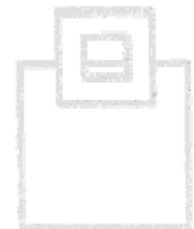
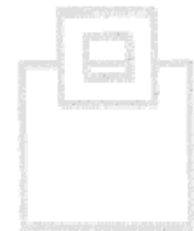


Insights for Outsiders

—

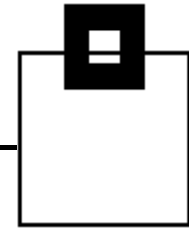
True DB2 performance simulation covering

- Environment changes
- Schema changes
- Application changes

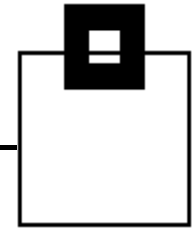
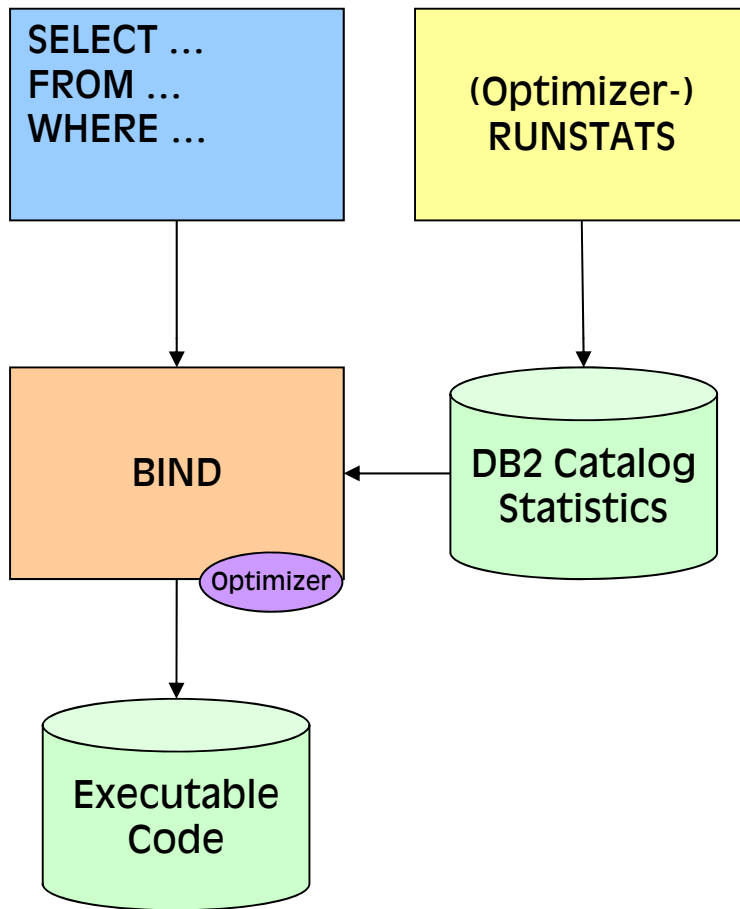


Agenda

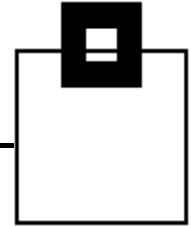
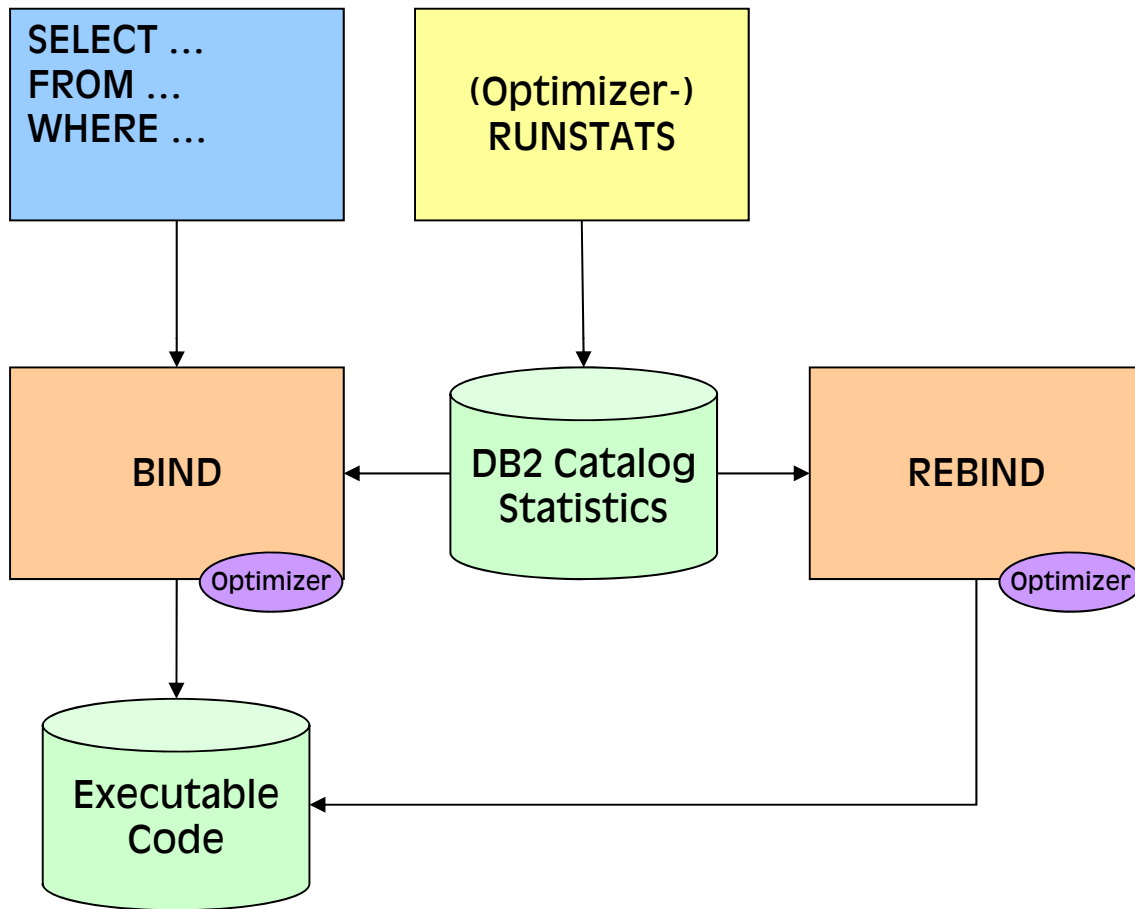
- What the DB2 Optimizer needs to make a choice
- How to model a production environment in test
- Compare access paths resulting from
 - Buffer pool changes
 - RID expansion
 - CPU changes
- Test “what if” you drop an index, or change the sort order of an index
- Real world examples



