

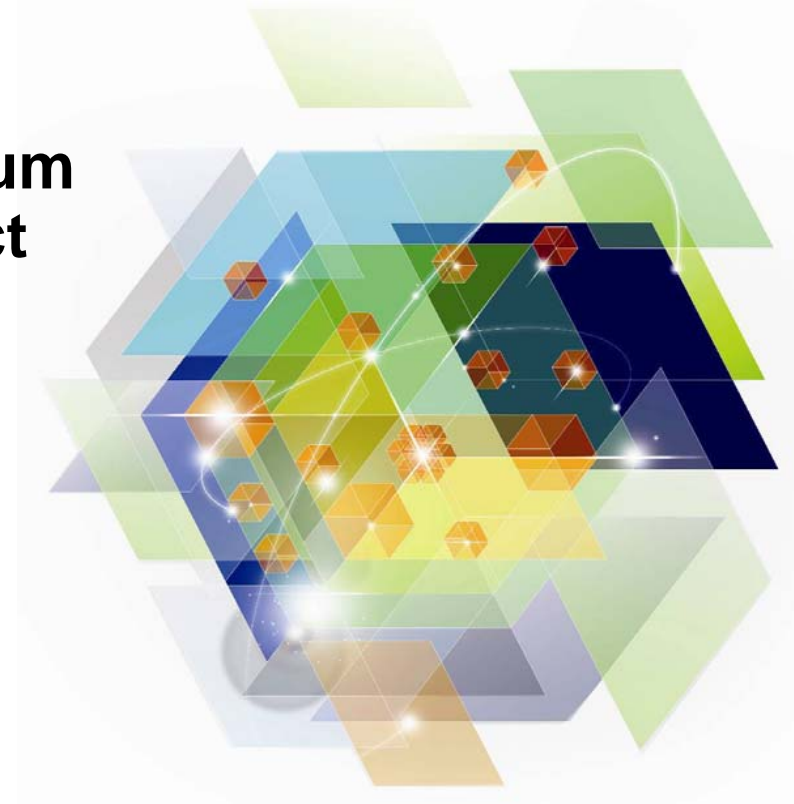
IBM System z Technology Summit



Migrating to DB2 10 - Get maximum CPU benefit with minimum impact

Presenter Name

Title



We all want to gain the benefits of DB2 10...

DB2 10 for z/OS: Out-of-the-Box Savings

Up to 20% CPU reductions for transactions, queries, and batch

- Out-of-the-box CPU reductions of 5-10% for traditional workloads
- Out-of-the box CPU reductions of up to 20% for new workloads
- Up to additional 10% CPU savings using new functions

Scales with less complexity and cost

- 5-10x more concurrent users – up to 20,000 per subsystem
- Significant scale-up capabilities in addition to existing scale-out support
- Consolidate to fewer LPARs and subsystems

Improved operational efficiencies and lower acquisition cost

- Automatic diagnostics, tuning, and compression

Even better performance

- Elapsed time improvement for small LOBS and



...But the need to rebind is a concern

- **Why are rebinds so scary? The perception that:**
 - Rebinding requires a lot of CPU
 - Rebinding is a tedious and arduous task
 - Rebinding is costly
 - Rebinding will regress SQL performance

“To REBIND or NOT to REBIND” ... is that the question?

- ⑩ **The question should be, “WHEN to rebind?”**
- ⑩ **...or “How can I perform necessary rebinds in a controlled and confident manner?”**

Migration steps for ensuring best performance

1. **Establish Key Performance Indicators and performance baseline**
2. **Manage packages that will have automatic rebinds**
3. **Identify packages that will have improved access path performance**
4. **Use triage techniques to manage problematic access paths**
5. **Handle remaining access path performance problems with SQL tuning tool**
6. **Re-examine Key Performance Indicators after migration**

Access Path Analysis using DB2 Path Checker for z/OS

The need for version-to-version binds

- **V7 to V8 requires a rebind to move from 31-bit mode to 64-bit mode**
- **V8, V9, and V10 have SPROC disabled with the migration and need a rebind to restore SPROC**
- **Falling back with Plan Management keeps the SPROC functionality**
- **Version Level Optimization requires a rebind**
- **Running packages bound in previous versions incur additional DB2 overhead**

Automatic rebinds

- **A V7 to V8 Migration will automatically rebind any package that has not been rebound since V3**
- **A V8 to V9 Migration will automatically rebind any package that has not been rebound since V4**
- **A V9 to V10 Migration will automatically rebind any package that has not been rebound since V5**
- **If you rebind at your current level rebinds will not be automatic**

Bind / rebind strategies

- Many sites have a “no rebind” policy
- This policy is challenged by V2V necessities
- Many sites do not have EXPLAINS for every package
- An assessment of your business risks is required
- This is the time to find a V2V rebind solution

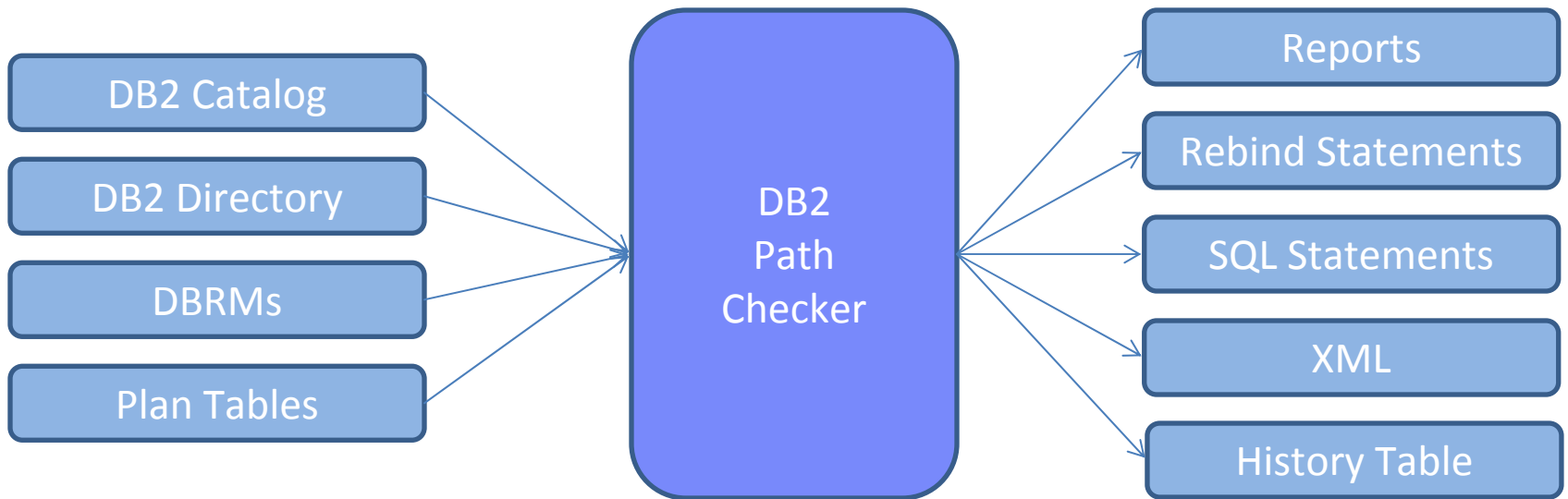
V2V migrations with DB2 Path Checker

- **Use the DSNTIJPA job to size the automatic rebind exposure**
- **Use our first analysis query to create Path Checker TEST commands to recreate Plan Table entries where they are missing. Missing means no cost data as well as Plan Table data.**
- **Use our Path Checker TEST procedure to create rebind commands for packages that will not have any access path changes**
- **Use our second analysis query to create Path Checker TEST commands for packages that were rebound before a given date**

V2V migrations with DB2 Path Checker

- **Example jobs are provided that will**
 - Identify and provide rebind cards for packages that will not have an access path change
 - Identify and provide rebind cards for packages that will have improved access paths
 - Iteratively walk you through the process by incrementing the amount of CPU increase
 - After the migration identify and removed rebind cards for packages where nothing will change

DB2 Path Checker inputs & outputs



DB2 Path Checker – first analysis

```
SELECT DISTINCT 'EXPLAIN DBRM '  
  CONCAT RTRIM(NAME) CONCAT ' TO PACKAGE '  
  CONCAT RTRIM(COLLID) CONCAT '.* IN P390I.PLAN_TABLE '  
FROM SYSIBM.SYSPACKAGE A  
  WHERE CREATOR = 'P390H' AND VALID = 'Y'  
  AND OPERATIVE = 'Y'  
  AND NOT EXISTS (SELECT 1 FROM P390H.PLAN_TABLE B  
                  WHERE A.COLLID = B.COLLID  
                  AND A.NAME = B.PROGNAME  
                  AND A.VERSION = B.VERSION );
```

