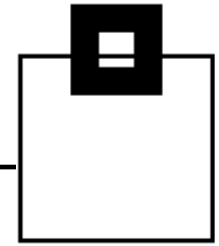


Mastering Dynamic SQL

for DB2 z/OS

-

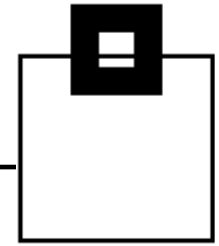
Can I control a dynamic world?

Agenda

- Dynamic SQL at a glance:
  - Characteristics
  - DB2 setup and support
  - DB2 commands and features

- See the possibilities:
  - Dynamic SQL Management & Protection
    using **Bind ImpactExpert for DB2 z/OS**

Dynamic SQL at a glance

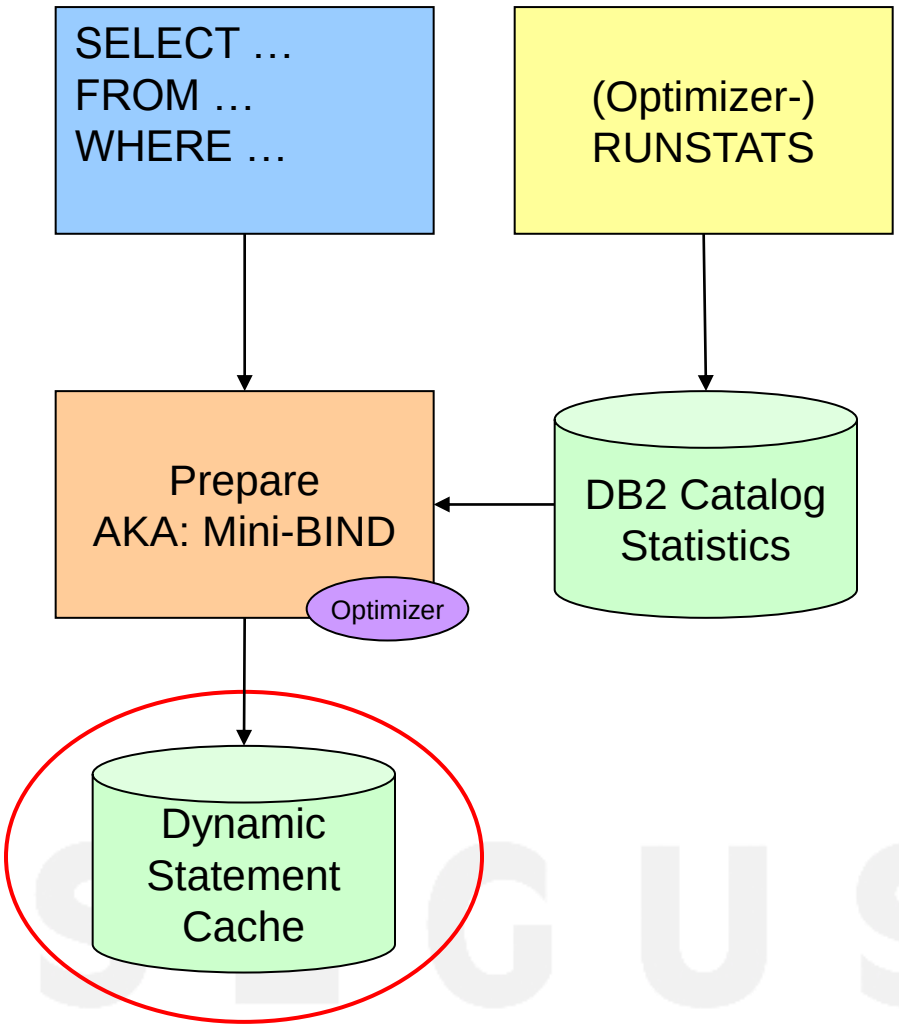


Characteristics:

- It's flexible
  → SQL statements can be built and executed on the fly
- It's dynamic
  → access paths are determined ad-hoc
- It's state of the art
  → widely supported in today's programming languages
- It's difficult to control
  → Statement and access path is only available at runtime
- It's expensive
  → Optimization and tuning is difficult

Dynamic SQL at a glance

Characteristics:



Access Paths for dynamic SQL are determined on the fly and can be stored in the DSC.

RUNSTATS, ALTERS, DB2 RESTART invalidates and flushes the DSC for an object.

Dynamic SQL at a glance

DB2 Setup and Support:

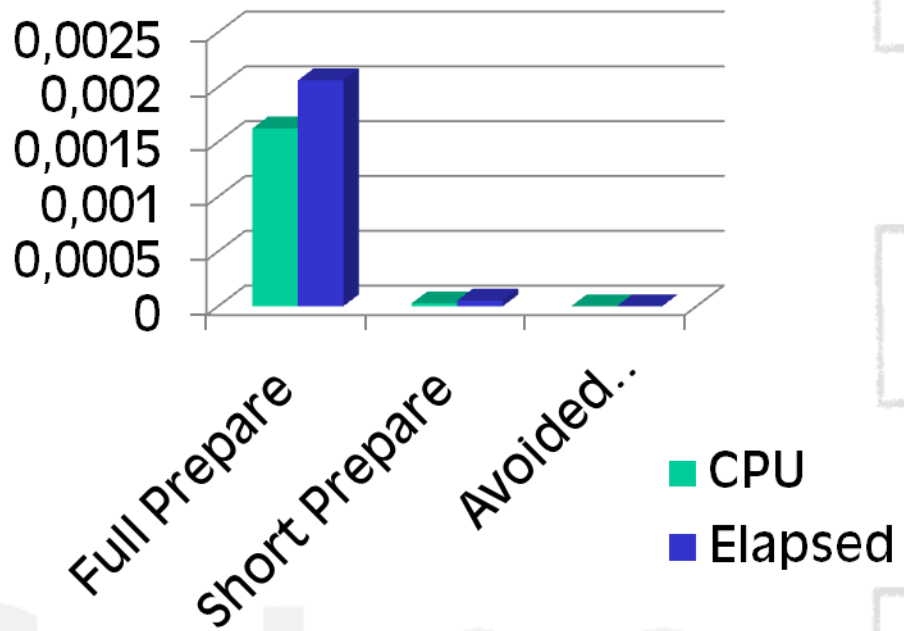
CACHEDYN->		NO	YES
KEEPDYNAMIC	NO	• No skeletons cached in EDMP • Only full prepares • No prepared statements kept across commits (note1) • No statement strings kept across commits NONE	• Skeletons cached in EDMP • 1st prepare full; others short (note 2) • No prepared statements kept across commits (note 1) • No statement strings kept across commits Global
	YES	• No skeletons cached in EDMP • Only full prepares • No prepared statements kept across commits (note 1) • Stmt strings kept across commits – implicit prepares LOCAL	• Skeletons cached in EDMP • 1st prepare full; others short (note 2) • Prepared stmts across commits – avoids prepares (note 3) • Stmt strings kept across commits – implicit prepares FULL AKA: Prepare Avoidance