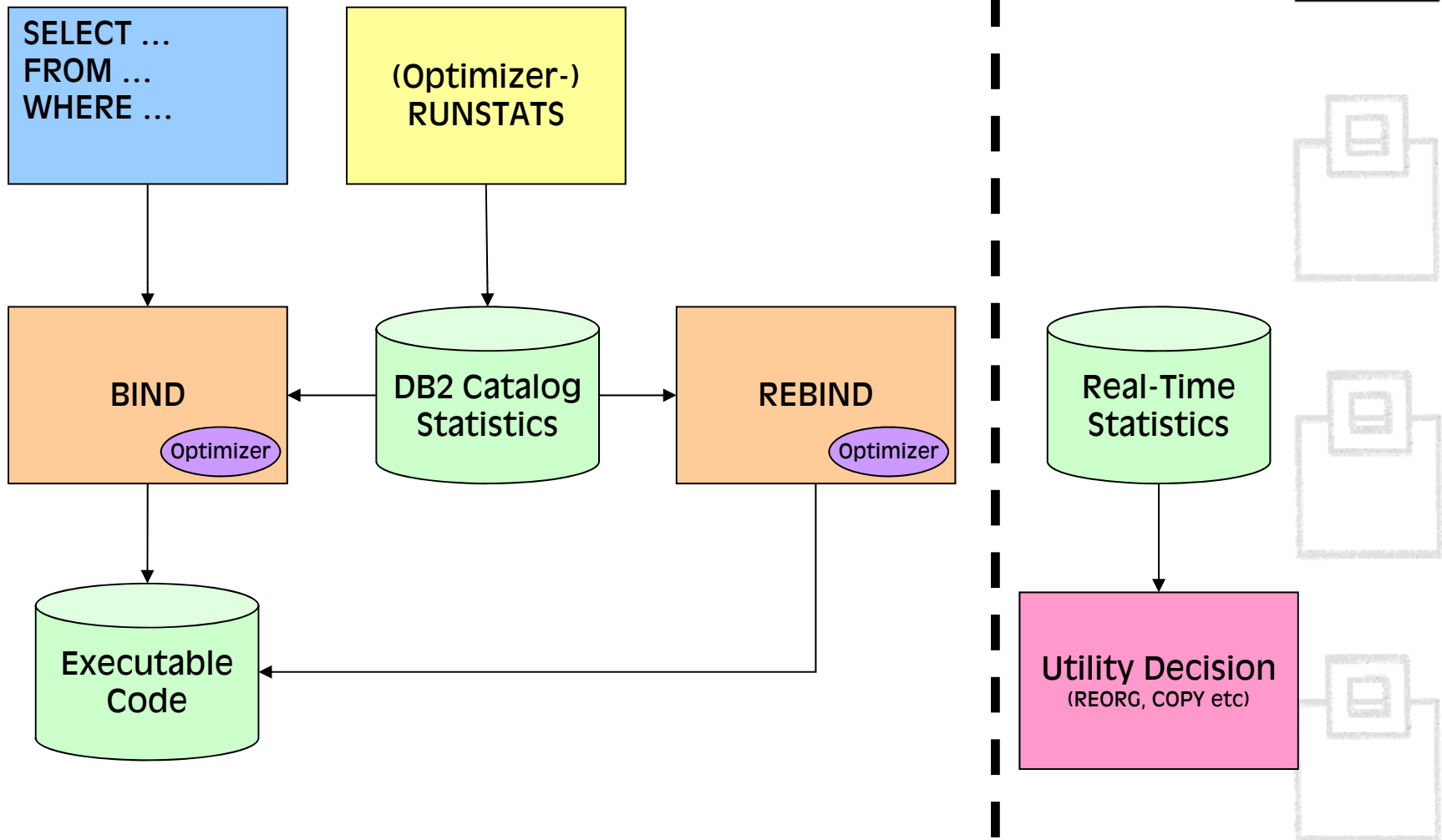
What the optimizer needs to make a choice



What the optimizer needs to make a choice



What the optimizer needs to make a choice



What the optimizer needs to make a choice

SYSCOLDIST / SYSKEYTGTDIST

CARDF
COLGROUPCOLNO /
KEYGROUPKEYNO
COLVALUE / KEYVALUE
FREQUENCYF
HIGHVALUE
LOWVALUE
NUMCOLUMNS / NUMKEYS
QUANTILENO
STATSTIME