You get a DB2 Path Checker EXPLAIN TO command for every package that does not have a plan table entry

Running these commands will give you an entry for the missing data in your target PLAN_TABLE and DSN_STATEMENT_TABLE

Build on success

- **Are your packages organized by collection ID or package name, or random event?**
- **Find an application area that is willing to work with you**
- **Follow the next steps to identify those packages that will not change access paths and those that will improve with access path change**

Find packages that will not change

- **Path Checker 4.1 can identify without rebinding those packages that will not have access path changes**
- **Because the access path does not change you are paying the cost of that access path regardless of the cost entry in the plan table**
- **These rebinds are as safe as they can get**

SYSCHG report sample

```
PCK218I PROGRAM TEST01      HAS A CHANGED ACCESS PATH
      QUERYNO 327
      OLD PROCSU 209
      NEW PROCSU 139
      COLLECTION TESTCOLL
      NEW VERSION 2005-04-11-18.34.53.754785
      OLD VERSION 2005-04-11-18.20.42.913225

PCK217I TOTAL DBRMS COMPARED 1
PCK217I TOTAL STATEMENTS COMPARED 2
PCK217I TOTAL ACCESS PATH CHANGES 1
PCK217I TOTAL ACCESS PATH SAME 1
PCK217I TOTAL NEW SQL STATEMENTS 0
PCK217I TOTAL DELETED SQL STATEMENTS 0
PCK217I TOTAL DSN_STATEMNT COST INCR 0
```


Status check

- **We have now rebound 60% to 80% of your packages**
- **We now want to identify those packages that will have improved access path performance**
- **We will do the second analysis**

DB2 Path Checker – second analysis

```
-- SELECT BIND DATE OLDER THAN ...
-- CHANGE CPUPCT nn ITERATIVELY
SELECT DISTINCT 'TEST DBRM '
  CONCAT RTRIM(NAME) CONCAT ' AS PACKAGE '
  CONCAT RTRIM(COLLID) CONCAT '.* '
  CONCAT ' IN TRAIN01.PLAN_TABLE '
FROM SYSIBM.SYSPACKAGE A
WHERE OWNER = 'TRAIN01'
      AND COLLID = 'TST01COLLX'
      AND TIMESTAMP < '2009-09-04-14.24.34.593683';
```

You get a DB2 Path Checker TEST command for every package bound before the timestamp value

Example Path Checker input

```
OPTIONS CPUPCT 00 CATALOGSQL
CONNECT TO GT8G
SET CURRENT SQLID = 'PUBLIC'
--TEST COMMANDS ARE FROM 2ND ANALYSIS QUERY
TEST DBRM TEST01 AS PACKAGE TST01COLLX.* IN
TRAIN01.PLAN_TABLE
TEST DBRM TEST02 AS PACKAGE TST01COLLX.* IN
TRAIN01.PLAN_TABLE
```

Results

- **CPUPCT 00 does not generate rebind cards for packages whose cost increases past zero so you get**
 - Rebind cards in RBINDOUT for everything that has a lower cost.
 - Rebind cards in PBINDOUT for everything else
- **You have now rebound an additional 5% to 10% of your packages**

Iteration

- **Repeat the last SPUFI to select TEST commands before the rebinds that completed**
- **Increase the CPUPCT 00 by 05**
- **Repeat the process until you feel the CPU percentage is approaching your limit**
- **Examine using the triage techniques**

DB2 Path Checker triage

- **SYSCHG DD will provide a list of access path changes by SQL statement and the costs and reasons**
- **Cost is represented in MSUs and CPU. If you are changing CPU types use the MSUs as the best reflection of change**
- **SYSCHG data can be written to a HIST_TABLE and examined by SPUFI**

DB2 Path Checker triage - 1

- **Look for inner and outer table join changes first, as these are the most common**
 - Usually this means a change in DB2 STATS between the original bind and the present bind
 - Use Optim Query Workload Tuner Statistics Advisor

DB2 Path Checker triage - 2

- **Change in MATCHCOLS either up or down**
 - Again this is likely a change in Statistics
 - Use Optim Query Workload Tuner Statistics Advisor
 - MATCHCOLS cannot be change with a DB2 Hint
 - The DB2 Hint will be accepted but simply ignore the input

DB2 Path Checker triage - 3

- **The older the bind the more likely the access path is to change**
 - This is more likely with complex SQL
 - The older the bind, the more likely the change will look more costly
 - Remember the original cost data was at the time of the original bind. Has the amount of data increased?

DB2 Path Checker triage - 4

- **The reason we did the easy stuff first was**
 - To gain credibility
 - To have time to work on the more challenging problems.
 - Some of these cannot be fixed

DB2 Path Checker triage - 5

- **You will find SQL that has coding tricks to get a specific access path.**
- **You will find SQL that would perform better if written to take advantage of present technology.**
 - Document these, do not rebind unless you have to, and send them back through your management to be corrected

Cost contrasts between DB2 versions

- **If the COST value goes up by 50% or higher then something has changed**
 - The stats are different
 - The buffer pool setup is different
 - The indexes are different
 - Access path definitions have changed

V2V - production systems

- **Access path most likely change**
- **Check order of tables in joins**
- **Check point-by-point plan table columns**
- **Most access path changes are for the better**
- **Have a hint strategy**
- **Hinting back to an old access path will most likely give performance stability**

IBM tools with explain functionality

- **DB2 Administration Tool for z/OS**
- **DB2 SQL Performance Analyzer for z/OS**
- **Optim Query Workload Tuner**
- **Data Studio**

DB2 Administration Tool for z/OS

- **Comprehensive administration functions**
 - Catalog navigation
 - Reverse engineering
 - Advanced DBA actions – alterations, migrations, etc.

- **Explain functions**
 - Create and upgrade explain tables
 - Simple ad-hoc explain of SQL statement
 - Interpret plan table data
 - Migrate statistics

DB2 Administration Tool – explain options

Create or upgrade plan tables to DB2 10

```

DB2 Admin ----- Explain ----- 13:53
Option ==> _

E - Explain an SQL statement                DB2 System: DB1S
L - List PLAN_TABLE                         DB2 SQL ID: DBA560
      Schema . . . . . >                  (default is DBA560)
      Plan name . . . . . >                (optional)
      DBRM/package name . . . >           (optional)
      Collection ID . . . . . >          (optional)

CT - Create a table used by EXPLAIN
CX - Create an index for the table
UT - Upgrade a table to current DB2 version
CA - Create an alias for the table

For the above create and upgrade options:
Schema . . . . . >                  (default is DBA560)
Table . . . . . 1. PLAN_TABLE
                  2. DSN_STATEMNT_TABLE
                  3. DSN_FUNCTION_TABLE
                  4. DSN_STATEMENT_CACHE_TABLE
  
```


DB2 Administration Tool – plan table view

View plan table – also available from package display

```

DB2 Admin ----- Rows from DBA560.PLAN_TABLE ----- Row 1 of 35
Command ==> _ Scroll ==> CSR

Commands: HINT PLAN INDEX
Line commands:
I - Interpretation T - Table X - Index P - Plan M - DBRM K - Package
DP - Delete rows for plan DK - Delete for package DQ - Delete for query no
? - Show all line commands

  Query Q Collect. Prognose Pl M Ac M I T Table
S Number Bl (COLLID) (Packg) No T Ty Co O No Schema Table Name
  * * * * * * * * * * * * * * * * * * * * * *
-----
  12345678 1 ADBL ADBMAIN 1 0 R 0 N 2 SYSIBM SYSTABLESPACE
  12345678 1 ADBL ADBMAIN 2 1 R 0 N 3 SYSIBM SYSTABLES
  12345678 1 ADBL ADBMAIN 3 1 R 0 N 1 SYSIBM SYSDATABASE
  100000001 1 DSNAEXPL DSNAEXPL 1 0 R 0 N 2 SYSIBM SYSTABLESPACE
  100000001 1 DSNAEXPL DSNAEXPL 2 1 R 0 N 3 SYSIBM SYSTABLES
  100000001 1 DSNAEXPL DSNAEXPL 3 1 R 0 N 1 SYSIBM SYSDATABASE
  100000001 1 ANLSQLPA ANLTSO 1 0 R 0 N 2 SYSIBM SYSTABLESPACE
  100000001 1 ANLSQLPA ANLTSO 2 1 R 0 N 3 SYSIBM SYSTABLES
  100000001 1 ANLSQLPA ANLTSO 3 1 R 0 N 1 SYSIBM SYSDATABASE
      111 1 ADBL ADBMAIN 1 0 I 0 N 1 DBA560 EMP
      1 1 DSNTDP2 DSNTDP2 1 0 R 0 N 1 SYS560 HDTEST
  
