

DB2 Access Paths

Surviving and Thriving



The DB2 Education Webinar Series by Craig S. Mullins and SoftwareOnZ – Part 1

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- Recent BIND advances in DB2 9
- Access Paths and Change Management
 - Lack of Control
- Version Management
 - Version Migration Issues
 - Understand and Prepare!
- New Product for Managing BINDs
 - zAPX Overview and Walkthru



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BIND / REBIND Review



- The BIND and REBIND commands:
 - Are used to create DB2 plans and packages
 - Many options to choose from, including:
 - DEGREE (ANY | 1)
 - EXPLAIN (YES | NO)
 - ISOLATION (RR | RS | CS | UR | NC)
 - OPTHINT(id)
 - ACQUIRE (USE | ALLOCATE)
 - RELEASE (COMMIT | DEALLOCATE)
 - VALIDATE (RUN | BIND)
 - CURRENTDATA (YES | NO)
 - and more...



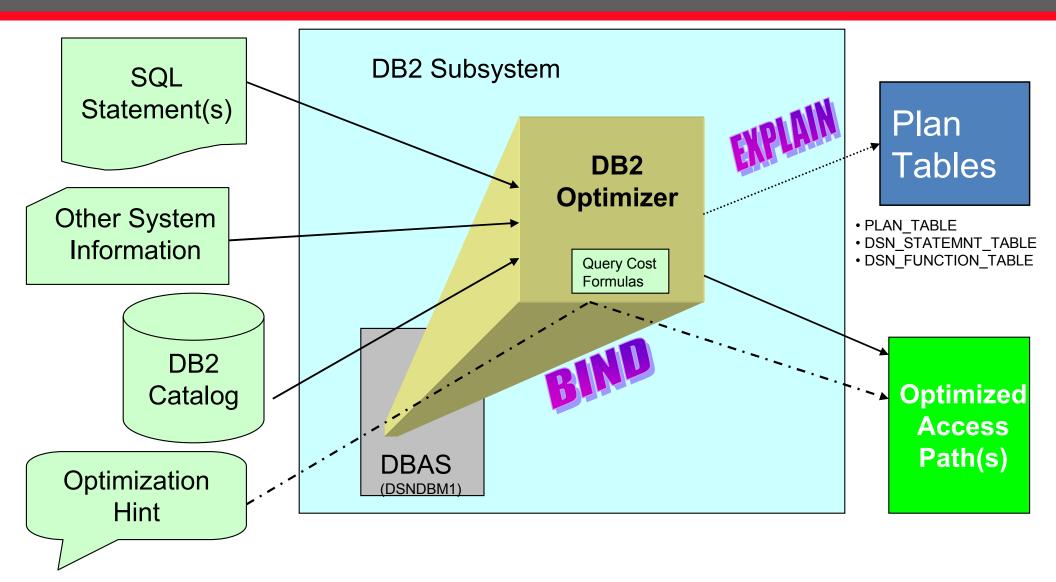


- BIND and REBIND are critical for application performance
- It is a wise course of action to plan your REBIND strategy
- BIND reads DBRM and converts SQL to access paths
 - SQL can change
- REBIND re-evaluates the access paths of a pre-existing plan or package
 - SQL cannot change



BIND and Optimization



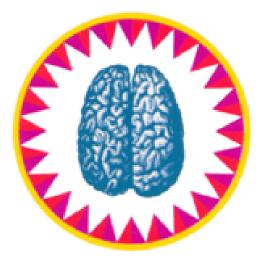


OPTHINT in PLAN_TABLE ©2010 SoftwareOnZ

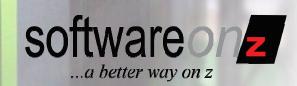
BIND / REBIND Accesses...



- SQL
- BIND Parameters
- DB2 Catalog
 - Database Object Information
 - Table Columns
 - Table Space LOCKSIZE
 - Database Statistics
- System Information
 - CPU
 - System Software
- DB2 Subsystem Information
 - RID Pool Parameters SIZE
 - Buffer Pool Parameters VPPSEQT
- Query Cost Formulas in the Optimizer code



OK, So What?



- We know that:
 - BIND and REBIND are critical for application performance
 - It is a wise course of action to plan your REBIND strategy
- There are several common approaches:
 - Daily maintenance: REBIND after RUNSTATS
 - Perhaps not every day, but REBIND are done after RUNSTATS
 - Global REBIND after migration to new DB2 version
 - Global REBIND after installing new PTFs
 - Above two mean access paths only change when DB2 changes
 - REBIND after x days / weeks / months ...
 - Let it Ride! ("If it ain't broke, don't fix it.")



Let It Ride

- Programs once bound, are (almost) never rebound.
- Reason:
 - Fear of access path degradation
- Result:
 - No improvement to access paths
 - No CPU savings from new DB2 efficiencies
 - Sub-optimal performance
 - Every DB2 program potentially suffers for fear that one or two SQL statements will become inefficient



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Regular REBIND



- Better Approach: Regular REBINDing
 - The Three R's (next slide)
- Reason:
 - Access paths are more up-to-date based on the current state of the data.
- Result:
 - Generally, improved access paths
 - CPU savings from new DB2 efficiencies
 - Optimal performance
- Of course, you can still get those "problem" access paths.



The Three R's

Problem:

How accurate is the RUNSTATS utility? Does RUNSTATS use estimates derived from data sampling or does it actually access each row to collect and accumulate full measurement statistics? Also, what are some "rules of thumb" to use for scheduling RUNSTATS?

The 3 R's: Rules for Running RUNSTATS



Statistics are collected by the RUNSTATS utility using both of the methods that you describe. When RUNSTATS INDEX is executed, exact statistics are collected. When RUNSTATS TABLESPACE is executed, the statistics for COLCARD are estimated using a technique called collective sample counting. However, the estimates are very accurate and reliable.

Some "rules of thumb" governing the execution of RUNSTATS follow:

- Consider running RUNSTATS whenever 10% or more of the data in a table has been modified. This includes INSERTS, UPDATES, DELETES, and LOADS.
- Collect column statistics only for those columns used in SQL predicates. The collection of column statistics can be very expensive and should be performed only when it can impact access paths.
- Keep a history of each application's statistics. After running RUNSTATS, select
 the statistics from the DB2 Catalog and insert them into a table or tables with a
 timestamp on each row. These tables can be analyzed to show data growth trends.
- Produce statistics reports using either the REPORT YES option of RUNSTATS
 or an SQL query against the DB2 Catalog. The SQL query will produce a more
 readable report, but the REPORT YES option is easier to implement.
- Do not blindly REBIND every package and plan after executing RUNSTATS. REBIND only if the data changes significantly or if performance is suffering.
- Optimally, statistics should reflect the status of the data during the period of highest data access. If possible, schedule RUNSTATS to achieve this.
- Analyze RUNSTATS data to determine when REORG is necessary. Always run RUNSTATS after a REORG.

