scans changed to a tablespace scan for small tables

- In a lot of cases this behaviour changed back to an index usage with DB2 9 even for tables with only 1 page

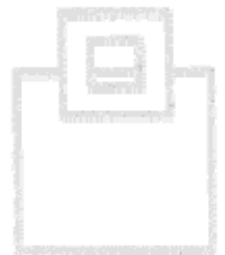
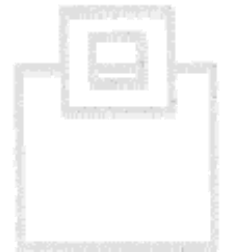
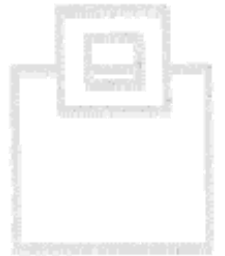


# DB2 Version Migration

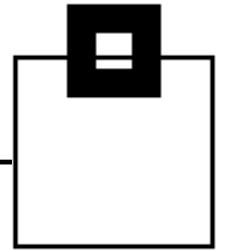
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- Results:
  - New access path patterns of DB2 9 – Index size (part 2)
    - DB2 9 tends to use the smallest index
    - even if index only access gets lost
    - in most cases the smaller ix was the partitioning index

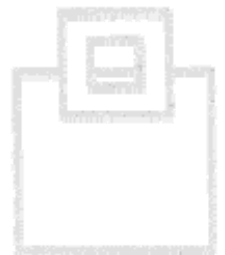
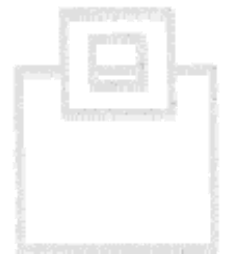
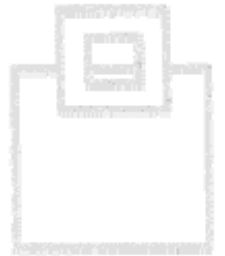


SOFTWARE ENGINEERING



How can I use it for ...

- DB2 Version Migration
- DB2 System Maintenance
- Daily Database Maintenance



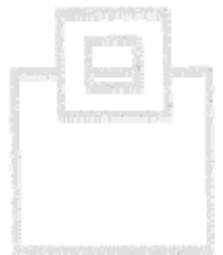
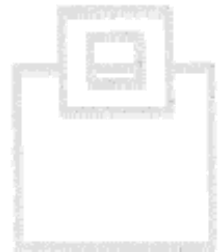
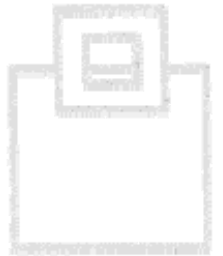
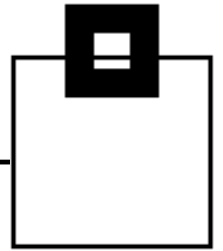
SOFTWARE ENGINEERING

# DB2 System Maintenance

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>> *The DB2 Optimizer has improved algorithms and a rewritten approach to handle performance information for tuning and for exceptions.<<*

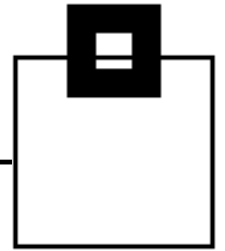
→ Improved algorithms widen the scope of optimization



SOFTWARE ENGINEERING

# DB2 System Maintenance

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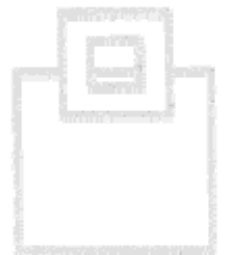
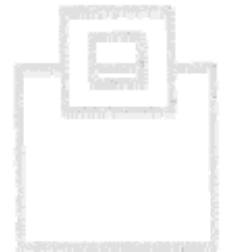
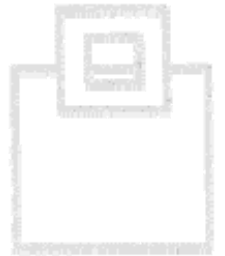
- Preparation:

- Make sure you have plan table data for all your access paths

REBIND EXPLAIN(YES)

- SET DB2 9 ZPARM PLANMGMT to BASIC\*

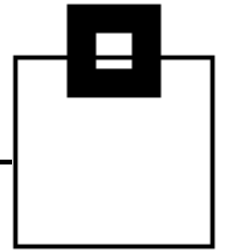
\* Watch out for the 64GB limit



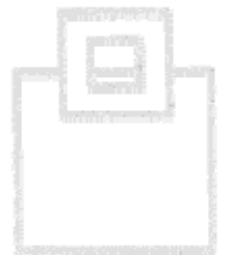
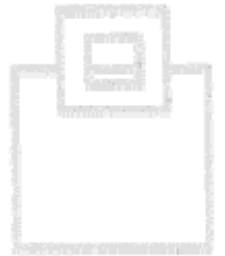
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# DB2 Version Migration

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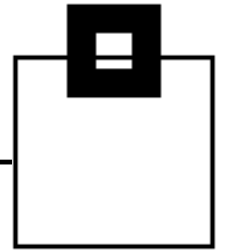
- Maintenance:
  - Apply APAR
  - Do APAR dependent activities if requested
  - Execute global REBINDs
    - Current access path considers the latest APAR
    - Previous access path is based on the preAPAR



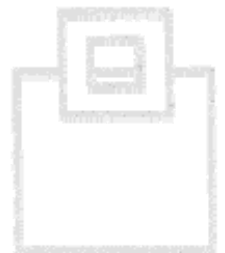
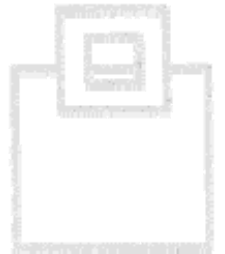
SOFTWARE ENGINEERING

# DB2 System Maintenance

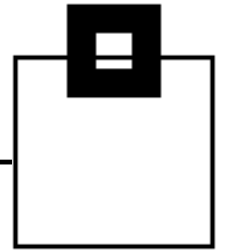
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- Fallback/Toggle:
  - Do a REBIND PACKAGE ... SWITCH(PREVIOUS)
  
- Cleanup:
  - Do a FREE PACKAGE ... PLANMGMTSCOPE(INACTIVE)

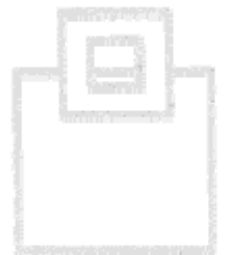
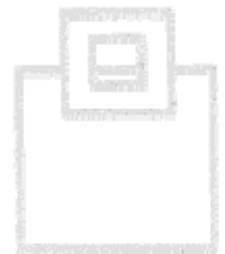
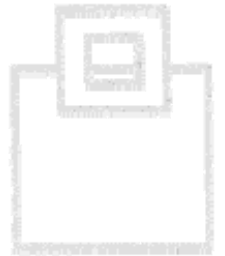


SOFTWARE ENGINEERING



How can I use it for ...