```

DB2 Administration Tool – interpret explain

Basic access path information at object level

```
DB2 Admin ----- Interpretation of Row from DBA560.PLAN_TABLE ----- 13:54
Command ==> _
```

```

Data as produced by EXPLAIN:
                                More:      +
                                DB2 System: DB1S
                                PLAN_TABLE Schema: DBA560

```

```

-----
Table space scan, no index will be used.
Standard sequential PREFETCH will be performed.
New table in parallel group 1, degree of parallelism 40
Inner join or no join.
Sysplex CP parallelism will be performed.
-----

```

```

Table schema . : SYSIBM           Table name . : SYSTABLESPACE
Index schema . :                  Index name . :
Query number . : 12345678        Access type . : R

```

DB2 SQL Performance Analyzer for z/OS

▪ SQL tuning tool

- Provides expert advice in detailed recommendations
- Variety of input sources
 - Catalog
 - Program source
 - Text files
 - And more...
- ISPF and batch SQL analysis
- Invoke from other IBM tools
 - DB2 Path Checker
 - OMEGAMON XE for DB2 Performance Expert
 - DB2 Query Monitor
 - DB2 Administration Tool

DB2 SQL PA - options

Choose input source – option 4 to read SQL file from DB2 Path Checker

```
SQLPA410 ----- Basic Processing Options ----- 13:51  
Option ==> _
```

Options:

DB2 system: DSNA
DB2 SQLID : DBA560

- 1 Process plans from the DB2 system catalog
- 2 Process packages from the DB2 system catalog
- 3 Process application DBRM
- 4 Process SQL from a sequential data set or PDS member
- 5 Process SQL from program source
- 6 Process a query number from the plan table
- 7 Process a QMF statement
- 8 Process tables from the DB2 system catalog

DB2 SQL PA – explain packages

Choose package identified in DB2 Path Checker by collection and name

```

SQLPA410 ----- Process Packages ----- 13:57
Command ==> _____ Scroll ==> CSR

Commands:  EXPLAIN SQL TABLES                                DB2 system: DSN4
                                                    DB2 SQLID : DBA560

Enter the package information:
 *Collection ID . . . ANLSQLPA >
 *Package name . . . ANLS* >
  Version ID . . . _____ >
  Current degree . . 1 (1 or Any)
  Generations . . . 1
  Force . . . . . N (Y or N)
Statements accessing the following table:
  Table owner . . . _____ >
  Table name . . . _____ >
Range of statements:
  Beginning QUERYNO . _____
  Ending QUERYNO . . _____
Location
  Remote location . . _____ >
 *Compare the old package to the new package? N (Y or N)

(An * indicates a required field.)

```

DB2 SQL PA – explain from text input

Choose SQL input file created by DB2 Path Checker

```
SQLPA410 ----- Process SQL ----- 13:57
Command ==> _____ Scroll ==> CSR

Commands:  EXPLAIN  SQL  TABLES  EDIT                DB2 system:  DSN4
                                                    DB2 SQLID :  DBA560

Enter the input data set name:

*Data set name. . . 'DBA560.DEMO.SQL(SQLDEMO)'

Enter optional parameters:

Table qualifier . . _____ >
Synonym creator . . _____
Current degree. . . 1__ (1 or Any)

(An * indicates a required field.)
```

DB2 SQL PA – query limits report

Establish thresholds and focus on high-cost SQL

```

SQLPA410----- Query Limits Report ----- Row 1 of 4
Command ==> _____ Scroll ==> CSR_

Commands:  PR - PRINT                                DB2 system: DSN4
                                                    DB2 SQLID  : DBA560
                                                    Time . . . : 13:59

Line commands:
C - Cost Report  E - Explain Report  S - SQL  T - Trace Report  R - EEE Report
W - What-if?

S CEIQ$  Error  Query No  Stmt CPU      Elapsed      Physical
-----  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -
---Y-    0      100000003 NB    0.00800    0.194      6      412      0.0018
---Y-    0      100000004 ST    0.00700    0.018      1      349      0.0016
-----  0      100000001 UE    0.00400    0.633      6      189      0.0009
-----  0      100000002 ST    0.00300    0.005      1      153      0.0007
***** Bottom of data *****

```

DB2 SQL PA – report sample - 1

Evaluate tuning advice – guidelines, recommendations, warnings...

```

EDIT ----- DBA560.ANL410.EXP----- COLUMNS 00001 00072
COMMAND ==> _ SCROLL ==> CSR
000516
000517 SQL PA Analysis for Queryno 100000003
000518
000519 SELECT NAME, NTABLES, PARTITIONS, SEGSIZE
000520 FROM SYSIBM.SYSTABLESPACE
000521 WHERE CREATOR = 'SYSIBM'
000522 AND NAME IN (
000523 SELECT TSNAME
000524 FROM SYSIBM.SYSTABLES
000525 WHERE PARENTS > 0
000526 OR CHILDREN > 0)
000527
000528 Queryno: 100000003 QBlk: 1 Pln: 1 Mix: 0 Prnt QBlk: 0 Prnt Pln: 0
000529 Process ->
000530
000531 +----- Queryno 100000003 -----+
000532 |ANL7002I *** GUIDELINE:
000533 |This plan step has not selected any Sequential|List Prefetch I/O.
000534 |If the SQL processes just a few rows that is OK, but if many rows
000535 |are involved, you can help promote Sequential Detection by both
000536 |accessing the data in sequential order (presort?) and by binding
000537 |with Release (Deallocate) to avoid resetting counters at Commit.

```


DB2 SQL PA – report sample - 2

Examine access path and table / index statistics

```

EDIT ----- DBA560.ANL410.EXP----- COLUMNS 00001 00072
COMMAND ===> SCROLL ===> CSR
000570 RANDOM_NONMATCH_IX_SCAN
000571 -----
000572 IX Creator: SYSIBM
000573 Index Name: DSNDX01
000574
000575 Vers: 1 Key Len: -1 Padded: N C-ed: N C-ing: Y CluRatio: 62.0000
000576 Fullkey card: 391 Firstkey card: 28
000577 Type: 2 Nleaf pages: 4 Nlevels: 2 Unique: P PRIMARY KEY
000578 0 of 2 columns are matched Close: N Lock mode: IS Bpool: BP0
000579 Ex Type: Key Target Cnt: 0 Unique Cnt: 0 Compress: N Owner Typ:
000580 Sparse index: - Hash overflow: -
000581
000582 Key Column Name Type Len ODNPGMH Colcard Dist# Hist#
000583 -----
000584 1 DBNAME VARCHAR 24 ANN---- 28 10 0
000585 2 NAME VARCHAR 24 ANN---- 276 0 0
000586
000587 +----- Queryno 100000003 -----+
000588 | ANL6052I *** NOTE:
000589 | This index is specified as "Not Padded", allowing storage of a
000590 | varying length index key. Padded indexes use blanks to fill out
000591 | their fixed length keys and are not eligible for Index Only scan.