- REORG
- RUNSTATS
- REBIND

Originally published February 1993 for DB2®V2R3.



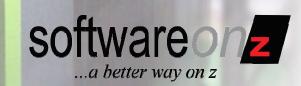
Problems With the Three R's



- They pose a lot of questions...
 - When should you REORGanize?
 - To properly determine requires RUNSTATS (or RTS).
 - So should it be RUNSTATS, REORG, RUNSTATS, REBIND?
 - When should you run RUNSTATS?
 - To properly determine you need to know the make-up, usage, and volatility of your data.
 - When should you REBIND?
 - When statistics have changed significantly enough to change access paths.
 - But...



Catalog Statistics



- Why correct statistics are so important
 - The DB2 Optimizer makes all access path decisions
 - Accurate data helps the Optimizer make the correct decisions
 - Incorrect statistics may cause:
 - Less efficient join sequence
 - Less efficient method of accessing individual tables (e.g. sync I/O instead of prefetch)
 - Wrong or no index may be used
- According to Terry Purcell (IBM)
 - "As much as 50% of all bad access paths are caused by incorrect statistics."

Getting Correct Statistics



- Ways to update statistics
 - RUNSTATS utility
 - REORG with inline statistics
 - LOAD with inline statistics
 - Using SQL for statistics manipulation
 - Transferring statistics from another system
 - Using tools for manipulation

OK, so When Should we REBIND?



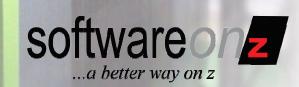
- When do we REBIND?
 - The best answer to this questions is:
 - "Whenever data has changed significantly enough that it may impact the performance of the existing access paths."
 - The problem is knowing exactly when this happens.
 - DB2 application performance can be negatively affected by uncontrolled REBINDs.
 - Causes
 - Optimizer inefficiency
 - Volatile tables
 - Catalog pollution
 - Inefficient use of RUNSTATS

Reviewing the Steps: The 3 5 R's



- RUNSTATS (or RTS)
- REORG
- RUNSTATS
- REBIND
- Recheck
 - In other words, what did the REBIND do?
 - Access path changes better or worse?

How Do We Do This?



- How do you determine what access paths have changed?
 - Program changes?
 - Just access paths changes?
- Do you evaluate every program that is rebound in production?
 - Or do you just wait for irate users to call?

Newill answer these questions.

The Latest in BIND from DB2 Access Path Stability

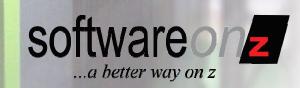
- Access Path Stability, which works on packages only, uses the PLANMGMT parameter to keep backups versions of your program's access paths.
- Why?
 - Because sometimes, after rebinding your program, performance degrades.
 - With plan stability you can fall back to a previous package.



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PLANMGMT BIND Options



Previous and active copies of package.

- PLANMGMT(OFF) No change to existing behavior. A package continues to have one active copy.
 - PLANMGMT(BASIC) A package has one active copy. One additional prior copy (PREVIOUS) is preserved.
- PLANMGMT(EXTENDED) A package has one active copy, and two additional prior copies (PREVIOUS and ORIGINAL) are preserved.



Original, previous and active copies of package.

The Ol' Switcheroo

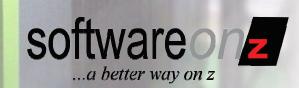


- SWITCH (PREVIOUS) changes the current and previous packages:
 - The existing current package takes the place of the previous package.
 - The existing previous package takes the place of the current package.
- SWITCH (ORIGINAL) clones the original copy to take the place of the current copy:
 - The existing current copy replaces the previous copy.
 - The existing previous copy is discarded.

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Only if you bound using PLANMGMT EXTENDED (refer to previous slide).

Change Management



- Your Mainframe Environment Requires Strict Change Control Procedures
 - Application Program Changes
 - Database Changes
 - System Software Changes
 - DB2 Subsystem Changes
- But what about Access Path changes?



When Are Access Paths Changed?



- Any time the program changes
 - BIND is required
 - Unless the SQL does not change and you have a tool to manage the process
- Every time we REBIND whether the program changed or not
- New DB2 Releases and Versions
 - Sometimes we must REBIND to get SQL performance improvements
 - But performance gains are *not* guaranteed

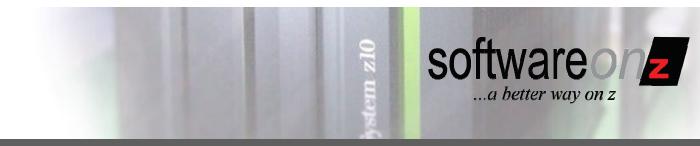


- Typically, you do not HAVE to REBIND all of your packages and plans when you move to a new version of DB2.
 - However, it is a really good idea.
- There are a lot of optimizer enhancements and performance improvements that you won't get without a REBIND.
- And there are some REBINDs you cannot avoid.
 - For DB2 9, plans and packages from DB2 V4 or earlier will be automatically rebound when accessed by DB2 9.

Access Path Change Management



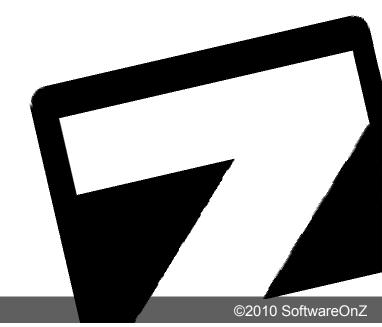
- Given the issues, features, and migration concerns, what do we need going forward?
 - A way to predict the performance of SQL before REBINDing in production
 - Both Static and Dynamic SQL
 - Preview the access paths resulting from execution of BIND commands
 - Show before and after access paths
 - Predicting better/worse/same
 - A way to analyze and determine the impact of REBINDing before:
 - DB2 version migrations
 - Major PTFs
 - A way to integrate BIND/REBIND into existing change control processes
 - Avoid BINDs where performance will deterioriate
 - Identify new statements
 - Show the access path for new statements



Introducing



New Generation SQL Access Path Rating & Comparison





Access Path Expert









- Graphical User Interface
- Single Point of Control for all DB2 systems
- Explain
- Automation
- DB2 Catalog Management