- DB2 Version Migration
- DB2 System Maintenance
- Daily Database Maintenance



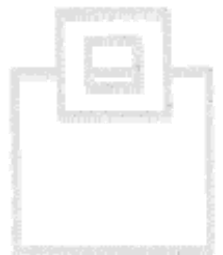
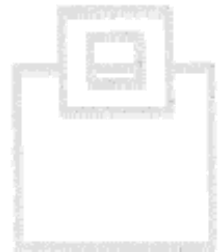
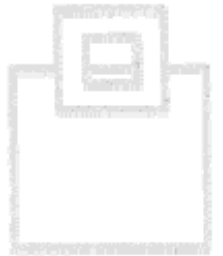
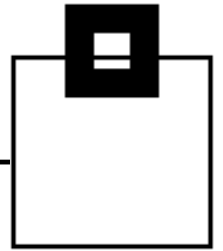
SOFTWARE ENGINEERING

# Daily Database Maintenance

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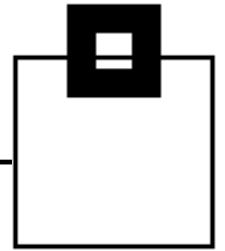
*>>The DB2 Optimizer gets the current statistics from DB2 catalog for the columns and tables identified in the SQL statements to select an access path.<<*

→ Practice the 3Rs – REORG → RUNSTATS → REBIND



SOFTWARE ENGINEERING

# Daily Database Maintenance



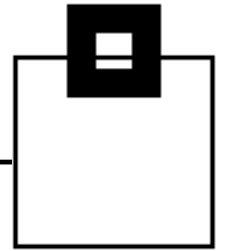
- Practice Roger Millers 3 R's
- Keep your system current
  - Whenever you do RUNSTATs also REBIND
    - Take care of AUTO REBINDs
- But find the right time
  - Consider the GIGA rule!
  - Be careful with volatile objects
  - Dynamic SQL is immediately affected and can not be secured by package stability



SOFTWARE ENGINEERING

# Daily Database Maintenance

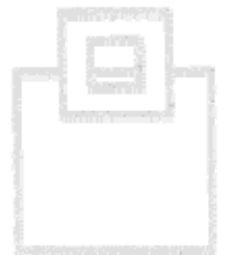
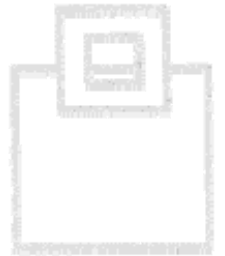
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- Preparation:

- Make sure you have plan table data for all your access paths

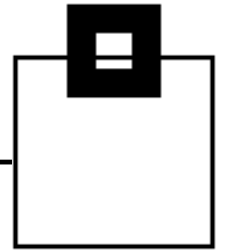
- REBIND EXPLAIN(YES)



SOFTWARE ENGINEERING

# Daily Database Maintenance

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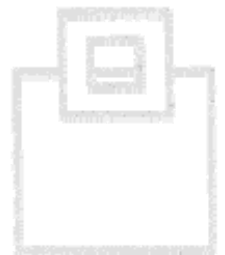
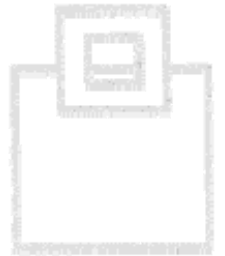


- Maintenance:

- **(REORG) → RUNSTATS → REBIND PLANMGMT(BASIC)**

- Current access path considers fresh statistics

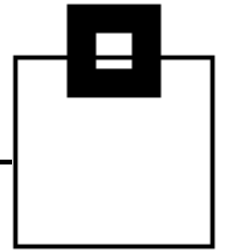
- Previous access path is based on the prior statistics



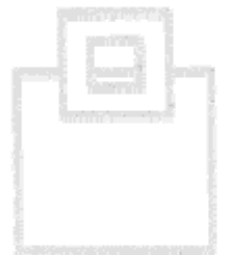
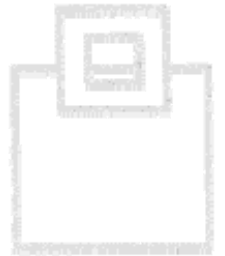
SOFTWARE ENGINEERING