```

DB2 SQL PA – report sample - 3

Examine related tables for problems – e.g., missing index on column

```

EDIT ----- DBA560.ANL410.EXP----- COLUMNS 00001 00072
COMMAND ==>                               SCROLL ==> CSR
000298
000299 Table is a Parent to SYSIBM .SYSRELS           in Relation: DSNDT@DR
000300 Primary key has 2 columns and Delete rule is: CASCADE
000301
000302 Table is a Parent to SYSIBM .SYSTABSTATS_HIST   in Relation: DSNTT@HB
000303 Primary key has 2 columns and Delete rule is: CASCADE
000304
000305 Table is a Parent to SYSIBM .SYSTABCONST         in Relation: DSNDT@CN
000306 Primary key has 2 columns and Delete rule is: CASCADE
000307
000308 Table is a Parent to SYSIBM .SYSCONSTDEP         in Relation: DSNDT@CC
000309 Primary key has 2 columns and Delete rule is: CASCADE
000310
000311 Table is a Parent to SYSIBM .SYSCHECKS           in Relation: DSNDT@SC
000312 Primary key has 2 columns and Delete rule is: CASCADE
000313
000314 Table is a Parent to SYSIBM .SYSTABLES_HIST       in Relation: DSNDT@HD
000315 Primary key has 2 columns and Delete rule is: CASCADE
000316
000317 Table is a Parent to SYSIBM .SYSTRIGGERS         in Relation: DSNDT@OT
000318 Primary key has 2 columns and Delete rule is: CASCADE
000319

```

Performance Analysis with OMEGAMON XE for DB2 Performance Expert

The role of performance monitoring

- **Monitoring tools help to identify your migration return on investment (ROI)**
- **Monitoring tools can help identify missed migration opportunities**
 - i.e. new DB2 capabilities
- **Monitoring tools capture data necessary for analysis of performance regression**

OMEGAMON XE for DB2 Performance Expert

- **Version 5.1 is required to monitor DB2 10**
 - There is no support for DB2 10 in OM PE V410/V420 – not even toleration
 - OMEGAMON XE for DB2 Performance Expert / Performance Monitor 5.1 supports DB2 8, 9, and 10
 - Buffer Pool Analyzer (included in OM PE) supports DB2 8, 9, and 10 as well

- **Customers should move to OM PE (or PM) 5.1 prior to beginning their DB2 10 migration**

Managing the migration to DB2 10

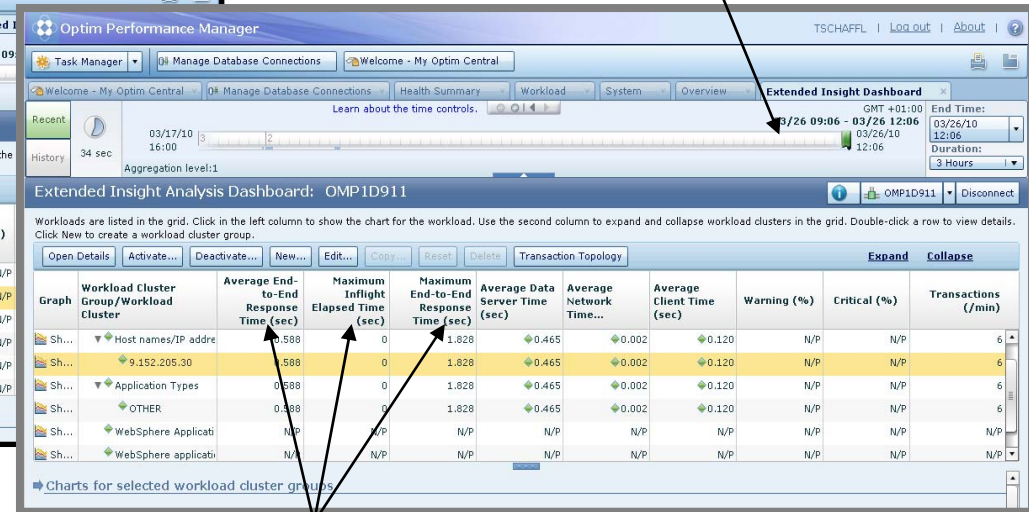
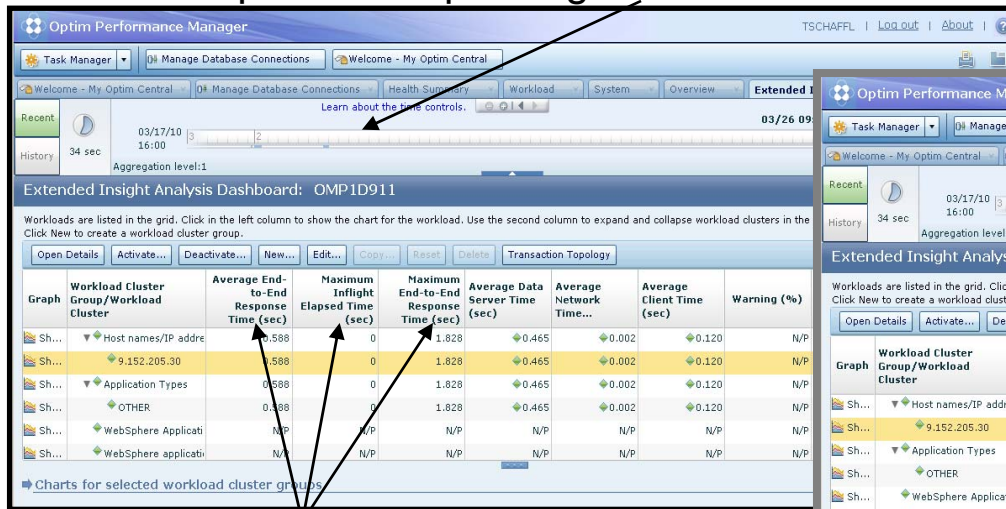
- **Identify Key Performance Indicators (KPIs), e.g.**
 - Elapsed time
 - In-DB2 CPU time
 - other
- **Identify critical business applications**
- **Baseline KPIs for critical business applications prior to migration**
- **Leverage the OMEGAMON 5.1 batch reporter with (optional) upload to PDB (Performance Database) running with DB2 9**
- **Applications which access DB2 on z/OS via DRDA using JCC, CLI, .Net can take advantage of Extended Insight and the repository database to store and compare average response time metrics**

Using Extended Insight to compare before and after

Note: as there is currently no side-by-side comparison for multiples point-in-time, open multiple web-consoles each with the appropriate time-period for analysis selected.