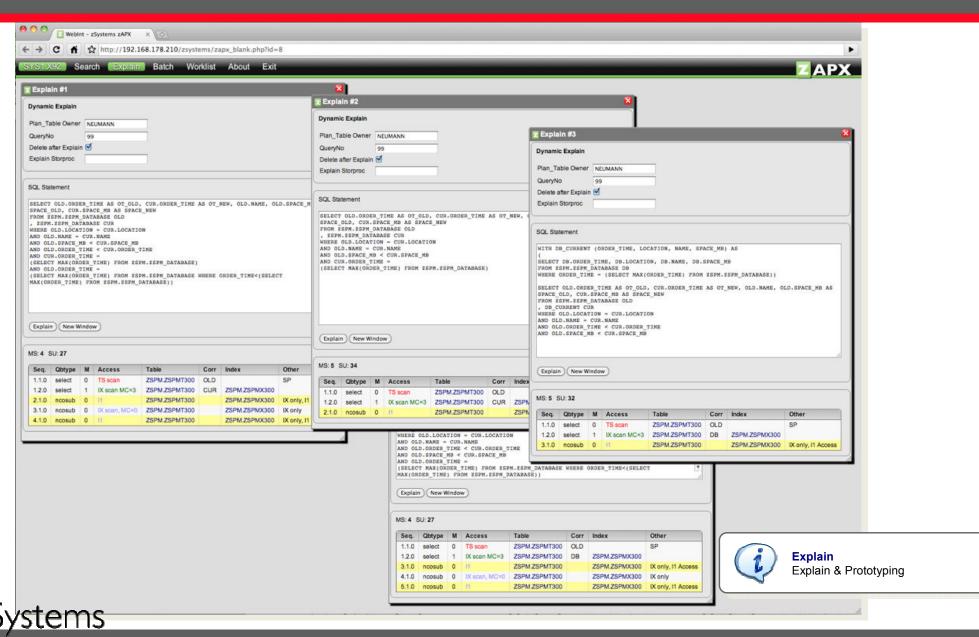




- Explain with controlled product authority
- Dynamic highlighting of Access Path Differences
- Static and dynamic SQL
- Correlates Views, Aliases and Synonyms to Plan_Table



Explain & Compare



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Difference Highlighting



ccess	Patl	h Old				Access	Pat	h New			
Seq.	М	Access	Table	Index	Other	Seq.	М	Access	Table	Index	Othe
1.1.0	3	Sort				1.1.0	3	Sort			
2.1.0	0	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP	2.1.0	0	TS scan	GH12.GH12T17		SP
2.2.0	1	IX scan MC=2	SYSIBM.SYSTABLESPACE	SYSIBM.DSNDSX01		2.2.0	1	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01	
2.3.0	4	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01		2.3.0	1	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP
2.4.0	2	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP	2.4.0	1	IX scan MC=2	SYSIBM.SYSTABLESPACE	SYSIBM.DSNDSX01	
3.1.0	0	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP	3.1.0	0	TS scan	GH12.GH12T17		SP
4.1.0	0	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP	4.1.0	0	TS scan	GH12.GH12T17		SP
4.2.0	1	IX scan MC=2	SYSIBM.SYSINDEXES	SYSIBM.DSNDXX01		4.2.0	1	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01	
4.3.0	4	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01		4.3.0	1	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP
4.4.0	2	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP	4.4.0	1	IX scan MC=2	SYSIBM.SYSINDEXES	SYSIBM.DSNDXX01	
5.1.0	0	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP	5.1.0	0	TS scan	GH12.GH12T17		SP

Dynamic Mouse Over Access Path Difference Highlighting

Access Path New

Seq.	Μ	Access	Table	Index	Other
1.1.0	3	Sort			
2.1.0	0	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP
2.2.0	1	IX scan MC=2	SYSIBM.SYSTABLESPACE	SYSIBM.DSNDSX01	
2.3.0	4	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01	
2.4.0	2	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP
3.1.0	0	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP
4.1.0	0	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP
4.2.0	1	IX scan MC=2	SYSIBM.SYSINDEXES	SYSIBM.DSNDXX01	
4.3.0	4	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01	
4.4.0	2	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP
5.1.0	0	IX scan, MC=0	GH12.GH12T17	GH12.GH12X171	SP

Systems

Seq.	Μ	Access	Table	Index	Other
1.1.0	3	Sort			
2.1.0	0	TS scan	GH12.GH12T17		SP
2.2.0	1	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01	
2.3.0	1	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP
2.4.0	1	IX scan MC=2	SYSIBM.SYSTABLESPACE	SYSIBM.DSNDSX01	
3.1.0	0	TS scan	GH12.GH12T17		SP
4.1.0	0	TS scan	GH12.GH12T17		SP
4.2.0	1	IX scan MC=1	SYSIBM.SYSPLAN	SYSIBM.DSNPPH01	
4.3.0	1	IX scan, MC=0	SYSIBM.SYSPLANDEP	SYSIBM.DSNGGX01	DP
4.4.0	1	IX scan MC=2	SYSIBM.SYSINDEXES	SYSIBM.DSNDXX01	
5.1.0	0	TS scan	GH12.GH12T17		SP

Highlight Tables, Aliases, Views & Synonyms



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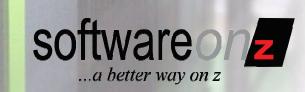
Switch DB2 subsystems