SYSCOLUMNS / SYSKEYTARGETS

COLCARDF / CARDF
HIGH2KEY
LOW2KEY
n/a / STATS_FORMAT

* Columns are not updated by
RUNSTATS
_ Columns are not updatable

SYSCOLSTATS

COLCARD
HIGHKEY
LOWKEY

SYSINDEXES

CLUSTERING*
CLUSTERRATIO
CLUSTERRATIOF
DATAREPEATFACTORF
FIRSTKEYCARDF
FULLKEYCARDF
NLEAF
NLEVELS

SYSINDEXPART

LIMITKEY*

SYSROUTINES

CARDINALITY*
INITIAL_INSTS*
INITIAL_IOS*
INSTS_PER_INVOC*
IOS_PER_INVOC*

SYSTABLES

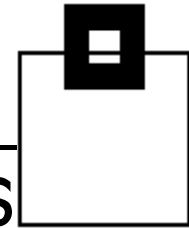
CARDF
EDPROC*
NPAGES
NPAGESF
PCTROWCOMP

SYSTABLESPACE

NACTIVE
NACTIVEF

SYSTABSTATS

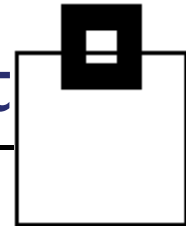
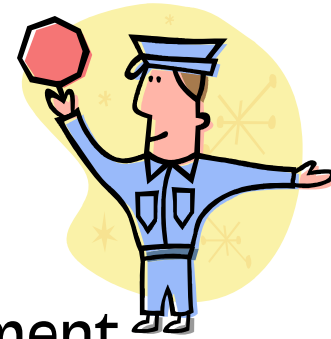
CARDF
NPAGES



How to model a production environment in test

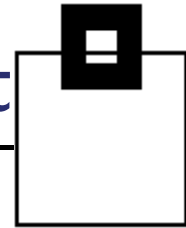
Create a Baseline

- Keep control of your environment
 - Quickly identify and understand performance degradation
 - Protect your production environment
 - Find out who executed the statement(s) and fix the problem not the symptom
 - Using program, user ID, qualifier, ...
 - Teach/enable the programmers and/or apply reliable QA
- Make dynamic SQL management a best practice

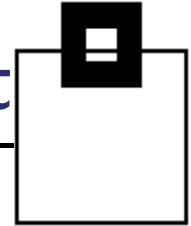


How to model a production environment in test

- A test system that exactly behaves like production allows to pre-check the results from a
 - New application version
 - New DB2 version (or APARs affecting performance)
 - New statistics
 - RUNSTATS can be painful in a dynamic environment

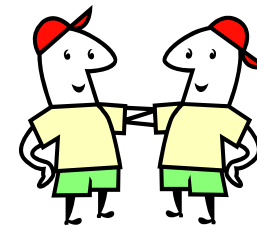


How to model a production environment in test

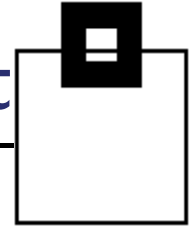


Gathering data for a simulation environment

- DB2P: Production
 - Take a snapshot of the Dynamic Statement Cache
 - Explain of all captured statements to central PLAN_TABLE
 - Determine CPU, # of CPs, BPs, rid & sort pool,...



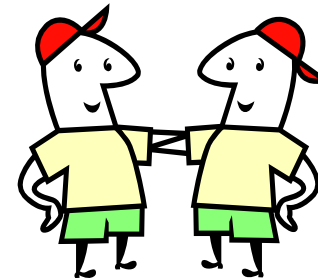
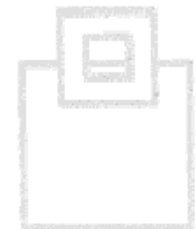
How to model a production environment in test



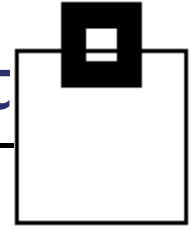
Applying data for a simulation environment

- DB2Q: Quality Assurance
 - Homogeneous System Copy (or Catalog Statistics) of DB2P
 - Apply environment modeling
 - Import the snapshot of the Dynamic Statement Cache
 - Explain all statements (needed)