Select time period A – pre-migration

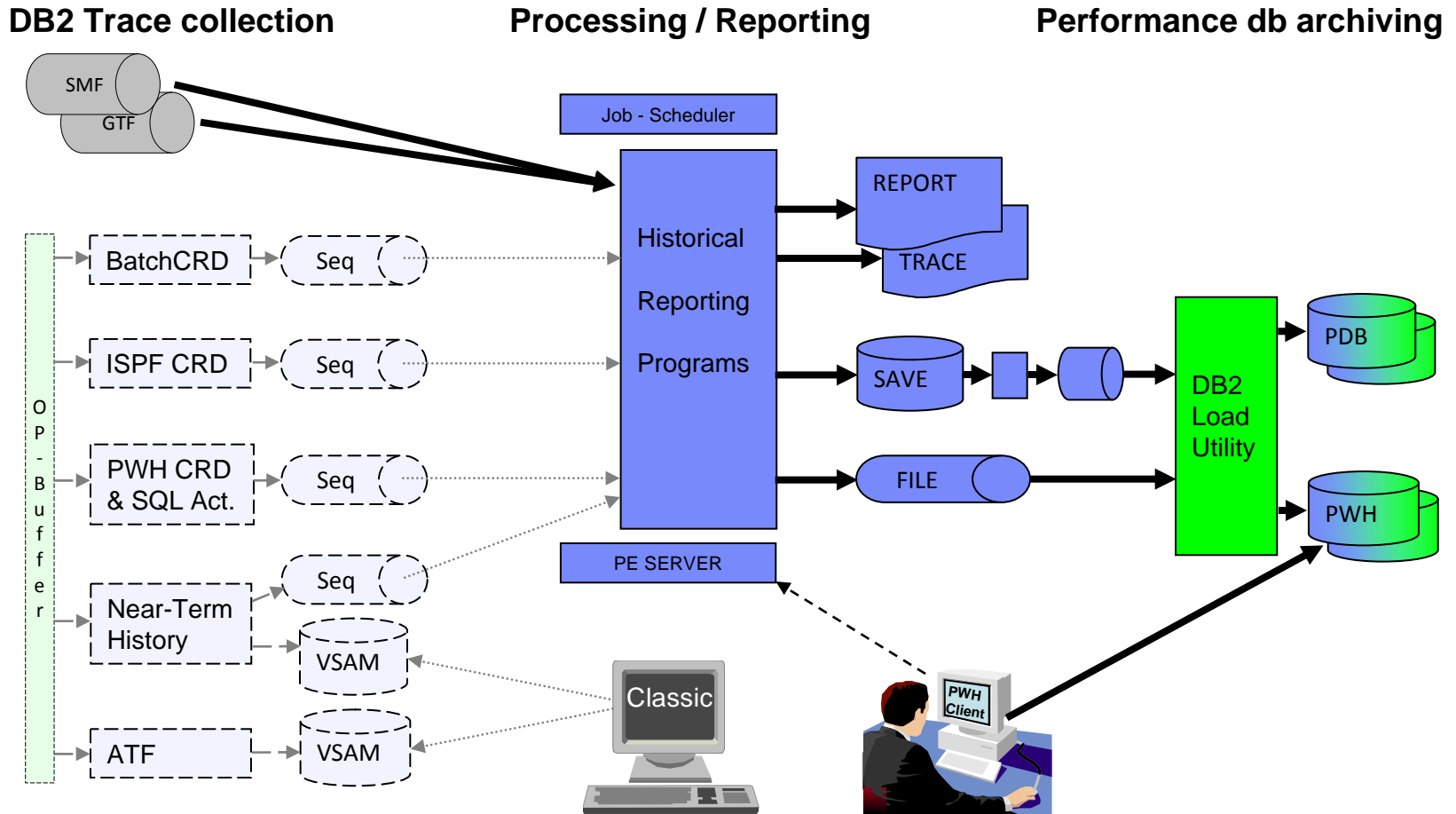
Select time period B – post-migration



Compare key metrics for different workloads

Evaluate key metrics

Analyzing application performance - PDB



Capture metrics before and after migration

- **STATISTICS reports/metrics identify potential DB2 system problems**
- **ACCOUNTING reports/metrics identify potential application problems**
- **There are metrics in DB2 10 that don't exist in DB2 9**
- **Use the lowest common denominator**
- **While certain metrics exist only in DB2 10, they can provide insight not previously available even if you can't compare the DB2 9 and 10 metrics side by side.**

Key areas to evaluate

⑩ Statistics reports

– IFCID 225 / DB2 for z/OS Storage – “STATISTICS REPORT – LONG”

☑ Expect to see storage relief in the DBM1 address space

☑ Monitor real storage utilization in the “...”

```

1  LOCATION: DSNDA1B                OMEGAMON XE FOR DB2 PERFORMANCE EXPERT (V5R1)
   GROUP: N/P                        STATISTICS REPORT - LONG
   MEMBER: N/P
   SUBSYSTEM: DA1B
   DB2 VERSION: V10                  SCOPE: MEMBER

----- HIGHLIGHTS -----
INTERVAL START : 04/26/11 21:07:00.00  SAMPLING START : 04/26/11 21:07:00.00  TO
INTERVAL END   : 04/26/11 21:38:00.00  SAMPLING END   : 04/26/11 21:38:00.00  TO
INTERVAL ELAPSED: 31:00.000039         OUTAGE ELAPSED: 0.000000         DA

DBM1 AND MVS STORAGE BELOW 2 GB                QUANTITY  DBM1 AND MVS STO
-----
TOTAL DBM1 STORAGE BELOW 2 GB                (MB)      86.19  24 BIT LOW PRIVA
TOTAL GETMAINED STORAGE                      (MB)       4.81  24 BIT HIGH PRIV
EDM POOL                                      (MB)       0.00  24 BIT PRIVATE C
TOTAL VARIABLE STORAGE                       (MB)     38.12  31 BIT EXTENDED
TOTAL AGENT LOCAL STORAGE                   (MB)     32.28  31 BIT EXTENDED
TOTAL AGENT SYSTEM STORAGE                  (MB)       5.58  31 BIT PRIVATE C
NUMBER OF PREFETCH ENGINES                  204.00  EXTENDED REGION
NUMBER OF DEFERRED WRITE ENGINES            300.00  EXTENDED CSA SIZ
NUMBER OF CASTOUT ENGINES                   0.00
NUMBER OF GBP WRITE ENGINES                 0.00  AVERAGE THREAD F
NUMBER OF P-LOCK/NOTIFY EXIT ENGINES        0.00  MAX NUMBER OF PO
TOTAL AGENT NON-SYSTEM STORAGE              (MB)     26.70  AVERAGE THREAD F
TOTAL NUMBER OF ACTIVE USER THREADS        967.74  MAX NUMBER OF PO
NUMBER OF ALLIED THREADS                    0.00
NUMBER OF ACTIVE DBATS                      967.74
NUMBER OF POOLED DBATS                     0.00
RID POOL                                    (MB)     N/A
PIPE MANAGER SUB POOL                      (MB)     N/A
LOCAL DYNAMIC STMT CACHE CNTL BLKS        (MB)     N/A

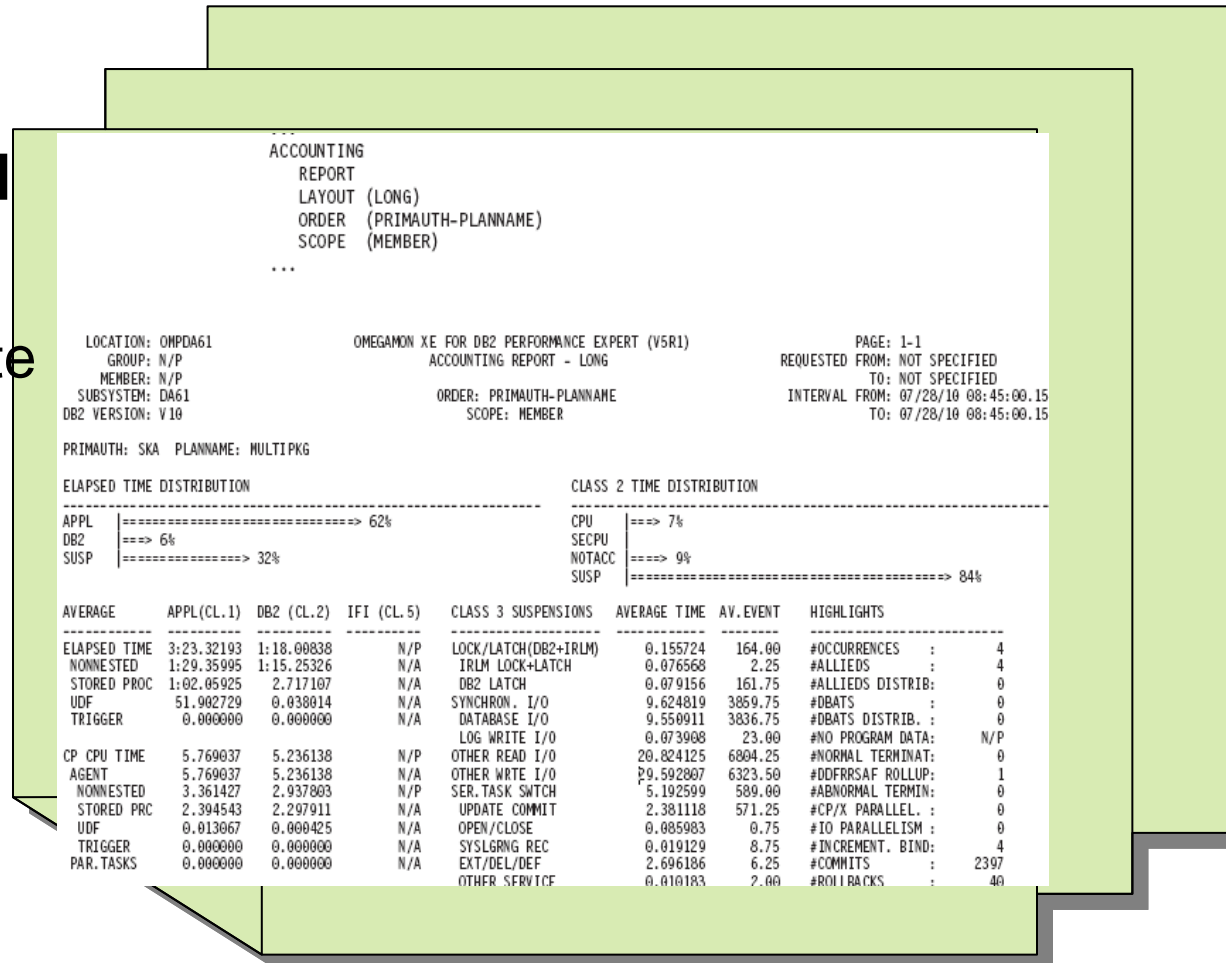
```

Key areas to evaluate

⑩ Application (i.e. Accounting) reports - "ACCOUNTING REPORT - LONG"