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IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, IVUGROWLEN, STATSTIME FROM SYSIEM. SYSTABLESPACE WHERE RT IAME) LIKE : H ORDER BY 1, 2 FOR FETCH ONLY QUERYNO 1 WI DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DBNAME), RTRIM (NAME), I ImpLicit, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, MAXROWS, NACTIVER AVGROWLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RTRIM (DBNAME) LIKE AVGROWLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RTRIM (DBNAME) LIKE NAME) LIKE : H ORDER BY 1, 2 FOR FETCH ONLY QUERYNO 1 WITH UR Explain New Window IS:1 SU:6	, DSSIZE ,								
MPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, NUCROWLEN, STATSTIME FROM SYSIEM. SYSTABLESPACE WHERE RT SQL Statement SQL Statement SQL Statement DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DBNAME), RTRIM (NAME), I MS: 1 SU: 6	, DSSIZE ,								
SQL Statement SQL Statement SQL Statement DECLARE SYSTABLESPACE WHERE RT IMPLICIT , NTABLES , SEGSIZE , TYPE , ENCODING SCHEME , MAXROWS , NACTIVEF AVGROWLEN , STATSTIME FROM SYSIEM . SYSTABLESPACE WHERE RTRIM (DBNAME) , IT IMPLICIT , NTABLES , SEGSIZE , TYPE , ENCODING SCHEME , MAXROWS , NACTIVEF AVGROWLEN , STATSTIME FROM SYSIEM . SYSTABLESPACE WHERE RTRIM (DBNAME) LIKE Explain New Window IS: 1 SU: 6 Predicates	, DSSIZE ,								
IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, NOROWLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RT SQL Statement SQL Statement DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIN (DBNAME), RTRIM (NAME), IN IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, MAXROWS, NACTIVEF AVGRONLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RTRIM (DBNAME) LIKE New Window Statement Explain New Window State Explain Seq. ? Qbtype ? M ? Access ? Table Table Seq. ? Qbtype ? M ? Access ? Table MS: 1 SU: 12	, DSSIZE ,								
IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, NOROWLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RT AME) LIKE : H ORDER BY 1, 2 FOR FETCH ONLY QUERYNO 1 WI DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DENAME), RTRIM (NAME), I IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME, MAXROWS, NACTIVEF AVGOWLEN , STATSTIME FROM SYSIBM . SYSTABLESPACE WHERE RTRIM (DENAME) LIKE New Window Stil SU:6 Predicates Supplain New Window	, DSSIZE ,								
IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING SCHEME, KOROWLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RT MME) LIKE : H ORDER BY 1 , 2 FOR FETCH ONLY QUERYNO 1 WI DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DANAME), RTRIM (NAME), 1 , IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING SCHEME, MARCONS, NACTIVEF AVGRONLEN, STATSTIME FROM SYSTABLESPACE WHERE RT SQL Statement DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DANAME), 1 , IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING SCHEME, MARCONS, NACTIVEF AVGRONLEN, STATSTEME FROM SYSTABLESPACE WHERE RTRIM (DANAME) LIKE SQL Statement DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DANAME), 1 , IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING SCHEME, MARCONS, NACTIVEF AVGRONLEN, STATSTABLESPACE WHICH RTRIM (DANAME) LIKE NAME) LIKE : H ORDER BY 1 , 2 FOR FETCH ONLY QUERYNO 1 WITH UR Explain New Window Si 1 SU: 6 Predicates Seq. ? Qbtype ? M ? Access ? Table 1.1.0 Select 0 IX scan MC=1 9 SYSIBM.SYSTABLESF	, DSSIZE ,								
InvElicit, NTABLES, SEGSIZE, TYPE, ENCODING SCHEME, R VGRWLEN, STATSTIME FROM SYSIBM. SYSTABLESPACE WHERE RT AME) LIKE : H ORDER BY 1 , 2 FOR FETCH ONLY QUERYNO 1 WT DECLARE SYSTABLESPACE CURSOR FOR SELECT RTRIM (DBMAME) , RTRIM (NAME) , I IMPLICIT, NTABLES, SEGSIZE, TYPE, ENCODING_SCHEME , MAKROWS, NACTIVEF NAME) LIKE : H ORDER BY 1 , 2 FOR FETCH ONLY QUERYNO 1 WT Explain New Window S:1 SU: 6 Predicates Seq. ? Obtype ? M ? Access ? Table 1.1.0 select 3 Sort MS: 1 SU: 12 Predicates	, DSSIZE , : H AND RTRIM (

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Automation





Batch Batch Comparison Reults

- ZAPX explains SQL and compares access paths of static and dynamic SQL for the purpose of:
 - Application Development
 - Quality Assurance
 - Securing REBINDs in the maintenance process
 - Securing dynamic SQL and REBINDS during migration to a new version of DB2



Analysis Job Overview



00	0							We	ebint – a	Systen	ns z8IN	D						
Resi	Its AP1.DEMO Ge	nerate Job	s Worl	dist	Abou	ut E	xit	_	_	_	_		_	_	_	_		РХ
Job	Overview																	
Re	sults				P	ackage	S			Sta	temen	ts						
Sv	Time	Src Loc	Tgt Loc	Eq	Imp	Deg	Chg	Err	Eq	Imp	Deg	Chg	Err	Jobname	Userid	Туре		
	2010-04-04 20:53:40	ZSYS1	ZSYS1	160	1	3	2	17	1517	4	4	2	<u>0</u>	ZBINDRB1	NEWMAN	Rebind	0	
	2010-05-02 12:24:05	DEMO	DEMO	115	Z	27	0	17	65	5	Q	0	0	ZBIND001	NEWMAN	Rebind		
	2010-05-02 12:50:43	DEMO	DEMO	<u>115</u>	Z	27	2	<u>17</u>	<u>45</u>	3	<u>8</u>	4	<u>0</u>	ZBIND001	NEWMAN	Rebind	٢	
-																		

The web-based Graphical User Interface allows direct access to every category, e.g.

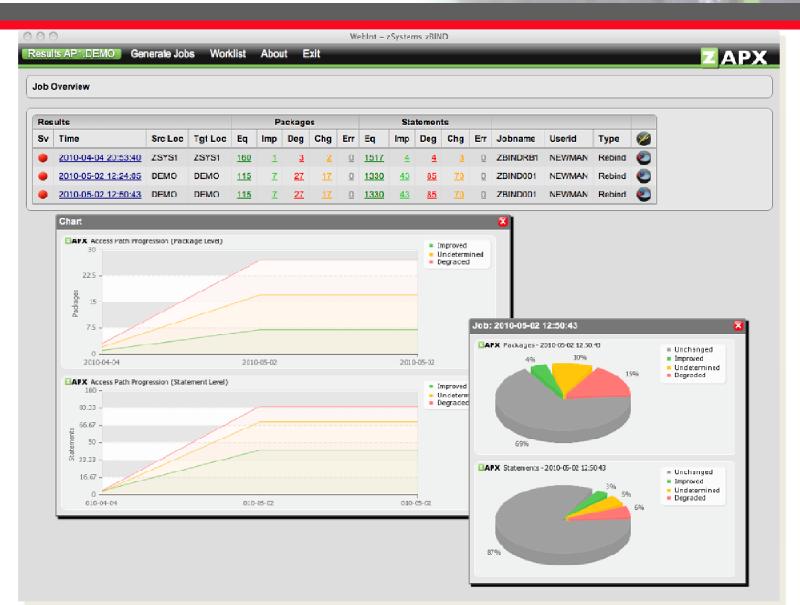
- Equal
- Improved
- Degraded

	Statements								
Eq	Imp	Deg	Chg						
1517	4	.4	3						
<u>65</u>	<u>5</u>	<u>0</u>	<u>0</u>						
<u>45</u>	<u>3</u>	<u>8</u>	4						