Note 1: unless a cursor WITH HOLD is open, Note 2: unless invalidated or flushed out due to LRU, Note 3: assuming MAXKEEPD > 0

Dynamic SQL at a glance

DB2 Setup and Support:

- Save money with the right setup
- Exploit the full flavor of caching
  - MAXKEEPD>0
  - CACHEDYN=YES
  - KEEPDYNAMIC(YES)



Dynamic SQL at a glance

DB2 Commands and Features:

Different to static SQL, the dynamic world allows to “re-explain” an access path using for example SPUFI, DSNTEP2:

- EXPLAIN STMTCACHE ALL
- EXPLAIN STMTCACHE STMTID
- EXPLAIN STMTCACHE STMTTOKEN

→ EXPLAIN STMTCACHE does not go through the EXPLAIN process, but tells you exactly about the current access!

Dynamic SQL at a glance

So far, so good …

Knowing how to handle it, opens up great opportunities for

- Packaged applications like SAP
- Less-mainframe-skilled developers
- Interactive multi-platform solutions
- The mainframe competing with the distributed environment
- Cost efficient and well performing applications

→ **The key is the Dynamic Statement Cache …**

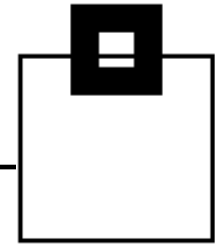
… USE IT

See the possibilities

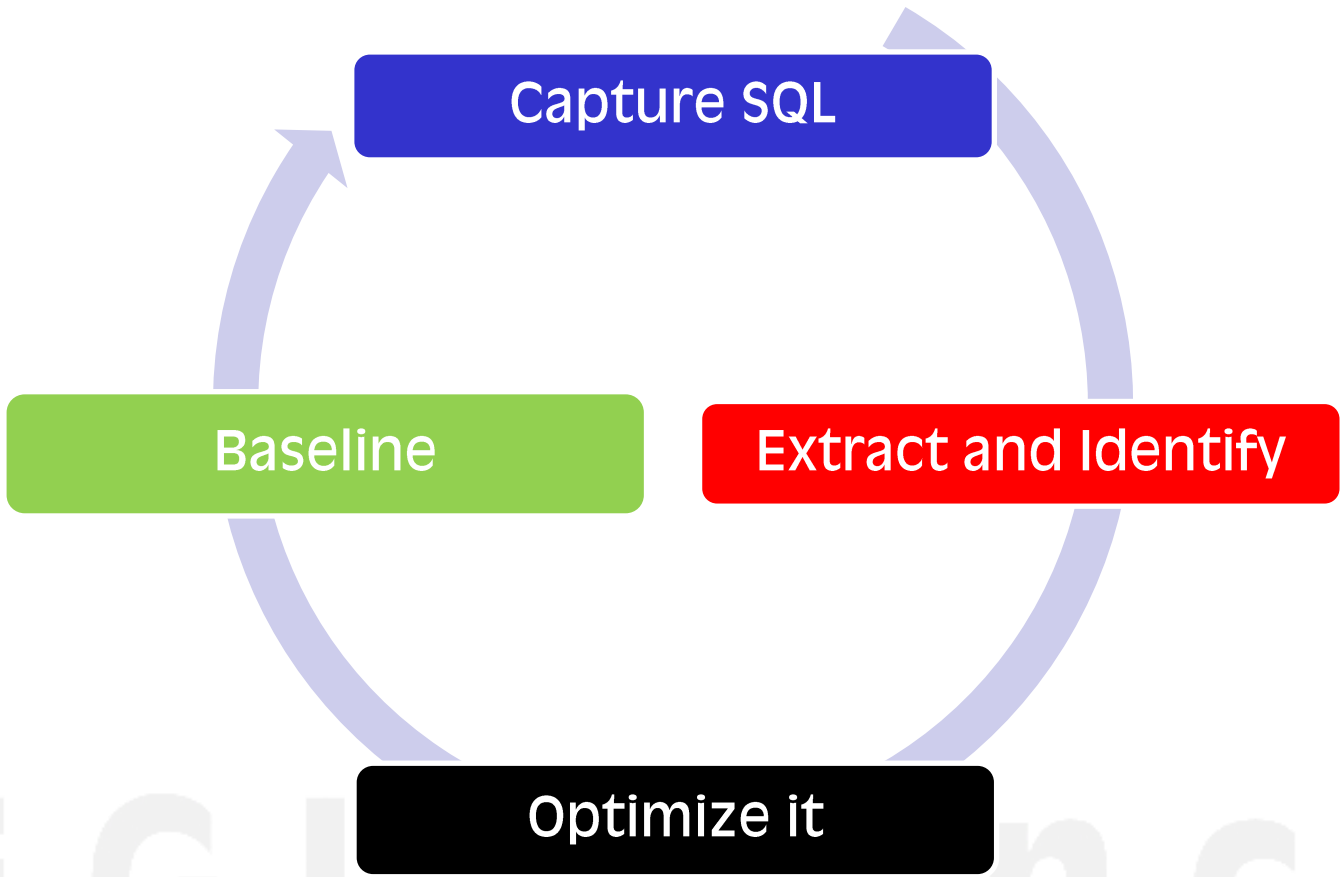
How SEGUS manages dynamic SQL reliably:

- Dynamic SQL management and protection:
- Protecting your production environment from unforeseen performance degradations requires quality assurance.
- SEGUS trend analysis system allows to pre-check the results from a
  - New application version
  - New statistics
    - REORG with Inline Statistics
    - RUNSTATS TABLESPACE/INDEX
    - LOAD with Inline Statistics
  - New DB2 version (or APARs affecting performance)

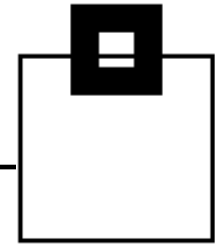
See the possibilities



How to manage dynamic SQL reliably:

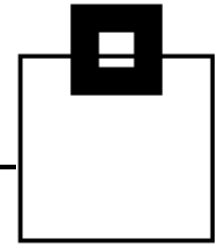


See the possibilities



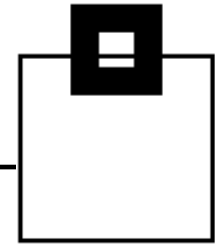
```
ImpactExpert for DB2 z/OS -- Dynamic Statement Cache (1/8) -- Stmt 1 from 117
Command ===> _____________________________________________ Scroll ===> CSR
                                                            DB2: Q91A
Primary cmd: END, F(ilter), Z(oom), L(ocate) getpages
Line    cmd: Z(oom), A(nalyze), E(dit statement), S(tatement text), T(able),
             X(EXecute)

     StmtID      Program   Lineno     UserID    Qualifier Executes   Getpages   S
     ---------- -------- --------- -------- -------- ---------- ---------- -
_         2162 IQADBACP       1086 NEWMANN  NEWMANN           14        245 V
_         2164 IQADBACP       1094 NEWMANN  NEWMANN           36        222 V
_         2152 IQADBACP       1086 NEWMANN  NEWMANN            3         61 V
_         2154 IQADBACP       1086 NEWMANN  NEWMANN            7         48 V
_         2247 IQADBACP       1042 NEWMANN  NEWMANN            1         48 V
_         2250 IQADBACP       1042 NEWMANN  NEWMANN            1         48 V
_         2192 IQADBACP       1082 NEWMANN  NEWMANN           10         47 V
_         2208 IQADBACP       1042 NEWMANN  NEWMANN            1         47 V
_         2138 IQADBACP       1082 NEWMANN  NEWMANN           12         39 V
_         2150 IQADBACP       1086 NEWMANN  NEWMANN            3         24 V
_         2155 IQADBACP       1086 NEWMANN  NEWMANN            7         24 V
_         2253 IQADBACP       1022 NEWMANN  NEWMANN            1         23 V
_         2255 IQADBACP       1090 NEWMANN  NEWMANN            3         21 V
_         2256 IQADBACP       1094 NEWMANN  NEWMANN            4         20 V
_         2142 IQADBACP       1086 NEWMANN  NEWMANN            8         18 V
_         2112 IQADBACP       1082 NEWMANN  NEWMANN            0         16 V
```

See the possibilities



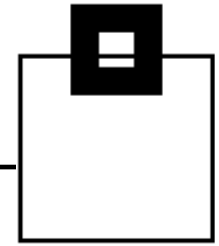
```
ImpactExpert for DB2 z/OS -- Dynamic Statement Cache (4/8) -- Stmt 1 from 117
Command ===> _____________________________________________ Scroll ===> CSR
                                                            DB2: Q91A
Primary cmd: END, F(ilter), Z(oom), L(ocate) getpages
Line    cmd: Z(oom), A(nalyze), E(dit statement), S(tatement text), T(able),
             X(EXecute)
               Synchr.     Synchr.    Rows        Rows        Index      Tablespc.
    StmtID     Buffer Rd   Buffer Wr  examined    processed   Scans      Scans
    ---------- ---------- ---------- ---------- ---------- ---------- ----------
_         2162          0          0         74         37         52         15
_         2164          0          0          0        185          0         74
_         2152          4          0         38         19         30          4
_         2154          0          0         16          8         16          0
_         2247          0          0        101          2          2          1
_         2250          0          0        101          2          2          1
_         2192          0          0        844          2          4         11
_         2208          4          0        100         39          2          1
_         2138          0          0         13         13         13          0
_         2150          0          0          8          4          8          0
_         2155          0          0          8          0          8          0
_         2253          0          0          3          1          0          0
_         2255          0          0          0          7          3          3
_         2256          0          0          0          2          0          8
_         2142          0          0          0          9          0          9
_         2112          0          0          1          0          0          1
```

See the possibilities



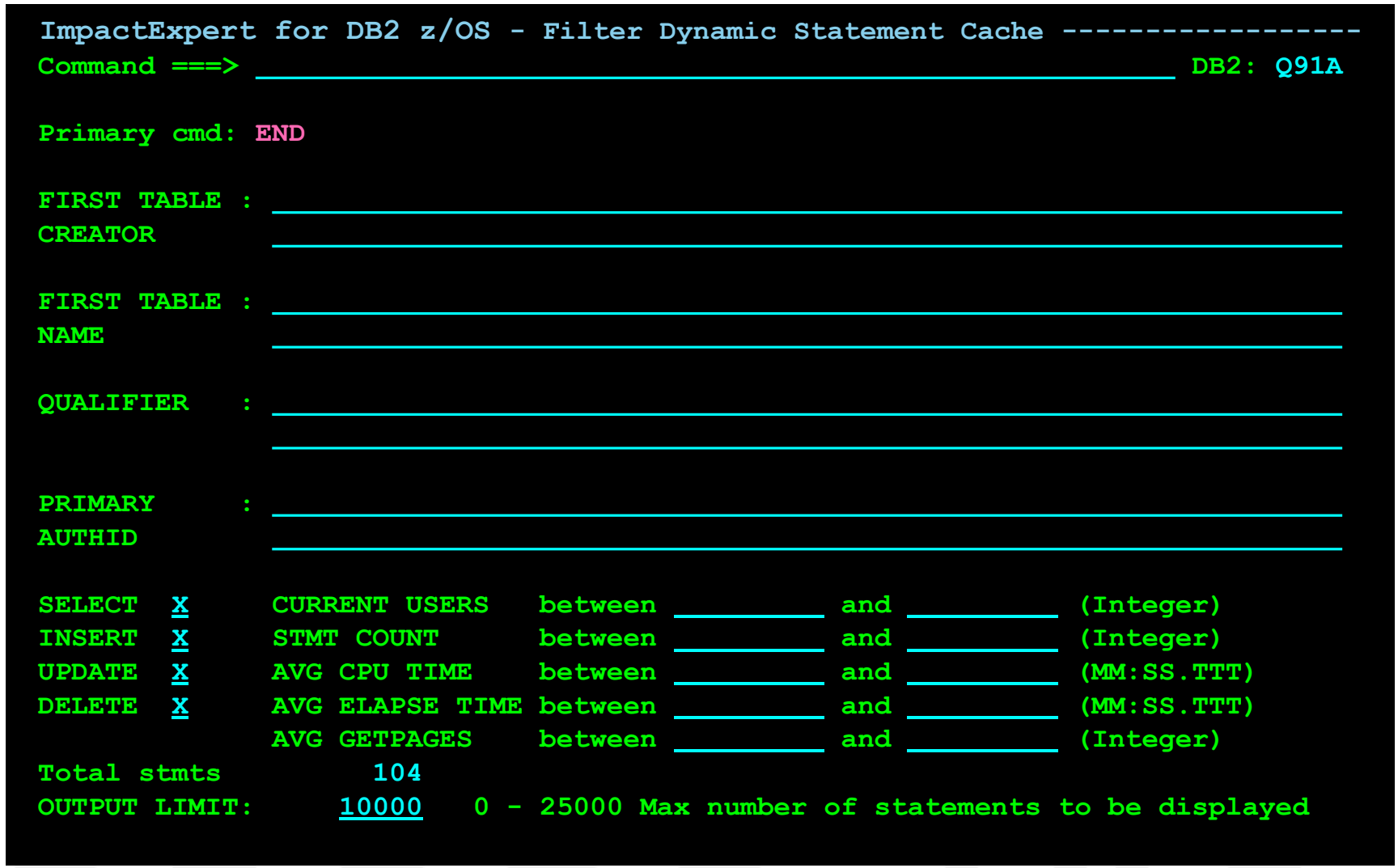
```
ImpactExpert for DB2 z/OS -- Dynamic Statement Cache (6/8) -- Stmt 1 from 117
Command ===> _____________________________________________ Scroll ===> CSR
                                                          DB2: Q91A
Primary cmd: END, F(ilter), Z(oom), L(ocate) getpages
Line    cmd: Z(oom), A(nalyze), E(dit statement), S(tatement text), T(able),
             X(EXecute)

     StmtID      Total CPU       Average CPU     Total Elapse    Average Elapse
     ---------- HHHH:MM:SS.ttt  HHHH:MM:SS.ttt  HHHH:MM:SS.ttt  HHHH:MM:SS.ttt
_          2162          0.040           0.003           0.373           0.027
_          2164          0.047           0.001           0.128           0.004
_          2152          0.014           0.005           0.104           0.035
_          2154          0.007           0.001           0.007           0.001
_          2247          0.006           0.006           0.006           0.006
_          2250          0.006           0.006           0.006           0.006
_          2192          0.005           0.001           0.005           0.001
_          2208          0.013           0.013           0.089           0.089
_          2138          0.004               -           0.004               -
_          2150          0.002           0.001           0.002           0.001
_          2155          0.002               -           0.002               -
_          2253              -               -               -               -
_          2255          0.004           0.001           0.004           0.001
_          2256          0.004           0.001           0.004           0.001
_          2142          0.002               -           0.002               -
_          2112              -               -               -               -
```