→ Compare original and new



How to model a production environment in test

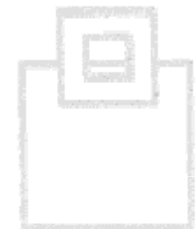


Production Modeling*

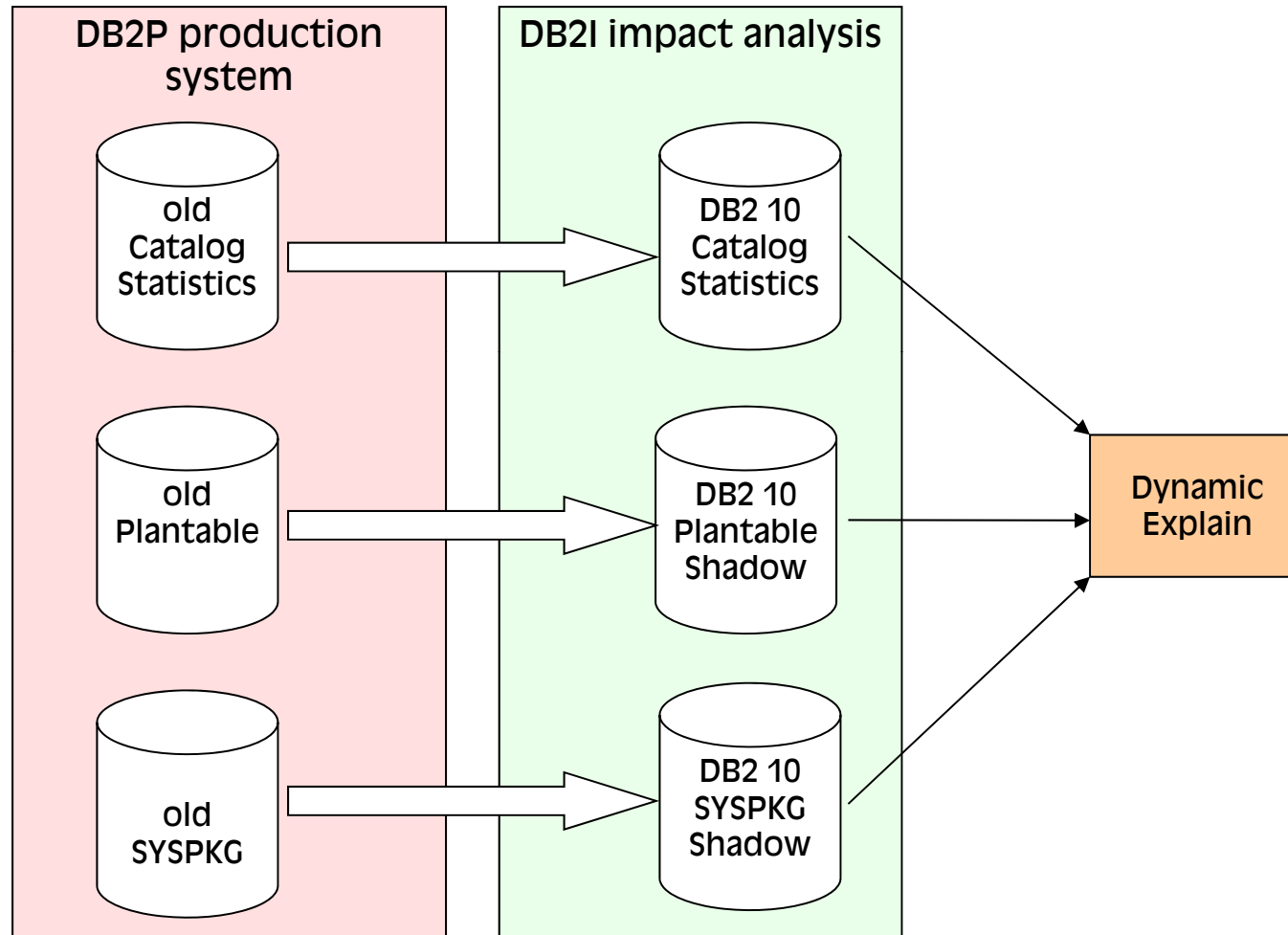
Supports optimizer overrides for optimizer relevant system settings

- New zparms
 - SIMULATED_CPU_SPEED
 - SIMULATED_COUNT
 - New SYSIBM.DSN_PROFILE_ATTRIBUTES
 - SORT_POOL_SIZE
 - MAX_RIDBLOCKS
 - For bufferpools
 - Same as the BP names shown at DSNTIP1
- KEYWORDS value of 'BP8K0' corresponds to BP BP8K0.

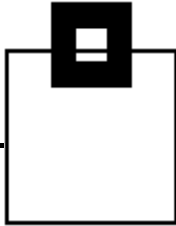
*just introduced by V9 APAR PM26475 & V10 APAR PM26973



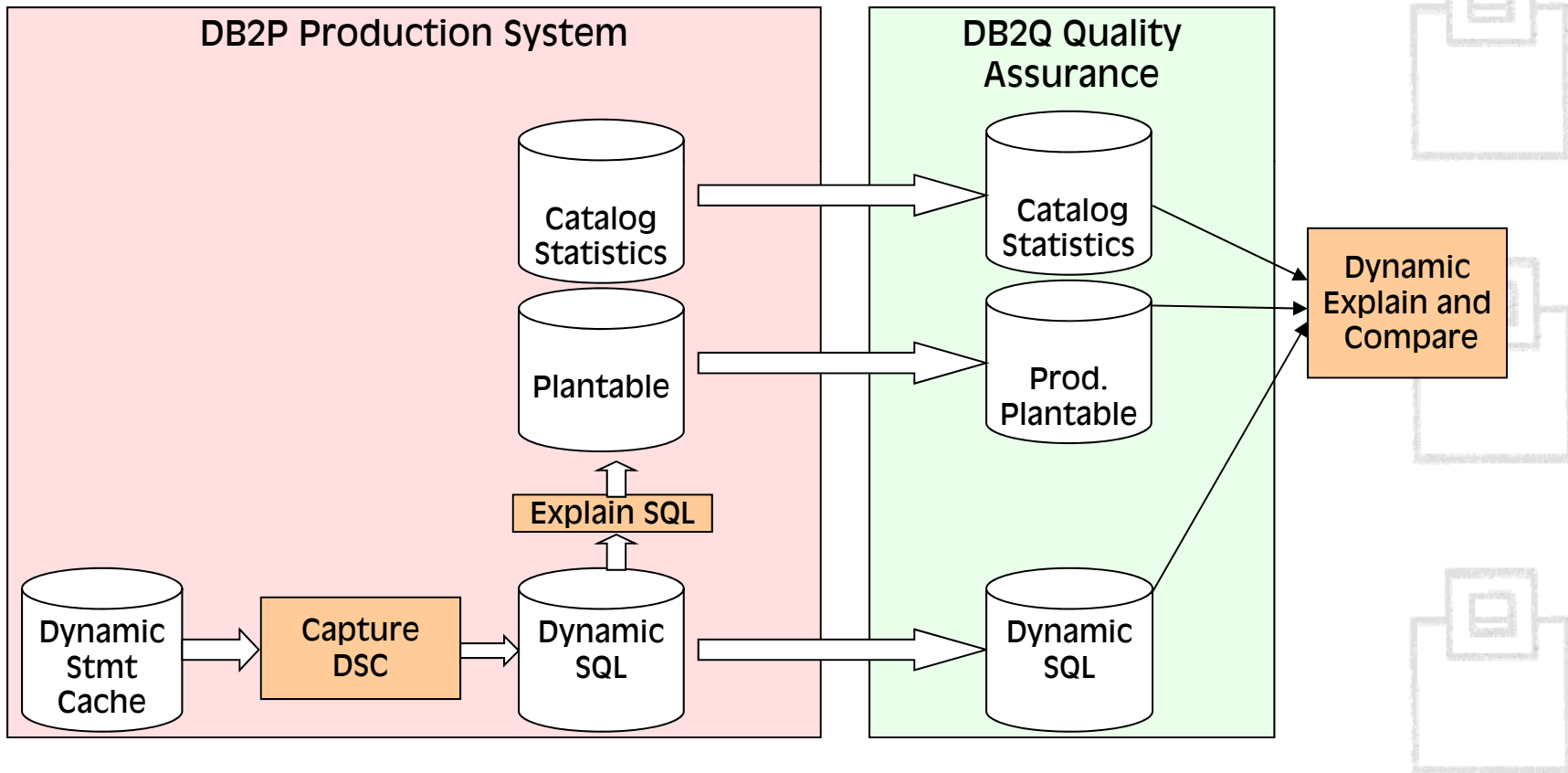
How to model a production environment in test