Graphical Overview

Systems



Generate Charts about SQL Access Path Progression over time or Categorys

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...a better way on z

Package Overview



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su	I.s AP1.DEM	Ceneral	e Jobs - Woi	rklist Save Mail	Chan	ge Profile	About	Exit			1	Millisecond	s	S	ervice Unit	s
ob '	Time: <u>2010-0</u>	5-02 12:50:43	Job: ZBIND00	1 User: NEWMAN							old 🛦 🔻	new▲▼	diff▲▼	old 🛦 🔻	new 🛦 🔻	diff 🔺 🔻
											1235	5619	4384	10874	11063	189
		-				1	Statements			Millise	60	270	202	501	520	19
₩ •		Package A V	Version 🛦 🔻	Bindtime▲▼	Eq 🛦 🔻	Imp 🛦 🔻	Deg 🔺 🔻	Chg 🛦 🔻	Err 🖌 🔻	old▲▼ new						1
2	ZSYS0110 ZSYS0110	X2DARTV9 X2DARIV9	0	2010-04-04 20:45:08 2010-04-04 20:44:51	<u>27</u> <u>16</u>	2	0	<u> </u>	0	1235 : 68	32	34	2	54	58	
ă.	ZSYS0110	GHDX7X	0	2010-04-04 20:45:39	34	0	0	a l	0	32	15	56	41	108	110	
ő.	ZSYS0110	ZDEXDBTS	0	2010-04-04 20:42:56	5	ō	ō	Ū.	D	15	15	00	41	108	110	
Ū.	ZSYS0110	ZDEXDBV9	0	2010-04-04 20:43:09	34	Q	Q	۵	۵	74	74	232	158	429	430	
ų.	ZSYS0110	ZDEXDEXC	0	2010-04-04 20:44:18	1	<u>0</u>	2	Q	1	1						
•	ZSY\$0110	ZDEXDBV8	0	2010-04-04 20:42:59	<u>29</u>	<u>3</u>	2	Q	<u>0</u>	226	1	2	1	1	2	
Q.	Z3Y30110	GHDX67	0	2010-04-04 20:45:34	9	Q	2	Q	<u>0</u>	9	226	933	707	1817	1818	
Ŵ.	ZSYS0110	DB2DSN1C	0	2010-04-04 20:46:45	<u>11</u>	<u>0</u>	2	Q	<u>0</u>	11	220		101			
Ψ.	ZSYS0110	ZDEXDBSG	0	2010-04-04 20:42:49	2	<u>0</u>	0	Q	<u>0</u>	2	9	12	3	16	16	
	ZSYS0110	ZDEXLST5	0	2010-04-04 20:44:25	2	0	2	Q	0	2	44		0	40	40	
9	ZSYS0110	GHDX86	0	2010-04-04 20:46:22	6	0	0	<u>0</u>	0	6	11	11	0	12	12	
9	ZSYS0110	GHDX91	0	2010-04-04 20:46:24	21	0	<u>u</u>	۵	0	21	2	2	0	2	2	
<u>e</u> .	ZSYS0110 ZSYS0110	GHDX75 ZDEXT001	0	2010-04-04 20:46:06 2010-04-04 20:44:35	<u>25</u> 1	<u>0</u> 0	0	Q	<u>0</u>	25	1 0	1 1	o			
W	ZSYS0110 ZSYS0110	GHRXSDLS	0	2010-04-04 20:44:35	1	0	0	<u>u</u> 0	0	1	4 3	7 7	0			
2	ZSYS0110	GHDX63	0	2010-04-04 20:45:30	9	0	<u>v</u>	u u	0	9	12 3	16 16	0	C	Sort by	cost
ő.	ZSYS0110	ZDEXLST6	0	2010-04-04 20:44:26	2	0	0	<u>u</u>	0	2	4 2	6 6	0	L L	JUILDY	0031
ž	ZSYS0110	ZDEXEAS2	0	2010-04-04 20:44:19	2	0		ŭ	0	2	2 0	2 2	0		or opto	2001
ő.	ZSYS0110	GHDX84	0	2010-04-04 20:46:17	12	ō	ō	ā	Ō	12	12 0	16 16	0	(or categ	JOLA
ŏ.	ZSYS0110	GHRXSU03	0	2010-04-04 20:46:30	3	ū	ū		ņ	3	a 0	વ વ	0			
ò.	ZSYS0110	SQDD2I	0	2010-04-04 20:41:46	5	0	0	Q	c			Statement	e			
ÿ.	ZSY50110	SQDDSLL	0	2010-04-04 20:41:42	4	Q	2	Q	ç			Statement	9		-	
9	ZSY50110	SQDW8	0	2010-04-04 20:42:07	1	<u>0</u>	2	Q	ç	Eq 🛦 🔻	Imp 🛦 🔻	Deg 🛦 🔻	Chg 🛦 🔻	Err A V	1	
ŵ.	ZSYS0110	GHDX68	0	2010-04-04 20:45:36	Z	<u>0</u>	<u>0</u>	Q	<u>(</u>						-	
ψ.	ZSYS0110	SQDW DB	0	2010-04-04 20:42:06	1	<u>0</u>	2	Q	2	12	14	<u>18</u>	<u>0</u>	0		
φ.	ZSYS0110	ZDEXDB01	0	2010-04-04 20:43:15	<u>58</u>	<u>0</u>	2	Q	<u>í</u>	7	0	11	0	0		
0	ZSYS0110	GHDX94	0	2010-04-04 20:46:28	4	0	0	Q	2	<u>7</u>	<u>0</u>	<u>11</u>	Ū	<u>0</u>		
ŵ.	ZSYS0110	GHDX62	0	2010-04-04 20:45:29	Z	<u>0</u>	Q	Q	2	<u>0</u>	1	<u>9</u>	3	0		
φ.	ZSYS0110	ZDEXLST4	0	2010-04-04 20:44:25	2	0	2	Q	2		-					
	ZSY50110	SQDEUC2	0	2010-04-04 20:41:59	3	<u>0</u>	2	Q	2	4	<u>0</u>	<u>5</u>	<u>0</u>	0		
	ZSY50110	DB2DV9R0	0	2010-04-04 20:46:50	6	0	0	<u>0</u>	2	18	0	5	0	0		
0		ZDEXLOGX	0	2010-04-04 20:44:20	1	0	2	<u>0</u>	4	10	Ū	5	Ū	<u>0</u>		
000	ZSYS0110	CHIDMEE		2010-04-04 20:45:32	9	<u>0</u>	2	0	1	3	0	4	0	0		
0000	ZSYS0110	GHDX65			1	0										
00000	ZSYS0110 ZSYS0110	ZDEXSYSC	0	2010-04-04 20:44:31	4	0	2	<u>0</u>	5							
00000	ZSYS0110	ZDEXSYSC DB2DV9SG			4 2 13	0	0	<u>u</u> 0	1	<u>0</u>	0	4	<u>0</u>	0		