☑ Evaluate Lock and Latch wait times

- There are separate counters for: DB2 Lock, IRLM, and DB2 latch wait



Optimizing Performance with Optim Query Workload Tuner

Capturing Workloads from Various Sources

- New SQL sources: OPM repository, DB2 Query Monitor, User-defined SQL Repository (typically used by other monitoring tools)
- Improved capture capability: Routine Editor, SQL procedure, SQL UDF, a limited set of PLAN tables...
- New in capture from Routine Editor: local variable substitution (into typed parameter marker)

The screenshot displays the 'Query Tuner Workflow Assistant' interface. On the left, a vertical navigation pane is divided into four sections: '1. Status', '2. Capture', '3. Manage', and '4. Invoke'. Under '2. Capture', the 'Non-DB2 Sources' list includes 'Input Text', 'File', 'SQL or Routine Editor', 'SQL Category', 'XML File', and 'Optim Performance Manager Repository'. The 'DB2 for z/OS Sources' list includes 'Statement Cache', 'Catalog Plan or Package', 'QMF', 'QMF HPO', 'DB2 Query Monitor', 'User-defined SQL Repository', 'SQL Procedure', 'Plan Table', 'Statement Table', 'Function Table', and 'View, Trigger, or SQL UDF'. Two red boxes highlight the 'SQL or Routine Editor' and 'DB2 Query Monitor' options. The main panel on the right is titled 'Input Text' and contains instructions to enter an SQL statement, a database connection dropdown set to 'Soonnee-806 (DB2 for z/OS V9.1 (New-Function Mode))', and buttons for 'Invoke Advisors and Tools' and 'Clear SQL Statement'. Below these is a text area for the SQL statement with the placeholder text '-- Enter an SQL statement here'.

Visualize queries and costs to speed analysis

Formatted Query	Annotation	Additional Information
<pre> SELECT A.EMPNO , A.FIRSTNME , A.LASTNAME , A.JOB , A.SALARY , A.BONUS , A.COMM , B.LOCATION , C.PROJNAME FROM DSN8910.DEPT AS B , DSN8910.EMP AS A , DSN8910.EPROJ AS C WHERE (A.EMPNO IN (SELECT DSN8910.DEPT.MGRNO FROM DSN8910.DEPT WHERE DSN8910.DEPT.MGRNO IS NOT NULL) AND A.WORKDEPT = B.DEPTNO AND B.DEPTNO = C.DEPTNO) ORDER BY A.EMPNO ASC , A.FIRSTNME ASC , A.LASTNAME ASC </pre>	<pre> CARDF=14 QUALIFIED_ROWS= CARDF=42 QUALIFIED_ROWS= CARDF=(missing) QUALIFIED_ROWS= COLCARDF=42 MAX_FREQ=(r CARDF=14 QUALIFIED_ROWS= COLCARDF=9 MAX_FREQ=42 COLCARDF=8/14 MAX_FREQ=? COLCARDF=14/(missing) MAX_FREQ= </pre>	<pre> DSN8910.DEPT.MGRNO contain(s) skewed data DSN8910.EMP.WORKDEPT contain(s) skewed data </pre>

Easily see tables, sections, join predicates, etc.

Examine table statistics and additional information

■ Accelerate analysis, reduce downtime

- Spot human errors
- Identify where filtering should occur

Workload Statistics Advisor Improvement

- Summary table lists all tables that have recommendations, allowing “slice and dice” view

The screenshot displays the Workload Statistics Advisor interface. At the top, there are tabs for 'Statements', 'Summary', 'Indexes', and 'Statistics'. Below the tabs, a status message reads: 'Existing statistics status - 9 tables need repair out of the 9 tables that were checked'. A 'Repair Complete' button is visible. A descriptive paragraph explains that the RUNSTATS command collects statistics and repairs problems found by the Workload Statistics Advisor. Below this is a toolbar with various icons. The main area features a table with columns: Database Name, Table Space Name, Table Name, Cardinality, Reference count, and Weighted Reference count. A blue callout box labeled 'Summary table' points to this table. Below the table are two text areas: 'RUNSTATS Control Statements' and 'RUNSTATS commands stored on database server'. A blue callout box labeled 'Recommendation details for selected tables' points to the 'RUNSTATS Control Statements' area.

Database Name	Table Space Name	Table Name	Cardinality	Reference count	Weighted Reference count
<input checked="" type="checkbox"/> DB2OSC	WIAT50	DSN_WIA_COLUMNS	-1.00000	25	0.0
<input checked="" type="checkbox"/> DB4CUST	TSCUST	CUSTOMER	4,500,000.000000	25	0.0
<input checked="" type="checkbox"/> DB4EMP	TSEMP	EMPLOYEE	4,500,000.000000	25	0.0
<input checked="" type="checkbox"/> DB4LINEI	TSLINEI	LINEITEM	179,998,372.000000	50	0.0
<input checked="" type="checkbox"/> DB4ORDER	TSORDER	ORDER	45,000,000.000000	25	0.0
<input checked="" type="checkbox"/> DB4PART	TSPART	PART	6,000,000.000000	25	0.0
<input checked="" type="checkbox"/> DB4PSUPP	TSPSUPP	PARTSUPP	24,000,000.000000	25	0.0
<input checked="" type="checkbox"/> DB4REGN	TSREGION	REGION	5.000000	25	0.0
<input checked="" type="checkbox"/> DB4SUPPLY	TSSUPPLY	SUPPLIER	300,000.000000	25	0.0

```

RUNSTATS TABLESPACE "DB2OSC", "WIAT50"
  TABLE("DB2OE", "DSN_WIA_COLUMNS")
  INDEX("DB2OE", "DSN_WIA_COL_IDX1",
        "DB2OE", "DSN_WIA_COL_IDX2")
SHRLEVEL CHANGE REPORT YES UPDATE ALL HISTORY NONE

RUNSTATS TABLESPACE "DB4CUST", "TSCUST"
  TABLE("SYSADM", "CUSTOMER") SAMPLE 40
  COLUMN("C_NAME")
  COLGROUP("C_ADDRESS") FREQVAL COUNT 10 HISTOGRAM NUMQUANTILES 20
  COLGROUP("C_NAME") FREQVAL COUNT 10 HISTOGRAM NUMQUANTILES 20
  
```


Improve statistics quality and collection

- Provides advice on
 - Missing statistics
 - Conflicting statistics
 - Out-of-date statistics

Existing statistics status - 5 tables need repair out of the 7 tables that were checked

Repair Complete

This version of the RUNSTATS command repairs the problems that the Workload Statistics Advisor found. Run this version to conserve time

RUNSTATS Control Statements

```

RUNSTATS TABLESPACE DB4LINE1.TSLINE1
TABLE(SYSADM.LINEITEM) SAMPLE 5
COLGROUP(L_QUANTITY) FREQVAL COUNT 10
COLGROUP(L_DISCOUNT) FREQVAL COUNT 10
COLGROUP(L_DISCOUNT) HISTOGRAM NUMQUANTILES 20
COLGROUP(L_SUPPKEY) HISTOGRAM NUMQUANTILES 20
COLGROUP(L_SHIPDATE) FREQVAL COUNT 10
COLGROUP(L_SHIPDATE) HISTOGRAM NUMQUANTILES 20
COLGROUP(L_RECEIPTDATE) FREQVAL COUNT 10
COLGROUP(L_RETURNFLAG) FREQVAL COUNT 10
COLGROUP(L_TAX) FREQVAL COUNT 10
COLGROUP(L_RECEIPTDATE,L_RETURNFLAG,L_SHIPDATE,L_SHIPMODE)
COLGROUP(L_SHIPMODE) FREQVAL COUNT 10
COLGROUP(L_ORDERKEY,L_QUANTITY)
    
```

Generates
RUNSTATS
control
statements

Statistics Advisor report

Interesting columns:

S_SUPPKEY
 Cardinality: 10000.0
 Uniform statistics collection time: 2008-09-29 16:06:48.376482
 Uniform statistics status: OK
 Frequency statistics collection time: 2008-09-29 16:06:48.376482
 Frequency statistics status: OK
 Histogram statistics collection time: null
 Histogram statistics status: missing
 Possibly point skewed: No
 Possibly range skewed: No

S_NATIONKEY
 Cardinality: 25.0
 Uniform statistics collection time: 2008-09-29 16:06:48.376482
 Uniform statistics status: OK
 Frequency statistics collection time: null
 Frequency statistics status: missing
 Histogram statistics collection time: null

Indicates
conflicting and
missing statistics

Results

- Accurate estimated costs
- Better query performance
- Less CPU consumption
- Improved maintenance window throughput