See the possibilities

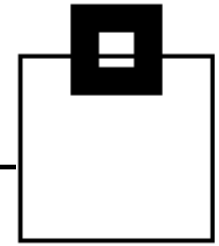


```
ImpactExpert for DB2 z/OS - Limit DSC Snapshot -----------------------------
Command ===> ____________________________________________________ DB2: Q91A

Primary cmd: END

MEMBER          : ________  Blank(Connected DB2) / *(All members) / member name

NO LIMITATION   : X
HIGHEST VALUES  : _
EXCEED THRESHOLD: _      THRESHOLD: _________

For limitation to highest values or exceeding of specified threshold
EXECUTIONS      : _      ROWS PROCESSED    : _      SORTS                  : _
BUFFER READS    : _      ROWS EXAMINED     : _      PARALLEL GROUPS        : _
BUFFER WRITES   : _      INDEX SCANS       : _      RID EXCEED DB2 LIMITS  : _
GETPAGES        : _      TABLE SPACE SCANS : _      RID EXCEED STORAGE     : _

For limitation to highest values only
ELAPSE TIME     : _      CPU TIME          : _

WAIT TIME FOR ...
SYNCRONOUS I/O  : _      SYNCR. EXECUTION  : _      READS  OTHER THREADS   : _
LOCK AND LATCH  : _      GLOBAL LOCKS      : _      WRITES OTHER THREADS   : _
```

See the possibilities



See the possibilities



How to manage dynamic SQL reliably:

Step 1 – Find the candidates – you may need to aggregate!

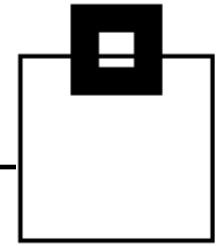
Level 1: Ignore values, spacing, cursor names, select clauses

….

SQL-Text	Count	CPU-Time
SELECT … WHERE COL = ‘ABC‘	1	1s
SELECT … WHERE COL = ‘BCD‘	1	1s
SELECT … WHERE COL = ‘CDE‘	1	1s
SELECT … WHERE COL = ‘DEF‘	1	1s
SELECT … WHERE COL = ‘EFG‘	1	1s
…		

SQL-Text	Count	CPU-Time
SELECT … WHERE COL = ‘ABC‘’	10,000	10,000s
…		

See the possibilities



How to manage dynamic SQL reliably:

Step 1 – Find the candidates – you may need to aggregate!

… Level 2: Level1 + operators in predicates

Level 3: Level2 + right hand side

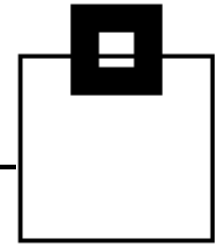
Level 4: Aggregate on object level

Optionally (for all levels): table creator

```
SELECT COLX, COL2 FROM CRE1.TAB1 WHERE COL5 = 'ABC'
SELECT COL1, COL2 FROM CRE1.TAB1 WHERE COL5 = '123'  => Level 1
SELECT COL1, COL2 FROM CRE1.TAB1 WHERE COL5 > '123'  => Level 2
SELECT COL1, COL2 FROM CRE1.TAB1 WHERE COL5 > :HV1  => Level 3
SELECT COL1, COL2 FROM CRE1.TAB1 WHERE COL7 > :HV1  => Level 4

SELECT COL1, COL2 FROM CRE2.TAB1 WHERE COL5 > :HV1  => Level 3
                                                       + tbcreator
```