# Daily Database Maintenance

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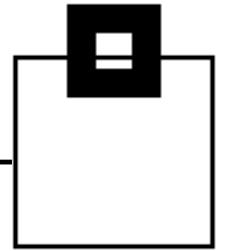
- Fallback/Toggle:
  - Do a REBIND PACKAGE ... SWITCH(PREVIOUS)
- Cleanup:
  - Do a FREE PACKAGE ... PLANMGMTSCOPE(INACTIVE)



SOFTWARE ENGINEERING

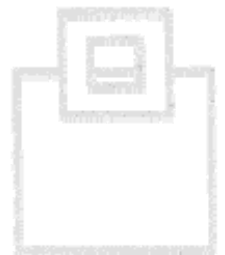
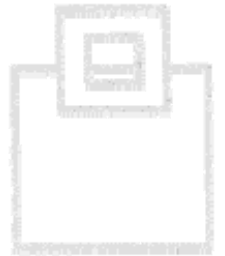
# Daily Database Maintenance

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- Results:

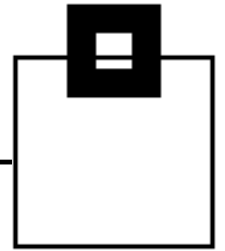
- Results from REBINDs after (REORG), RUNSTATS
  - Improved: 7,4 %
  - Degraded: 1,8 %
  - Unchanged: 79,2 %
  - Changed: 11,6 % (not categorized)



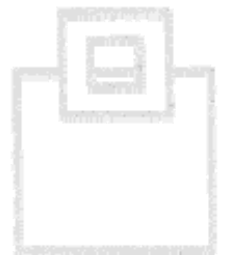
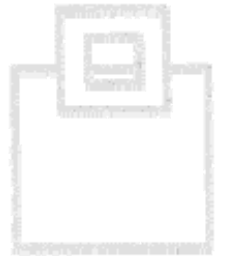
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# PreCheck with **Bind ImpactExpert**

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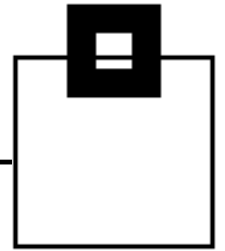
- All access path changes are shown before REBIND
- **PLANMGMT integrated comfortably**
  - Overview about existing copies of a package
  - History for PLAN\_TABLE data allows to compare active, previous and original access path
  - Generates REBIND SWITCH commands for selected packages
- New settings allow to create REBIND commands with PLANMGMT clause for different BIX categories like IMPROVED, CHANGED etc.



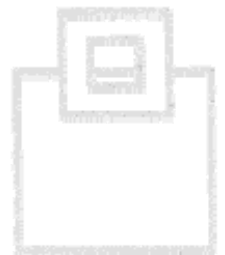
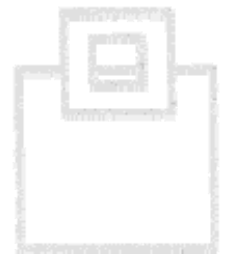
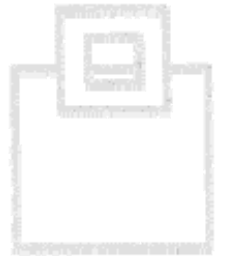
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# Benefits

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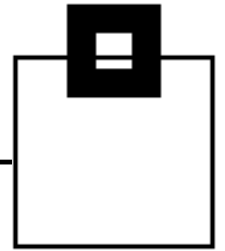
- **Using BIX and PLANMGMT allows to**
  - Reduce the risk of bad access paths after REBIND
  - Allow to execute REBINDs for packages that e.g. are rated CHANGED with the ability to switch back in case of a performance degradation
  - Reduces the amount of space needed in SPT01 due to the fact that no REBIND is generated by BIX for unchanged packages
  - Allows to REBIND unchanged packages in a migration scenario without creating a copy
  - Adds transparency to the new DB2 feature
  - Shows access paths for package copies