How to model a production environment in test



Dynamic SQL management and protection:



See the possibilities

```
ImpactExpert for DB2 z/OS ----- Comparison ----- LINE 0000001 COL 001 080
Command ==> _____ Scroll ==> CSR
Mode: Precheck Dynamic DB2: DB2Q
Primary cmd: END, C(atalog data), D(etails on/off), S(tatement text)

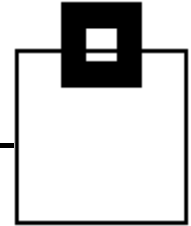
RunID old . DSCSNP01 RunID new . DSCSNP01
Created TS. 2010-07-24-09.23.39.408107 Created TS. 2010-07-24-09.23.39.408107
StmtID old. 355 StmtID new. 355
ExplainID . 1 ExplainID . 2
```

Verify the access path changes

```
Access path OLD -----! Access path NEW -----
```

| TABLE INDEX | QB | PN | AC TY | MA CO | ME TH | IX ON | PR FT | ! | TABLE INDEX | QB | PN | AC TY | MA CO | ME TH | IX ON | PR FT |
|---------------|----|----|-------|-------|-------|-------|-------|---|---------------|----|----|-------|-------|-------|-------|-------|
| IDUGY001 | 1 | 1 | R | 0 | | N | S | ! | IDUGY001 | 1 | 1 | I | 0 | | N | |
| | | | | | | | | ! | IDUGY0011 | | | | | | | |
| IDUGY002 | 1 | 2 | I | 1 | 1 | N | | ! | IDUGY002 | 1 | 2 | R | 0 | 1 | N | S |
| IDUGY0021 | | | | | | | | ! | | | | | | | | |
| IDUGY008 | 1 | 3 | I | 1 | 1 | Y | | ! | IDUGY008 | 1 | 3 | I | 1 | 1 | Y | |
| IDUGY0081 | | | | | | | | ! | IDUGY0081 | | | | | | | |
| | | | | | | | | ! | | | | | | | | |
| Milliseconds: | | | 119 | | | | | ! | Milliseconds: | | | 1 | | | | |
| Serviceunits: | | | 465 | | | | | ! | Serviceunits: | | | 2 | | | | |

BIX Virtual



Create a true production alike environment anywhere

1. Extracts a “baseline” from production including:

- Object DDL
- Catalog statistics
- CPU, #CPU, RID, Sort and Buffer pools, etc.
- PLAN_TABLE data (for comparison)



2. Change/convert names, schema, or setup

- Simulate different statistics
- Simulate index changes
- Simulate different environment characteristics



3. Creates the baseline in one, or multiple, target environments



BIX Index Simulator

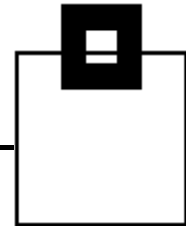
```
SQPX or DB2 z/OS ----- Settings Menu ----- Version 6.10
Command ==> _____ DB2: F91D
Primary cmd: END

1. Administer groups, their privileges and users
2. Display users and their group privileges
3. Administer user specific settings

4. Administer DRDA settings
5. Administer product explain tables
6. Create or alter user explain tables

V. Administer virtual indexes
X. Exit Settings
```


BIX Index Simulator



```
SQPX or DB2 z/OS ----- Filter Virtual Indexes -----
Command ==> _____ DB2: F91D

Primary cmd: END, C(reate table DSN_VIRTUAL_INDEXES)

Explain Tables
CREATOR : HEINRIC
Name    : DSN_VIRTUAL_INDEXES

Table
CREATOR : *
NAME    : *

Index
CREATOR : *
NAME    : *

Note : For table creator, table name, index creator, and index name,
wildcards '*' and '?' are allowed.
```



BIX Index Simulator

```
SQPX or DB2 z/OS ----- Virtual Index Overview ----- Index 1 from 2
Command ==> _____ Scroll ==> CSR
DB2: F91D
Primary cmd: END, N(ew), C(opy), L(ocate) index creator
Line cmd: C(olumns), D(isable), E(nable), R(emove), U(pdate), Z(oom)
```

Explain table used : HEINRIC.DSN_VIRTUAL_INDEXES

| Index Creator | Index Name | Table Creator | Table Name | Enable | Mode |
|---------------|--------------------|---------------|-------------|--------|--------|
| HEINRIC | VRT_IX_20110809212 | SYSIBM | SYSDATABASE | YES | CREATE |
| SYSIBM | DSNDDH01 | SYSIBM | SYSDATABASE | YES | DROP |