Conflicts detail

TABLE SYSADM.LINEITEM
 One of the frequency records (-1.0) of the L_ORDERKEY column group is out of range [0, 25].
 Tolerance: 0.0010

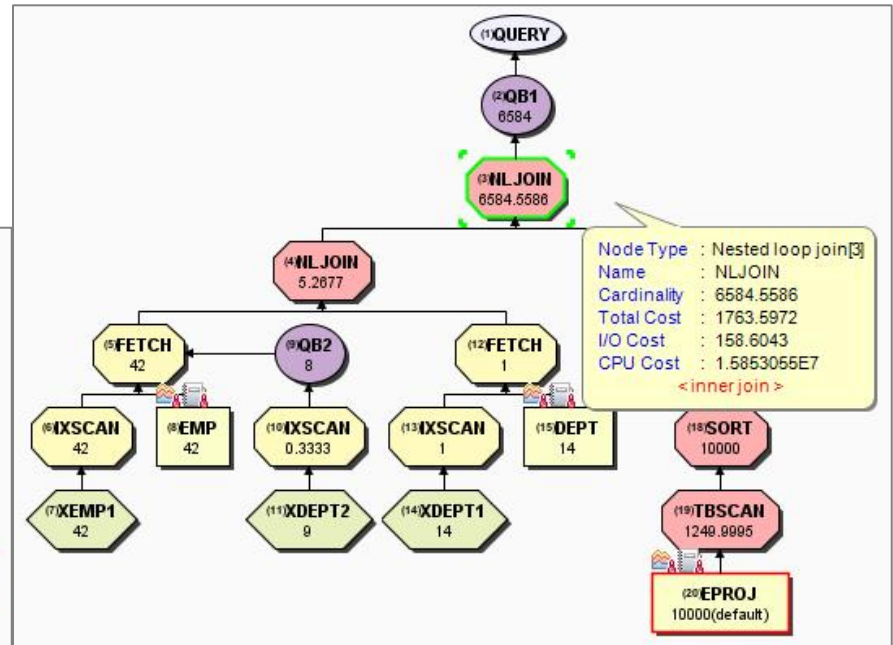
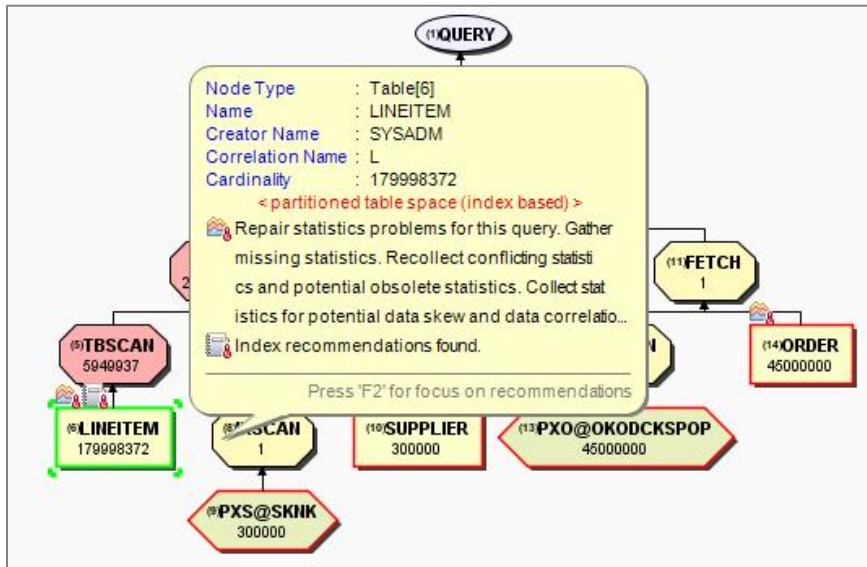
The maximum frequency of the column group or column (L_ORDERKEY), (0.0), is less than the average frequency, or 1 divided by the greater than the average unless only least-frequently occurring values are being collected.
 Tolerance: 0.0010

Conflicting
statistics
explanation

Analyze access plans

- Visualize access path

- See flow of query processing
- See indexes and operations
- See optimizer rationale



- Assess access path stability to reduce risk of performance regression

- Is the optimizer able to apply the filtering early?
- Are there indexes that support an efficient path?
- Do statistics allow distinction between the choices?

Workload access plan advisor

Review Workload Advisor Recommendations

This page shows the recommendations from the advisors that you ran.



Workload name: top10_select Number of statements: 10
 Workload owner: ADMF001 Workload status: EXPLAINED
 Description:

Statements Summary Statistics Queries Indexes **Access Paths**

Here is a summary of the results of the analysis of the query workload.

Statements analyzed: 7
 Statements with warnings: 7

To view the statements, the warnings, and the recommendations, select a method of filtering, select warning types, and click the Show Statements icon.



Filter by severity

	Count
<input checked="" type="checkbox"/> Statements with High-Severity Warnings	0
<input checked="" type="checkbox"/> Statements with Medium-Severity Warnings	0
<input checked="" type="checkbox"/> Statements with Low-Severity Warnings	7

Filter by warning type

<input type="checkbox"/> Avoid using table space scans to access the specified tables.
<input type="checkbox"/> Avoid using list prefetches to read large numbers of record...
<input type="checkbox"/> Avoid sorting on large numbers of records.

Count the number of statements with different warnings

Detail information about warnings for each statement

Statements Summary Statistics Queries Indexes **Access Paths** Access Path Advisor Details

Statement List

< Previous 1-7 rows out of 7 are displayed. Next >

Stmt. NO.	Stmt. Type	High Severity Warning	Medium Severity Warning	Low Severity Warning	Total Cost	CPU Cost	ID	Query Block	Table Scan	Index Scan	Nested Loop
1	SELECT	0	0	0	1 457.108...	744	1...	744	0	0	
2	SELECT	0	0	0	1 74.636768	9	2...	9	0	0	
4	SELECT	0	0	0	2 1133.85...	140	4...	140	0	0	
5	SELECT	0	0	0	1 37.081089	6	1...	6	0	0	
8	SELECT	0	0	0	1 37.081089	9	1...	9	0	0	
9	SELECT	0	0	0	1 457.108...	714	1...	714	0	0	
10	SELECT	0	0	0	1 457.108...	714	1...	714	0	0	

Workload Index Advisor Improvement

Summary table lists all tables that have recommendations, allowing “slice and dice” view

- Details of selected tables in summary table will be shown along the existing indexes and recommendations

Statements | Summary | **Indexes**

Original Recommendations

Estimated performance improvement: 94.88% **Summary table** N/A ms
 Disk space required (DASD space): 20619.06 MB Estimated CPU time: 199184 ms
 Total IUDM cost: 0 ms **Detail recommendations for selected tables**

Table	Cardinality	References to Table	Accumulated Query Total Cost	Recommended Indexes for Table	IUDM Statements on Table
<input checked="" type="checkbox"/> SYSADM.ORDER	45000000	3	1652715.068778	0	0
<input checked="" type="checkbox"/> SYSADM.LINEITEM	179998372	3	1652714.812551	2	0
<input checked="" type="checkbox"/> SYSADM.PARTSUPP	24000000	1	1652667.246461	1	0
<input checked="" type="checkbox"/> SYSADM.EMPLOYEE	4500000	3	178436.463109	0	2
<input checked="" type="checkbox"/> SYSADM.PART	6000000	2	50.021329	0	0
<input checked="" type="checkbox"/> SYSADM.CUSTOMER	4500000	1	47.566089	0	0
<input checked="" type="checkbox"/> SYSADM.REGION	5	1	2.089999	0	1
<input checked="" type="checkbox"/> SYSADM.SUPPLIER	300000	1	0.23218	0	0

Recommendations | Existing Indexes | Indexes Chosen by Optimizer but not Recommended | Constraints

Index	Table	Action	New Index Columns	Old Index Columns	Estimated Performance Improvement (%)	Estimat
<input checked="" type="checkbox"/> DSN_WIA_COLUMNS_VIRT_IDX_13092303616280	DB2OE.DSN_WIA_COLUMNS	Create	SESSION_ID(ASC)		0	
<input checked="" type="checkbox"/> DSN_WIA_COLUMNS_VIRT_IDX_13092303629411	DB2OE.DSN_WIA_COLUMNS	Create	TABLE_ID(ASC)		0	
<input checked="" type="checkbox"/> LINEITEM_VIRT_IDX_1309230728805	SYSADM.LINEITEM	Create	L_LINESTATUS(ASC),L_COMME...		83.778208	
<input checked="" type="checkbox"/> LINEITEM_VIRT_IDX_1309230397133	SYSADM.LINEITEM	Create	L_LINESTATUS(ASC),L_ORDER...		99.999551	
<input checked="" type="checkbox"/> MIS	SYSADM.PARTSUPP	Alter	PS_SUPPKEY(ASC),PS_AVAILQ...	PS_SUPPKEY	99.999551	

Workload summary report

- Allows user to review, e-mail or print the html report that summarizes the run states of all last successful run of the workload advisors
- Lists the recommended RUNSTATS and indexes, and displays the query and access path warnings.