Statement Overview

<u>Systems</u>

0.0			_	_		WebInt - zSystems zAPX						
S1.	TEST F	unctions	Worklist	Save Mail	About Logout							
b Tin	ne: <u>2010-09-0</u>	02 14:40:10.607	<u>958</u> ?									
ollid :	CSPM14											
	e: ZSPM											
		02 14:39:35.830	0448									
_					Acces	is Path ?			Service Unit	S		
šγ	Stmtno 🛦 🔻	Sectno. 🔺 🔻	Old	New	Old 🛦 🔻	New A V	Chg▲▼	Old 🔺 🔻	New 🔺 🔻	Diff	Length A V	Stmt 🛦 🔻
)	<u>1920</u>	0			lp(1)	ts(1)	IX, AT, MC, PF	311	2	-309		DELETE FROM ZS
)	5054	0	-		ts(1)	TS(1)		2743	49568	46825	78	DELETE FROM ZS
)	5551	0			ts(1)	TS(1)		4753	44924	40171	72	DELETE FROM ZS
)	<u>5990</u>	0			lp(1)	TS(1)	IX, AT, MC, PF	10	3188	3178	261	SELECT SUM (CA
)	<u>6141</u>	C			lp(1)	TS(1)	IX, AT, MC, PF	141	44860	44719	43	DELETE FROM ZS
0	<u>6649</u>	0			nmix(2), sort(1)	ts(2), hbj(1), sort(1), lp(1)	IX, MTD(1), AT, JSQ, JSQ, PF	10	485	475	3187	DECLARE LPS_SE
D	<u>2403</u>	0			ts(1), nmix(1)	ts(1), nmix(1)	PF	75	2	-73	371	SELECT CASE WH
)	<u>3306</u>	0			ts(1), nmix(1)	ts(1), nmix(1)	PF	75	2	-73	361	SELECT CASE WH
D	4186	C			ts(1), nmix(1)	ts(1), nmix(1)	PF	75	2	-73	366	SELECT CASE WH
C	<u>5103</u>	C			ts(1), nmix(1)	ts(1), nmix(1)	PF	75	2	-73	368	SELECT CASE WH
)	<u>2370</u>	C			lp(1)		PF	80	7	-73	45	DELETE FROM ZS
C	<u>635</u>	C			ts(1)	ts(1)		1	1	0	66	SELECT CURREN
)	<u>1790</u>	0						1	1	0	152	SELECT LAST_SN
)	<u>1845</u>	0						1	1	0	197	UPDATE ZSPN_OF
)	1887	0						1	1	0	72	UPDATE ZSPM_O
C	<u>1994</u>	C						2	2	0	275	INSERT INTO ZSPI
)	<u>208 1</u>	C						2	2	0	4 14	INSERT INTO ZSPI
D	<u>2182</u>	C			ts(1)	ts(1)		2743	198	-2545	85	DELETE FROM 2S
D	<u>2195</u>	0		-	ts(1)	ts(1)		2743	2	-2741	90	DELETE FROM ZSI
D	2208	0		-	ts(1)	ts(1)		2743	325	-2418	78	DELETE FROM ZS
D	2278	0						2	2	0	375	INSERT INTO ZSPN
								2	2	0	419	INSERT INTO ZSPM

Access path rating & changes at a glance

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Statement Overview

<u>Systems</u>

	TEST F	unctions	Worklist	Save Mail	About L	ogout							ZAPX
b Tin	ne: <u>2010-09-0</u>	02 14:40:10.607	<u>958</u> ?										
ilid :	CSPM14												
ckaş rsior	ge: ZSPM												
		02 14:39:35.830)448										
					T Help - /	Access Types ar	nd Changes	X	1				
						es and Changes		_		ervice Uni	te		
šv	Stmtno 🛦 🔻	Sectno.	Old	New	TS(n)	-	can on a Table > 500 Pages		Ţ	New T		Length 🛦 🔻	Stmt 🛦 🔻
)	1920				ts(n)	Table Space s	can on a Table < 500 Pages			2		-	DELETE FROM ZS
5	5054	-	-		NMIX(n) nmix(n)			t is > 50% of the table size t is < 50% of the table size	13	49568	46825		DELETE FROM ZS
5	5551	C			mix(n)	Multiple Inde	x Access		53	44924	40171		DELETE FROM ZS
5	5990	C			wfs(n) msj(n)	Workfile Scan Merge Scan Jo	(Accesstype=RW) in (Method=2)		ho	3188	3178	261	SELECT SUM (CA
)	6141	C		-	hbj(n)	Hybrid Join () Sort			41	44860	44719	43	DELETE FROM ZS
5	6649	C			sort(n) lp(n)	List Prefetch			10	485	475	3187	DECLARE LPS_S
5	2403	C			(n) = No	of occurrences			75	2	-73	371	SELECT CASE W
5	3306	0			(or occurrences			75	2	-73	361	SELECT CASE W
)	4186	C			Access Typ	e Changes			75	2	-73	366	SELECT CASE W
)	<u>5103</u>	C			SEQ	Sequence Chan	ae		75	2	-73	368	SELECT CASE W
)	<u>2370</u>	C			IX	Diffenent Ind	ex used or Sequence Change		30	7	-73	45	DELETE FROM ZS
)	<u>635</u>	0			MTD AT	Access Type c	ess Method used hanged		1	1	0	66	SELECT CURREN
)	<u>1790</u>	0			JSQ MC	Changed Join	Sequence Matching Columns		1	1	0	152	SELECT LAST_SN
)	<u>1845</u>	0			IXO	Index Only ch	anged		1	1	0	197	UPDATE ZSPM_0
)	1887	C			TSL PF	TSLockmode ch Prefetch chan			1	1	0	72	UPDATE ZSPM_0
)	<u>1994</u>	0			JT	Join Type cha			2	2	0	275	INSERT INTO ZSP
)	<u>2081</u>	C							2	2	0	414	INSERT INTO ZSP
)	<u>2182</u>	0			ts(1)		ts(1)	27	43	198	-2545	85	DELETE FROM 25
)	<u>2195</u>	C			ts(1)		ts(1)	27	43	2	-2741	90	DELETE FROM 2S
)	<u>2208</u>	0			ts(1)		ts(1)	27	43	325	-2418	78	DELETE FROM 28
)	2278	0							2	2	0	375	INSERT INTO ZSP
0	2496	0							2	2	0	419	INSERT INTO ZSPI