BIX Index Simulator

```

SQPX or DB2 z/OS ----- Virtual Index Overview ----- Index 1 from 2
C                                                                    Scroll ==> CSR
                                                                    DB2: F91D
P
L
SQPX ----- New Virtual Index -----
New virtual index for object:
CREATOR : SYSIBM +
NAME    : SYSDATABASE +
MODE    : C      C(reate)/D(drop)
-----+-----
C HEINRIC  VRT_IX_20110809212  SYSIBM  SYSDATABASE  YES  CREATE
SYSIBM    DSNDDH01             SYSIBM  SYSDATABASE  YES  DROP
-----+-----

```



BIX Index Simulator

```
SQPX or DB2 z/OS ----- New Virtual Create Index -----
Command ==> _____ DB2: F91D

Index
  Creator      : HEINRIC      +      Mode      : CREATE
  Name         : VRT IX 20110823100954 +      Enable   : YES
on Table
  Creator      : SYSIBM       +
  Name         : SYSDATABASE  +

INDEXTYPE. . . : 2           2(Nonpartitioned) / D(ata-partitioned)
UNIQUERULE . . : D           D(uplicates allowed) / U(nique)
CLUSTERING . . : Y           Y(es) / N(o)
PADDED . . . . : N           Y(es) / N(o)

NLEAF. . . . . : -1         The number of active leaf pages in the index.
NLEVELS. . . . : -1         The number of levels in the index tree.
PGSIZE . . . . : 4 KB      Size of leaf pages in index: 4, 8, 16, or 32.

FIRSTKEYCARDF : -1         Number of distinct values of first key column.
FULLKEYCARDF  : -1         Number of distinct values of the key.
CLUSTERRATIOF : 0.5        Percentage of rows in clustering order.
```



BIX Index Simulator

```

SQPX or DB2 z/OS ----- Select Columns for Virtual Index ----- Column 1 from 21
Command ==> _____ Scroll ==> CSR
MODE: DB2: F91D
Primary cmd: END, CAN(cel), L(ocate) colseq
Line cmd: S(elect), R(emove), Z(oom), 1 - 64 (Position in index)

Table creator:
Table name :

+
+

-----+-----+-----+-----+-----+-----+-----+-----+
Colno  Name          +  ColType      Length  Scale  Nulls  CCSID
-----+-----+-----+-----+-----+-----+-----+-----+
 1  NAME            VARCHA      24      0      N      1208
 2  CREATOR         VARCHA     128      0      N      1208
 3  STGROUP         VARCHA     128      0      N      1208
 4  BPOOL           CHAR         8        0      N      1208
 5  DBID            SMALLINT     2        0      N         0
 6  IBMREQD         CHAR         1        0      N      1208
 7  CREATEDBY       VARCHA     128      0      N      1208
 8  ROSHARE         CHAR         1        0      N      1208
 9  TIMESTAMP       TIMESTMP    10       0      N         0
10  TYPE            CHAR         1        0      N      1208
11  GROUP_MEMBER    VARCHA      24      0      N      1208
12  CREATEDTS       TIMESTMP    10       0      N         0
13  ALTEREDTS       TIMESTMP    10       0      N         0
14  ENCODING_SCHEME CHAR         1        0      N      1208
15  SBCS_CCSID      INTEGER      4        0      N         0
16  DBCS_CCSID      INTEGER      4        0      N         0
17  MIXED_CCSID     INTEGER      4        0      N         0
18  INDEXBP         CHAR         8        0      N      1208
19  IMPLICIT        CHAR         1        0      N      1208
20  CREATORTYPE     CHAR         1        0      N      1208
21  RELCREATED      CHAR         1        0      N      1208
-----+-----+-----+-----+-----+-----+-----+

```

BIX Index Simulator

```

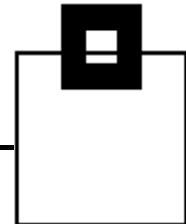
ImpactExpert for DB2 z/OS ----- Access Paths ----- LINE 00000001 COL 001 080
Command ==> _____ Scroll ==> CSR
Mode: REBIND ANALYSIS WITH/WITHOUT MIGRATION RULES          DB2: Q91A
Primary cmd: END, C(atalog data), D(etails on/off), S(tatement text), T(ables),
           I(All Indexes), X(Used indexes)

Collection . DDLGEN          Timestamp. . 2011-02-25-14.09.29.890000
Package. . . SQLDDL         Contoken . . 18E9104F0C187370
StmtNo old . 2262          Bindtime . . 2011-02-25-14.08.59.956412
StmtNo new .

Access path before REBIND ----- ! Access path with REBIND -----
!
TABLE          QB PN AC MA ME IX PR ! TABLE          QB PN AC MA ME IX PR
INDEX          TY CO TH ON FT ! INDEX          TY CO TH ON FT
-----
SYSTABLES     1  1 I  1  0 N  S ! SYSTABLES     1  1 I  3  0 N
DSNDTX02          ! VRT_IX_20110218115 VIRTUALLY CREATED
          1  2    0  3 N  !
!
Milliseconds:          5 ! Milliseconds:          1
Serviceunits:         10 ! Serviceunits:          2
-----
***** Bottom of Data *****