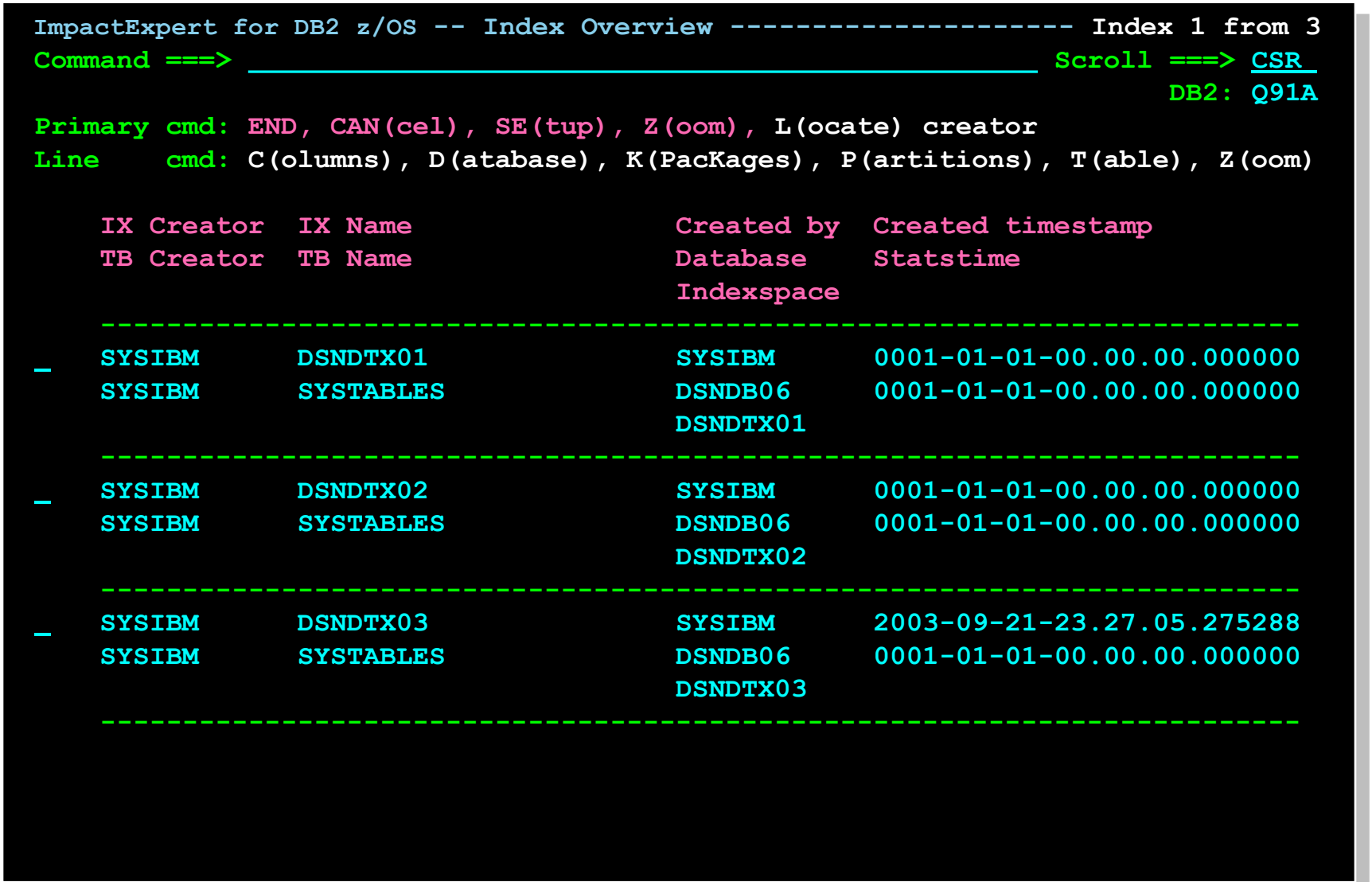
```
SELECT COL1, COL2 FROM CRE1.TAB1 WHERE COL = 'ABC'
```

See the possibilities

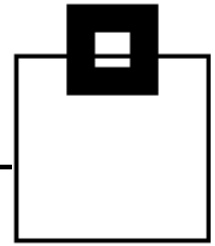


```
ImpactExpert for DB2 z/OS - Explain Data (1/5) -------------- Entry 1 from 1
Command ===> _____________________________________________ Scroll ===> CSR
                                                            DB2: Q91A
Primary cmd: END, T(Explain Text), V(iolations), R(unstats), P(redicates),
             S(tatement Text), PR(int Reports), Z(oom), SAVExxx, SHOWxxx
Line    cmd: Z(oom), I(ndexes of table), S(hort catalog), T(able), X(IndeX)

DSN = NEWMANN.ADB2.IN                                Member = DELME
Stmt =          1
Milliseconds:         433  Service Units:        1696  Cost Category: B

  QBNO QBTYPE CREATOR  TABLE NAME         ACCS MTCH IX  METH PRNT TABL PRE  MXO
  PLNO TABNO  XCREATOR INDEX NAME         TYPE COLS ON   OD   QBLK TYPE FTCH PSQ
  ---- ------ -------- ------------------ ---- ---- --- ---- ---- ---- ---- ---
_    1 SELECT SYSIBM   SYSTABLES          R       0  N     0    0   T    S    0
     1 1
  ---- ------ -------- ------------------ ---- ---- --- ---- ---- ---- ---- ---
```

See the possibilities



See the possibilities

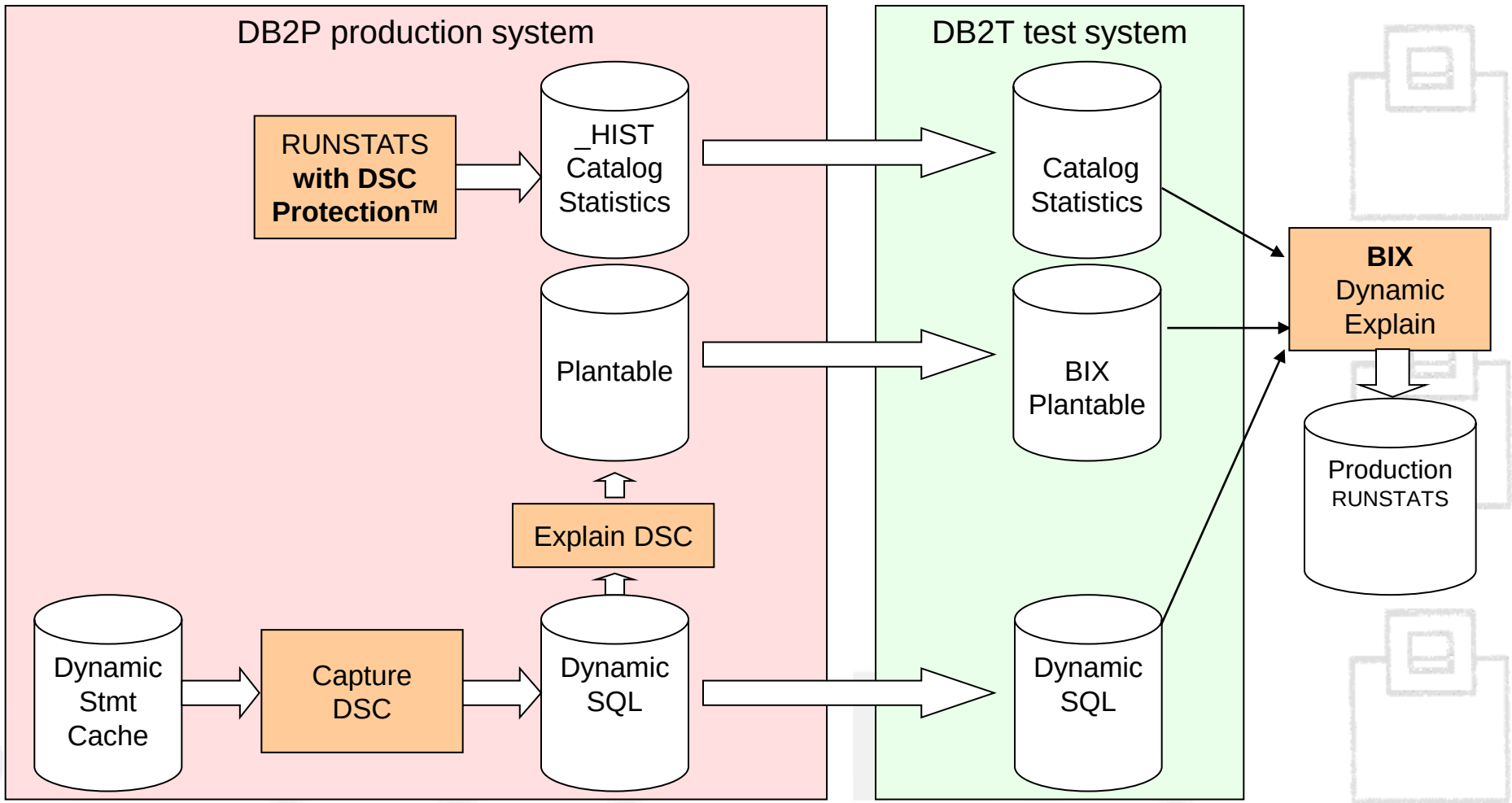


```
Analyze for DB2 z/OS ----- Violations -------------- LINE 00000001 COL 001 080
Command ===> _____________________________________________ Scroll ===> CSR
                                                          DB2: Q91A
Primary cmd: END, E(xplain Data), T(Explain Text), R(unstats), P(redicates),
             S(tatement Text), PR(int Reports), SAVExxx, SHOWxxx

DSN = NEWMANN.ADB2.IN                                  MEMBER = DELME
STMT =          1

--------------------------------------------------------------------------------
                ----- RULE-NO.:  9072   (WARNING) -----
Predicate is stage 2 (neither stage 1 nor indexable)). QBLOCKNO: 1, Access:
STAGE2, Predicate: 5 BETWEEN SYSIBM.SYSTABLES.DBID AND SYSIBM.SYSTABLES.OBID
Try to rewrite the predicate as stage 1 or indexable or try to add another (
stage 1 or indexable) predicate for this column(s) to the WHERE or ON clause.
                ----- RULE-NO.:  9201   (WARNING) -----
A predicate like: '(EXPR) BETWEEN COL1 AND COL2' should be rewritten like:
'(EXPR) >= COL1 AND (EXPR) <= COL2'.
Then the predicates are INDEXABLE.
                ----- RULE-NO.:  9065   (WARNING) -----
SELECT * can lead to unnecessary data transfer. QBLOCKNO(s) affected: 1.
Select only columns which are really used by your application.
                ----- RULE-NO.:  9070   (SEVERE-ERROR) -----
Runstats check found critical rule violations.
Please look into the runstats report.
                ----- RULE-NO.:  9099   (WARNING) -----
```