Access path rating & changes at a glance

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Stmt Overview



osuns,	AD1	.DEMO Gen	erate Jobs Worklist S	ave Mail Abou	Weblnt – zSi It Exit					_	
	AP I	.DEMU Gen	erate Jobs Workinst 3	ave Man Abou			_				AP
ob Tim	ne: 2	010-05-02 12:50	:43 Job: ZBIND001 User: N	IEWMAN							
ollid :	ī	ZSYS0110									
		ZDBXDBPD									
ersion											
indtim tmtno		2010-04-04 20:42 1686	221								
		TUDU									
ECLARE			SOR WITH HOLD FOR								
ELECT			PG . COLLID , PG . NAME								
FROM		G . COLLID = 1	, ZCATTRIGGERS PD , ZCAT PD , SCHEMA	TABLESPACE TS							
AND		G . NAME = PD									
AND	P	G . TYPE = 'T		_		\ /'			· -		
AND		G . BINDTIME -			etail	Vie	۱M	/ with .	Access Pa	ath	
FROM		AX (TS2 . ST/ CATTABLESPACE			Clair	v i O		VVICIT /			
WHERE		$S2 \cdot DBID = PI$				(2	mnor	000		
AND		OT	,				JC	mpari	ISON		
TSTS	(•			
FROM		XX . PACKAGE DBXRESTO ZXX		ar	Δh	CCA	20	: Tvne	Highlighti	ina	
PROM		XX . FLAG = 'I		a	יה טו	bbb	20			III	
TIDEE								J 1		0	
WHERE AND		G . NAME = ZXX	. PACKAGE) UNION					71	0 0	0	
and Elect	P	G . LOCATION	(. PACKAGE) UNION PG . COLLID , PG . NAME					71	0 0	0	
AND ELECT FROM	P P Z	G . LOCATION , CATPACKAGE PG	C . PACKAGE) UNION , PG . COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT					51	0 0	0	
AND ELECT FROM WHERE	P P Z P	G . LOCATION , CATPACKAGE PG G . COLLID = 1	C . PACKAGE) UNION , PG . COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT PD . SCHEMA					51	0 0	0	
AND ELECT FROM	P P Z P P	G . LOCATION , CATPACKAGE PG	 C. PACKAGE) UNION PG . COLLID , PG . NAME ZCATTRIGGERS PD , ZCAT PD . SCHEMA NAME 					51	5 5	0	
AND ELECT FROM WHERE AND AND AND	P P Z P P P P	G . LOCATION , CATPACKAGE PG G . COLLID = M G . NAME = PD G . TYPE = 'T' G . BINDTIME -	C. PACKAGE) UNION PG. COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT PD . SCHEMA . NAME . (51	5 5	0	
AND ELECT FROM WHERE AND AND AND ELECT	Pi Pi Zi Pi Pi Pi N	G . LOCATION , CATPACKAGE PG G . COLLID = H G . NAME = PD G . TYPE = 'T G . BINDTIME - AX (IX2 . ST/	(. PACKAGE) UNION , PG . COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT PD . SCHEMA . NAME : (MISTIME)					51	5 5	0	
AND ELECT FROM WHERE AND AND AND ELECT FROM	P P P P P P M Z	G . LOCATION , CATPACKAGE PG G . COLLID = H G . NAME = PD G . TYPE = 'T' G . BINDTIME - AX (IX2 . STA CATINDEXES IX3	(. PACKAGE) UNION , PG . COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT PD . SCHEMA . NAME ((YTSTIME)					51	5 5	0	
AND ELECT FROM WHERE AND AND AND ELECT FROM	P P P P P P P P P P S I I I	G . LOCATION , CATPACKAGE PG G . COLLID = H G . NAME = PD G . TYPE = 'T G . BINDTIME - AX (IX2 . ST/	(. PACKAGE) UNION , PG . COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT PD . SCHEMA . NAME ((YTSTIME)					51	5 5	5	
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AND ELECT FROM WHERE AND AND ELECT FROM WHERE AND CCCESS Seq.	Pi Pi Pi Pi Pi Ti No Pati	G . LOCATION , CATPACKAGE PG G . COLLID = I G . NAME = PD G . TYPE = 'T' G . BINDTIME 'T' G . BINDTIME 'T' AX (IX2 . STY CATINDEKES IXX X2 . DBID = PI OT	C. PACKAGE) UNION PG . COLLID , PG . NAME , ZCATTRIGGERS PD , ZCAT PD . SCHEMA . NAME . NAME . (MISTIME) . DBID)	INDEXES IX		Access	Pati	h New			Oth
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Statistics Browser

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Worklist



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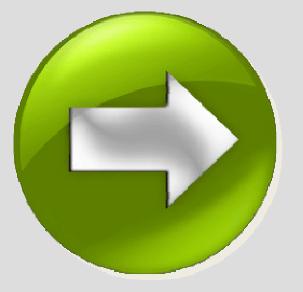
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Worklist



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Vorklist								
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Neumann	bernd@dev	2010-05-18 19:58:47	new	high	Please review access path	0	💎	0
Neumann	karl@intern.com	2010-05-14 08:50:37	new	high	Slmt List	0	😌	0
Neumann	Neumann	2010-05-18 11:25:37	new	high	Workfile TS Scans	0	(0
Neumann	karl@intern.com	2010-05-14 08:50:12	new	medium	Simt	0	(7)	0
Neumann	Neumann	2010-05-18 16:01:12	new	medium	AP with sequence changes	0	(0
Neumann	Neumann	2010-05-17 17:04:41	new	medium	Langer AP	0		0

Worklist allows direct access to the stored results



		2010-00-02 12:00	45 Job: ZSIND001 User: P	COMPANIE							
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Send Worklist As Link