```

BIX VOX



```
BIX6MENU ert for DB2 z/OS ----- Main Menu ----- Version 6.10
Command ==> _____ DB2: Q91A

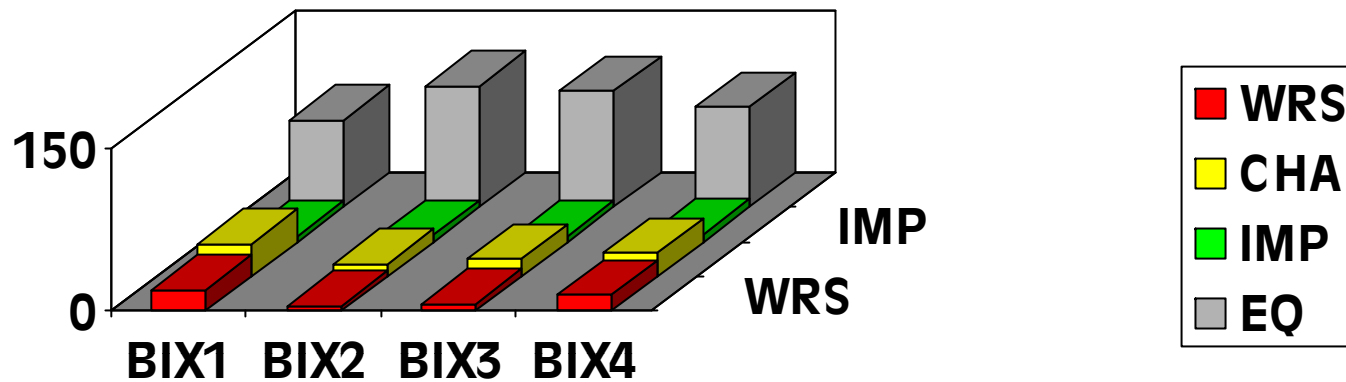
Primary cmd: END, S(ettings), C(leanup), A(bout), F(ilter Jobs), H(istory)
Line      cmd: S(elect), I(nfo), F(ilter Jobs)

Scenario          Base          Recent          Dyn  Migr. Convert
                  Base          Recent          Expl Rules Qual. DRDA VOX
-----
- REBIND Analysis  Catalog        -              YES  N      -      -      -
- Pre-BIND Local   Catalog        DBRM           YES  -      -      -      -
- Post-BIND Local  History        Catalog        NO   -      -      -      -
- Pre-BIND Prod-Baseline Export (*)     DBRM           YES  -      Y      Y      N
- Post-BIND Prod-Baseline Export (*)     Catalog        NO   -      Y      Y      -
- Early Precheck Static Export (*)     -              YES  Y      N      Y      N
- Early Precheck Dynamic Export (*)     -              YES  Y      Y      -      N
- DSC Protection  Export (*)     -              YES  -      N      -      -
- Dynamic SQL     DynStmtCache  -              YES  -      -      -      -
- Static and dynamic SQL Trace          -              YES  -      -      -      -

- Plan_table compare Plan_table 1 Plan_table 2
- DBRM reconstruct  Catalog

NOTE (*): Use export/import function to update BIX export tables.
```

BIX VOX and MAX



- Here are four BIX batch runs with normal data spread
- The question is: Where are the data deltas?
 - The answer is: Use MAX

BIX VOX and MAX

ImpactExpert for DB2 z/OS ----- Job Overview (5/5) ----- Job 16 from 113

Command ==> _____ Scroll ==> CSR

Mode: REBIND ANALYSIS WITH/WITHOUT MIGRATION RULES DB2: Q91A

Primary cmd: END, A(11), N(ew), R(efresh), Z(oom), L(ocate) submit time

Line cmd: P(rograms), C(ompare), D(elete), G(raphic), L(PLans),
S(tatements), Z(oom)

| | Submit time | Submitter | Jobname | Stepname | PLTB owner | PTF Level | Mode |
|---|---------------------|-----------|----------|----------|------------|--------------|------|
| C | 2011-02-25-14.13.14 | BOXWELL | RBNDPACK | CHKRBIND | BOXWELL | PTF_10179 RC | P |
| C | 2011-02-25-14.09.26 | BOXWELL | RBNDPACK | CHKRBIND | BOXWELL | PTF_10179 RC | P |
| _ | 2011-02-07-16.08.26 | DUDEK | RBNDPALE | CHKRBIND | IMPALE | PTF_10179 RC | P |
| _ | 2011-02-07-16.08.26 | DUDEK | RBNDPAIR | CHKRBIND | IMPAIR | PTF_10179 RC | P |
| _ | 2011-02-07-14.19.40 | DUDEK | RBNDPAC2 | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-07-12.56.03 | DUDEK | RBNDPAXX | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-07-12.56.03 | DUDEK | RBNDPACK | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-07-11.08.49 | DUDEK | RBNDPAC2 | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-07-11.08.49 | DUDEK | RBNDPAC1 | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-03-14.32.42 | DUDEK | RBNDPAC1 | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-03-14.04.36 | DUDEK | RBNDPACK | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-02-16.43.14 | DUDEK | RBNDPACK | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-02-16.19.42 | DUDEK | RBNDPACK | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-02-15.57.27 | DUDEK | RBNDPACK | CHKRBIND | IMPACT | PTF_10179 RC | P |
| _ | 2011-02-02-14.04.59 | DUDEK | RBNDPACK | CHKRBIND | IMPACT | PTF_10179 RC | P |

BIX VOX and MAX

```
ImpactExpert for DB2 z/OS --- Meta-Data Analysis Expert ----- DB2: PDBG
Command ==> █
Mode: REBIND ANALYSIS

Primary cmd: END
Line cmd: I(mproved), C(hanged), U(nchanged), W(orsened)

COLLECTION : *
PACKAGE : *
PLAN : *

First run : 2011-03-20-00.30.02.200000
Second run : 2011-03-27-00.30.01.100000
```

| | | 2nd run | | | |
|-------------|--------|----------|---------|-----------|---------|
| | Totals | IMPROVED | CHANGED | UNCHANGED | WORSENE |
| 1st run | | 78 | 1538 | 29362 | 296 |
| _ IMPROVED | 78 | 0 | 0 | 0 | 0 |
| _ CHANGED | 1520 | 0 | -14 | 12 | 2 |
| _ UNCHANGED | 29384 | 0 | 30 | -42 | 12 |
| _ WORSENE | 292 | 0 | 2 | 8 | -10 |