IBM Query Tuner Workload Summary Report

This report contains a summary of the recommendations from the workload advisors. Examine the recommendations and any corresponding scripts, and take appropriate actions. Recommendations were generated when the workload advisors analyzed the query workload, not when this report was generated. Navigate to the different section [top of page](#).

[Recommended Actions](#)
[Statistics](#)
[Indexes](#)
[Access Paths](#)
[Queries](#)
[Run Log](#)

Overview

Recommendation generation timestamp: 2011-06-27 22:19:14

Database server configuration: jdbc:db2://dtec630.vmec.svl.ibm.com:446/STLEC1 (DSN10015)

Owner of the query workload: ADMF001

Workload name: top10_select

Default schema: ADMF001

Number of statements in the query workload: 10

Number of statements analyzed in the query workload: 10

Workload description:

Advisor	Warnings			Recommendation		
	High	Medium	Low	RUNSTATS Commands	INDEX DDL Statements	Timestamp
Workload Statistics Advisor	1	0	0	5	0	2011-06-19 19:30:23
Workload Index Advisor	0	0	0	0	1	2011-06-19 11:59:30
Workload Query Advisor	0	0	1	0	0	2011-06-19 11:58:22
Workload Access Path Advisor	0	0	8	0	0	2011-06-19 12:00:23

Environment capture facilitates collaboration

- **Enable environment reproduction**
- **Speed up service process**

Collect Data about the Workload Environment

This page generates a report that you can send to IBM support after you opened a problem management record. The report contains information about the environment in which your workload runs. After you generate the report, use this page to send the report to an FTP server for IBM support.

Report Options

Include information about parallel processing Change values for storage group name, PRIQTY, and SECQTY

Send the files to IBM Support

PMR or ETR Number (xxxxx,yyy,zzz): , , Version:

Send the files to another subsystem or save them to your workstation only

Unique ID

Path:

FTP Server Settings

Server name: Port:

User: Password:

Directory:

Files to upload:

Query tuning technical articles

The screenshot shows a Firefox browser window displaying the IBM developerWorks search results page. The search query is 'tuning sql with optim'. The results list two articles:

- Tuning SQL with Optim Query Tuner, Part 2: Tuning individual queries**
May 19, 2011 ... The first article in this series introduced the concept of access paths and showed you how to read an access path diagram in **Optim Query** ...
<http://www.ibm.com/developerworks/data/library/techarticle/dm-1105optimquerytuner2/index.html?ca=drs->
- Tuning SQL with Optim Query Tuner, Part 1: Understanding access ...**
Jun 17, 2010 ... If you are a developer, DBA, or query **tuning** specialist, it is critical that you understand the basics of access paths so that you can precisely **tune** ...
<http://www.ibm.com/developerworks/data/library/techarticle/dm-1006optimquerytuner1/>

Other ways to search options include: Documentation, Redbooks, Technical support, Downloads and drivers, Software product finder, Google, Bing, and Yahoo!.

Also useful with
Data Studio

<http://www.ibm.com/developerworks>

Workstation-based query tuning offerings

	Data Studio	Optim Query Workload Tuner for z/OS
Queries from all sources	✓	✓
Reports	✓	✓
Query Formatter	✓	✓
Access Plan Graph	✓	✓
Query Statistics Advisor	✓	✓
Query Annotation		✓
Visual Plan Hint		✓
Query Index Advisor		✓
Query Advisor		✓
Access Path Advisor		✓
Workload Statistics Advisor		✓
Workload Index Advisor		✓
Workload Query Advisor		✓

Comparison of query tuning tools for z/OS

▪ **Optim Query Workload Tuner**

- Better support for modern development environment and dynamic SQL
- Eclipse-based, GUI and stored procedure driven
- Integrates with OMEGAMON and Query Monitor GUI interfaces
- Provides virtual index capability for single queries and across workloads
- Recommends rewriting queries only when improvements result
- Has limited support to create statistics in Query Environment Capture and Workload Environment Capture service support
- Strategic investment spans platforms

▪ **DB2 SQL Performance Analyzer**

- Better support for classic z/OS environment, DBRMs, batch analysis, and z/OS libraries
- ISPF and batch driven
- Integrates with OMEGAMON VTAM and Query Monitor 3270 interfaces
- Creates real indexes for “WHAT-IF” scenarios for single queries
- Offers a best practices Query Advisor with approximately 150 rules
- Has full support for cloning statistics
- Continued z/OS specific investment

Tools used in this presentation

Migration Step	DB2 Tool Used
Step 1 Examine Key Performance Indicators and establish performance baseline	OMEGAMON XE for DB2 Performance Expert
Step 2 Identify and analyze packages that will have automatic rebinds	DB2 Path Checker
Step 3 Identify and analyze packages that will have equivalent or better performance	DB2 Path Checker
Step 4 Use triage techniques to identify additional problematic SQL	DB2 Path Checker
Step 5 Improve Statistics and resolve access path regressions	Optim Query Workload Tuner for z/OS DB2 SQL Performance Analyzer
Step 6 Re-examine Key Performance Indicators after migration	OMEGAMON XE for DB2 Performance Expert

Other IBM DB2 tools useful with DB2 migrations

Migration task / capability	DB2 for z/OS Tool
Create pre-production test environment (subsystem & object clones) to test DB2	DB2 Cloning Tool
Convert LOBs to in-line; Convert existing tables to Hash Access	DB2 Admin Tool
Measure and track SQL performance before & after migration	DB2 Query Monitor
Identify & free unused packages; reduce bind impacts	DB2 Bind Manager
Undo and Redo Temporal Data	DB2 Log Analysis Tool
Ensure access to critical DB2 10 core functions (during & after migration) with cost reductions and performance	DB2 Utilities Suite & DB2 Sort
Establish and maintain DB2 10 utility syntax as company standards	DB2 Utilities Enhancement Tool
Take advantage of DB2 10 utility improvements that reduce CPU and elapsed time for increased productivity	DB2 Automation Tool
Safeguard DB2 10 Data	InfoSphere Guardium Data Encryption Tool for DB2

IBM's portfolio of tools for DB2

Database Management

- DB2 Administration Tool
- DB2 Object Comparison Tool
- DB2 Utilities Suite
- DB2 Sort
- DB2 High Performance Unload
- DB2 Utilities Enhancement Tool
- DB2 Automation Tool
- DB2 Cloning Tool
- DB2 Bind Manager
- DB2 Path Checker
- Optim Data Growth

Backup & Recovery

- DB2 Recovery Expert
- DB2 Log Analysis Tool
- DB2 Change Accumulation Tool

Performance Management

- Tivoli OMEGAMON XE for DB2 Performance Expert
- Tivoli OMEGAMON XE for DB2 Performance Monitor
- DB2 Buffer Pool Analyzer
- DB2 Query Monitor
- DB2 SQL Performance Analyzer
- InfoSphere Optim Query Tuner
- InfoSphere Optim Query Workload Tuner
- InfoSphere Optim pureQuery Runtime

Data Governance

- Guardium S-TAP for z/OS
- Optim Test Data Management
- IBM Data Encryption for DB2 and IMS Databases



www.ibm.com/software/data/db2/zos

www.ibm.com/software/data/tools

THANK
YOU

The image features the words "THANK YOU" in large, 3D, light blue letters. Each letter is filled with a different photograph of a diverse group of people. The 'T' shows a man in a suit and tie. The 'H' shows a woman with dark hair. The first 'A' shows a man with a beard. The 'N' shows a man with glasses. The 'K' shows a man with glasses. The 'Y' shows a man looking at a document. The first 'O' shows a man in a red shirt. The 'U' shows a woman in profile. The letters have a slight shadow, giving them a three-dimensional appearance.