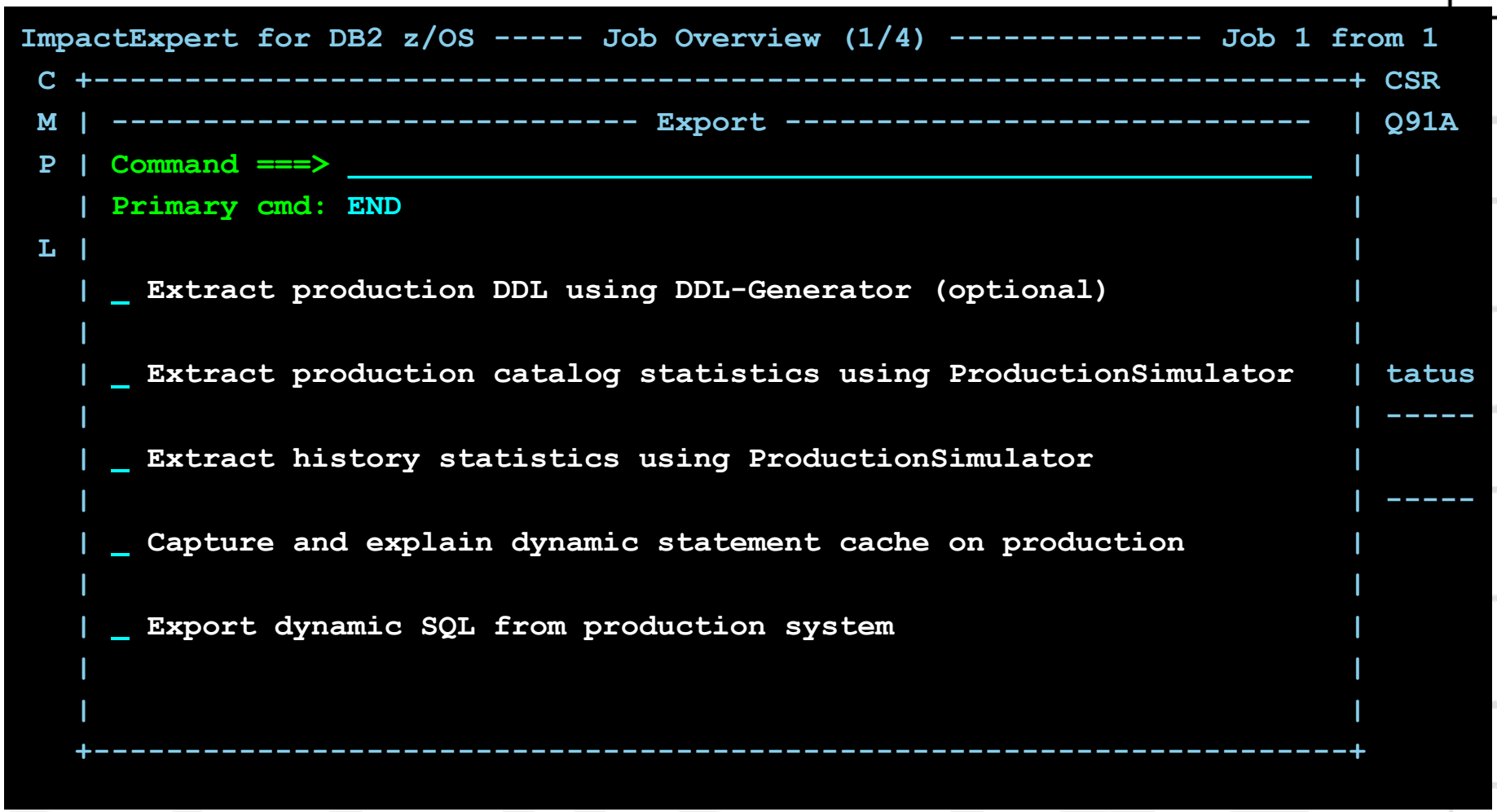
See the possibilities

How SEGUS manages dynamic SQL reliably:

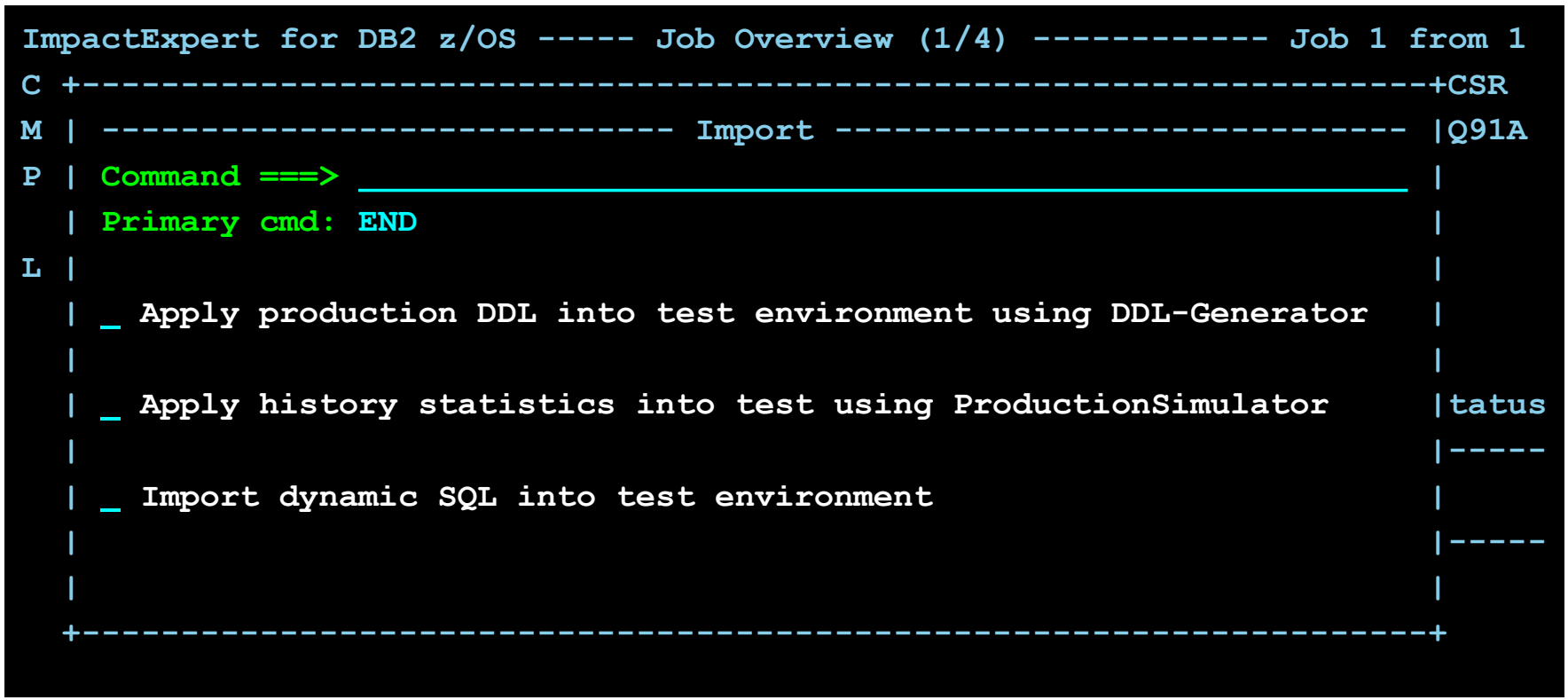
Dynamic SQL management and protection: Proactive QA