BIX VOX and MAX

```

ImpactExpert for DB2 z/OS ----- Job Overview (1/5) ----- Job 16 from 113
C +-----+
M ! Mode      : REBIND ANALYSIS WITH/WITHOUT MIGRATION RULES      !
P ! Submitter: BOXWELL      Submit time: 2011-02-25-14.09.26      DB2: Q91A !
L !
! Programs      Total :           23 (100%)                        !
! - Improved    0          0,00%                                !
! - Worsened    5          21,74%                                ! d
! - Changed     1          4,35%                                ! -
! - Unchanged   11         47,83%                                ! 7
G ! - Non-Dtrm.  4          17,39%                                ! 1
! - PLTA Iss.   2          8,70%                                ! 0
! - Errors      0          0,00%                                ! 0
!
! Statements    Total :           208 (100%)                       !
! - Improved    4          1,92%                                ! 0
! - Worsened    10         4,81%                                ! 0
! - Changed     3          1,44%                                ! 0
! - Unchanged   120        57,69%                                ! 0
! - Non-Dtrm.   10         4,81%                                ! 0
! - PLTA Iss.   61        29,33%                                ! 0
! - Errors      0          0,00%                                ! 0
+-----+
2011-02-02-14.04.59  DONE          0          0          0          0
  
```

BIX VOX and MAX

```
ImpactExpert for DB2 z/OS --- Meta-Data Analysis Expert ----- DB2: Q91A
Command ==> _____
Mode: REBIND ANALYSIS WITH/WITHOUT MIGRATION RULES

Primary cmd: END
Line   cmd: I(mproved), C(hanged), U(nchanged), W(orsened)

COLLECTION : *
PACKAGE    : *
PLAN       : *
First run  : 2011-02-25-14.09.26   Second run : 2011-02-25-14.13.14
                        2nd run
                        IMPROVED  CHANGED  UNCHANGED  WORSENERD
Totals      0          0          137         0
1st run
I IMPROVED    4         -4          0           4           0
_ C  CHANGED    3          0         -3           3           0
_ U  UNCHANGED  120         0          0           0           0
_ W  WORSENERD  10          0          0          10          -10
```

BIX VOX and MAX

```
ImpactExpert for DB2 z/OS -- Statement Overview ----- Stmt 1 from 4
Command ==> _____ Scroll ==> CSR
Mode: REBIND ANALYSIS WITH/WITHOUT MIGRATION RULES          DB2: Q91A
Primary cmd: END, Z(oom), L(ocate) collid/plan
Line   cmd: S(tatement text), Z(oom), 1(First run), 2(Second run)
```

```
First run : 2011-02-25-14.09.26   Second run : 2011-02-25-14.13.14
```

| | Collection/Plan + | Program + | Version/Contoken | + | StmtNo | SectNo |
|----------|-------------------|-----------|-------------------------|---|--------|--------|
| | ----- | ----- | ----- | | ----- | ----- |
| <u>2</u> | 1 DDLGEN | SQLDDLD | CONTOKEN=18E9104F0C1873 | | 2262 | 4 |
| - | DDLGEN | SQLDDLD | CONTOKEN=18E9104F0C1873 | | 4642 | 23 |
| - | DDLGEN | SQLDDL | CONTOKEN=18E33349101C91 | | 1862 | 21 |
| - | DDLGEN | SQLDDL | CONTOKEN=18E33349101C91 | | 2007 | 23 |
| | ----- | ----- | ----- | | ----- | ----- |

BIX VOX and MAX

```

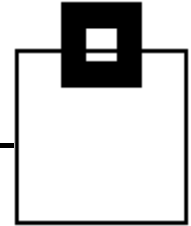
ImpactExpert for DB2 z/OS ----- Access Paths ----- LINE 00000001 COL 001 080
Command ==> _____ Scroll ==> CSR
Mode: REBIND ANALYSIS WITH/WITHOUT MIGRATION RULES          DB2: Q91A
Primary cmd: END, C(atalog data), D(etails on/off), S(tatement text), T(ables),
            I(All Indexes), X(Used indexEs)

Collection . DDLGEN          Timestamp. . 2011-02-25-14.13.17.060000
Package. . . SQLDDL         Contoken . . 18E9104F0C187370
StmtNo old . 2262          Bindtime . . 2011-02-25-14.08.59.956412
StmtNo new .

Access path before REBIND ----- ! Access path with REBIND -----
!
TABLE          QB PN AC MA ME IX PR ! TABLE          QB PN AC MA ME IX PR
INDEX          TY CO TH ON FT ! INDEX          TY CO TH ON FT
-----
SYSTABLES     1 1 I  1 0 N S ! SYSTABLES     1 1 I  1 0 N S
  DSNCTX02    !  DSNCTX02
              1 2    0 3 N !
              !
Milliseconds:          5 ! Milliseconds:          5
Serviceunits:         10 ! Serviceunits:         10
-----
***** Bottom of Data *****

```

See the possibilities

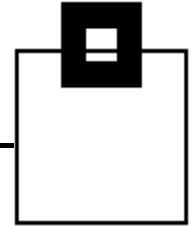


What you can expect from exploiting it right:

- Flexibility in developing and running your applications
- Even more insight out of the box than in your static world
- Cost efficiency in development and operations



See the possibilities



References:

- IBM Redbook – Squeezing the Most out of Dynamic SQL