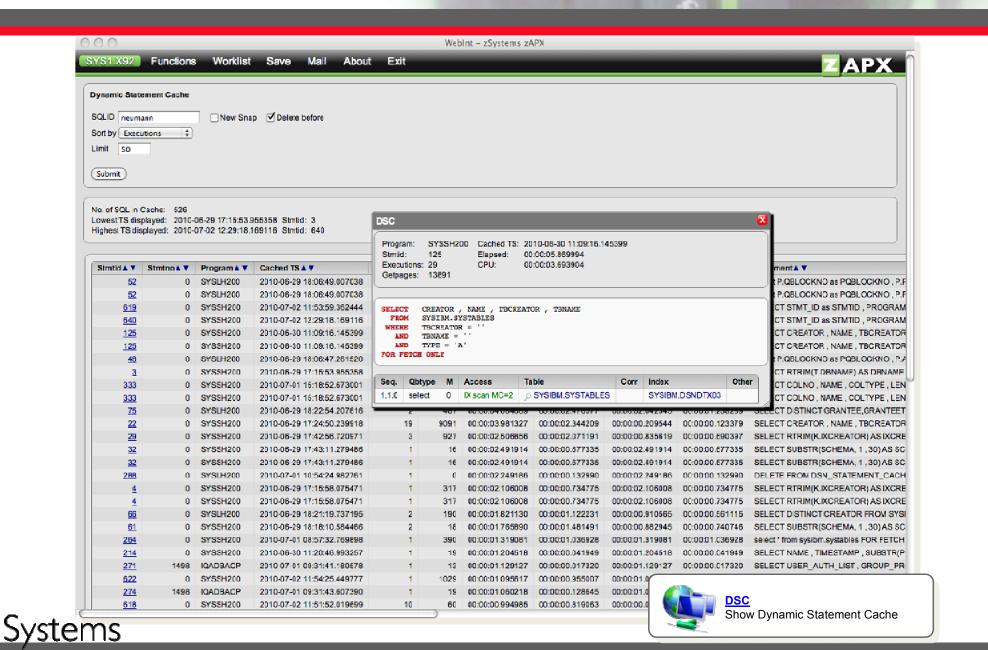
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Dynamic SQL

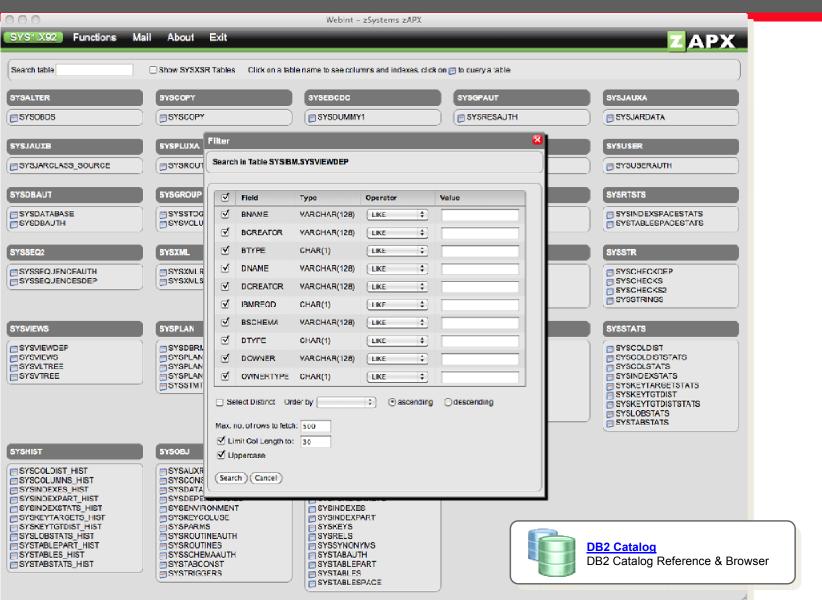


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Query the Catalog

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DB2 Objects Search DB2 Objects

Query Any Table

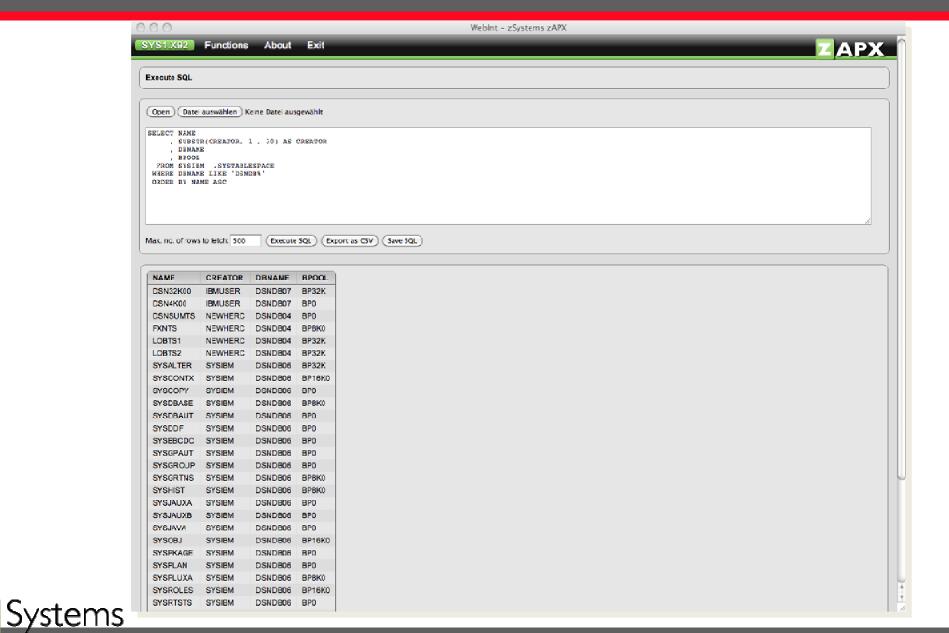
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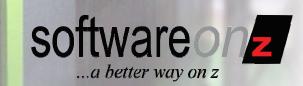
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Packages & History		Softwareonz a better way on z
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To Summarize



- Understand your BIND | REBIND parameters
 - And their impact on optimization & performance
- Move from the 3 R's to the 5 R's
 RTS, REORG, RUNSTATS, REBIND, Recheck
- Control access path changes
 - Analysis and checking is important
 - Avoid binding when access paths will degrade
- Adopt automated solutions
- Questions?
 - Craig S. Mullins: <u>Craig.Mullins@softwareonz.com</u>
 - Ralf Neumann: <u>r.neumann@z-dbs.com</u>





• To learn more about ZAPX or to start a trial



Don't forget to register for the remaining three Tuesday webinars in this series! http://www.softwareonz.com/index_files/Page560.htm