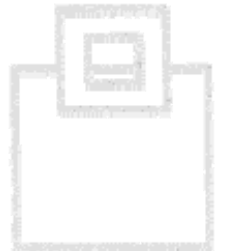
SOFTWARE ENGINEERING

# Conclusion

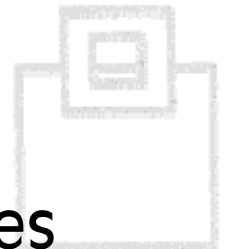
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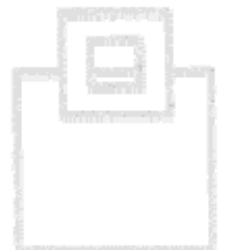
*It's all about statistics... – Garbage in, garbage out!*



Since DB2 V8 we encounter that the DB2 Optimizer makes as good decisions as it's knowledge base is.



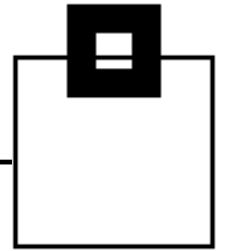
If you provide proper statistics, the DB2 Optimizer provides a good access path to the data.



SOFTWARE ENGINEERING

# Conclusion

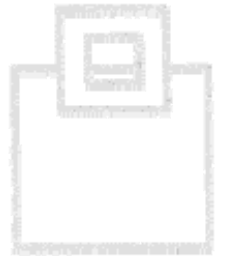
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*It's all about statistics... – Garbage in, garbage out!*

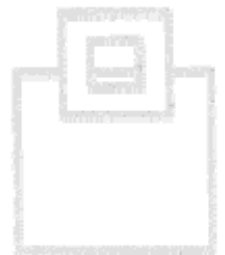
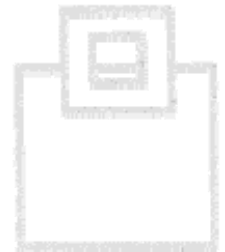
## DB2 V8 Recommendation:

Keep your Catalog Statistics current      AND  
determine DISTRIBUTION STATS



## DB2 9 Recommendation:

Keep your Catalog Statistics current      AND  
determine DISTRIBUTION STATS      AND  
determine HISTOGRAM STATS



SOFTWARE ENGINEERING

# Summary

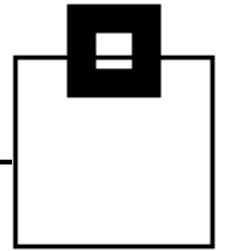
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- IBM significantly improved the DB2 Optimizer by over all as well as specific enhancements
- „Usual“ RUNSTATS don't provide detailed statistics to enable Optimizer finding best access path
- Access path decisions of Optimizer in DB2 z/OS V9 (CM, NFM) are different from DB2 z/OS V8
- Requirements regarding quality and efficiency to maintenance procedures (RUNSTATS and REBIND) are higher for DB2 Version 9 and upcoming versions
  - Growth of tables
  - Column Distribution Statistics
  - Histogram Statistics

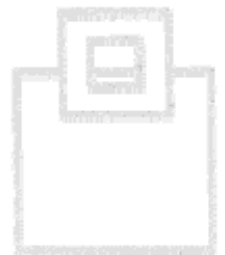
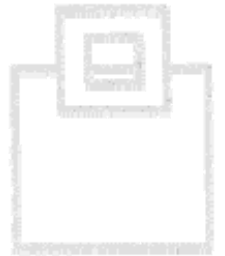
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# Summary

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- **Pro's:**
  - PLANMGMT saves an access path for easier fallback
- **Con's:**
  - Use it carefully! - It can flood your SPT01
    - Space requirements in SPT01 increase by factor 2 or 3
      - Don't set the ZPARM, but use the REBIND option only
      - Don't mess around with access path backups there are no timestamps
  - No support for Plans
  - No support for BINDs
  - 30% REBIND overhead
  - Does not restore plan\_table information
  - Auto-REBIND replaces an active copy



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