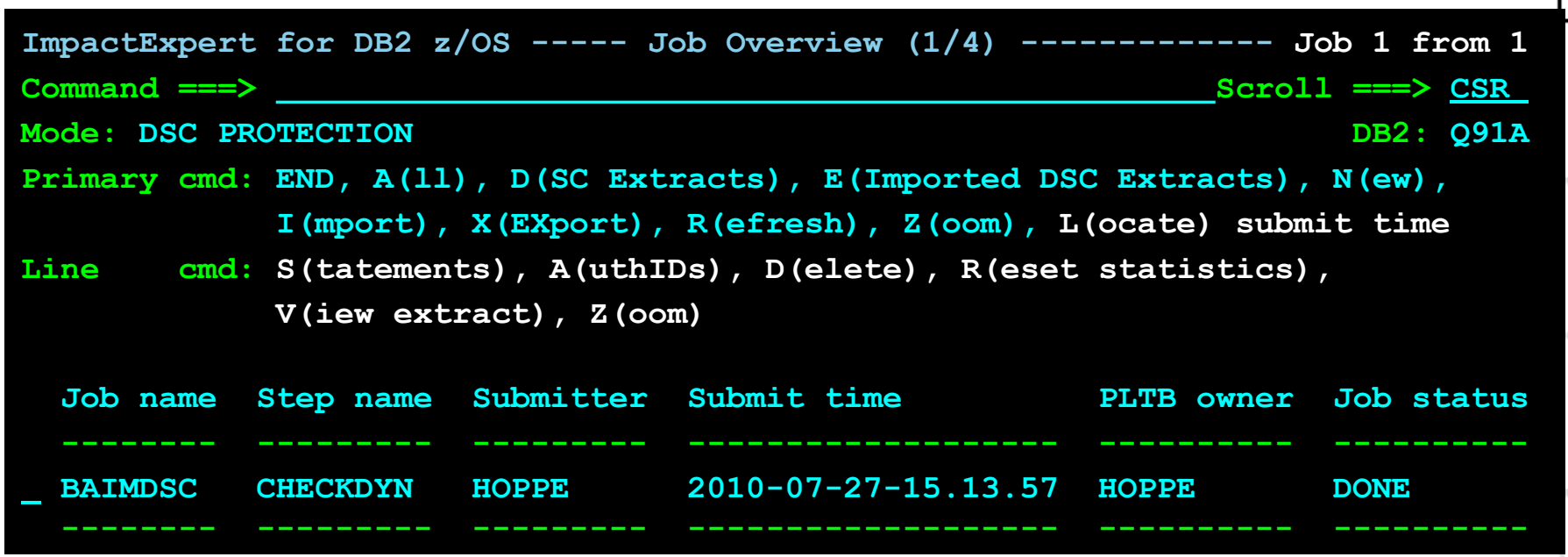
See the possibilities



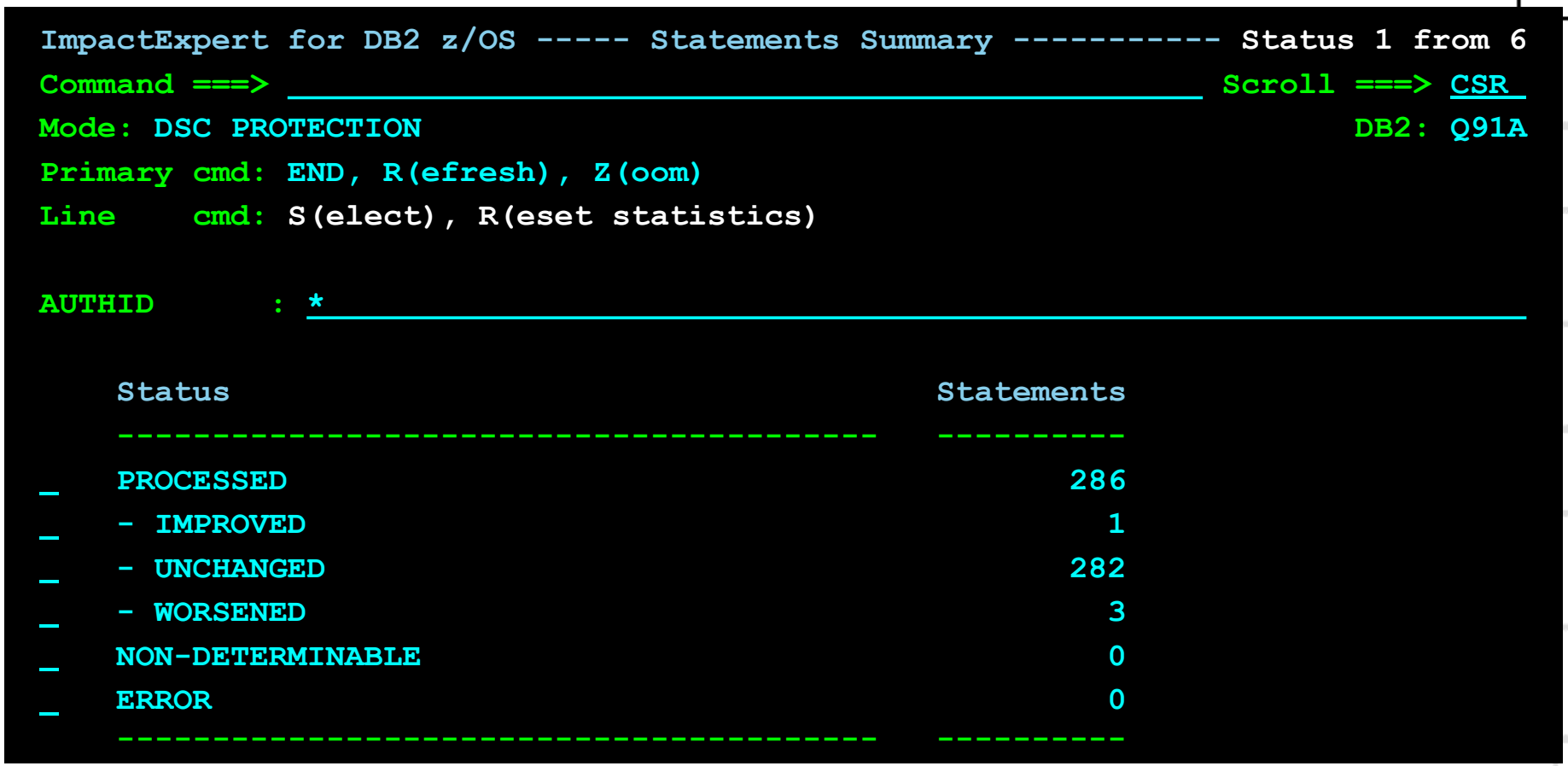
See the possibilities



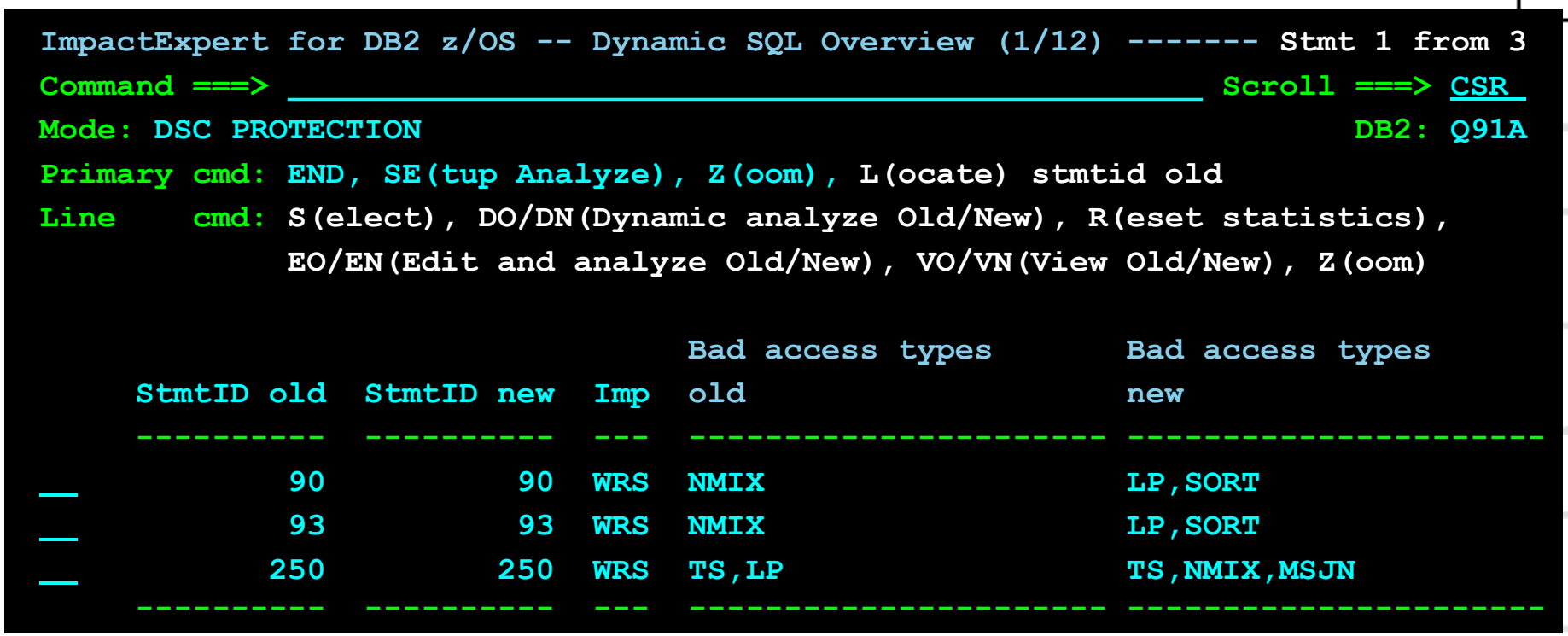
See the possibilities



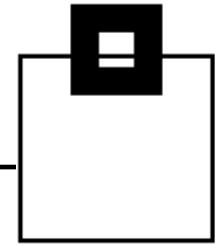
See the possibilities



See the possibilities



See the possibilities

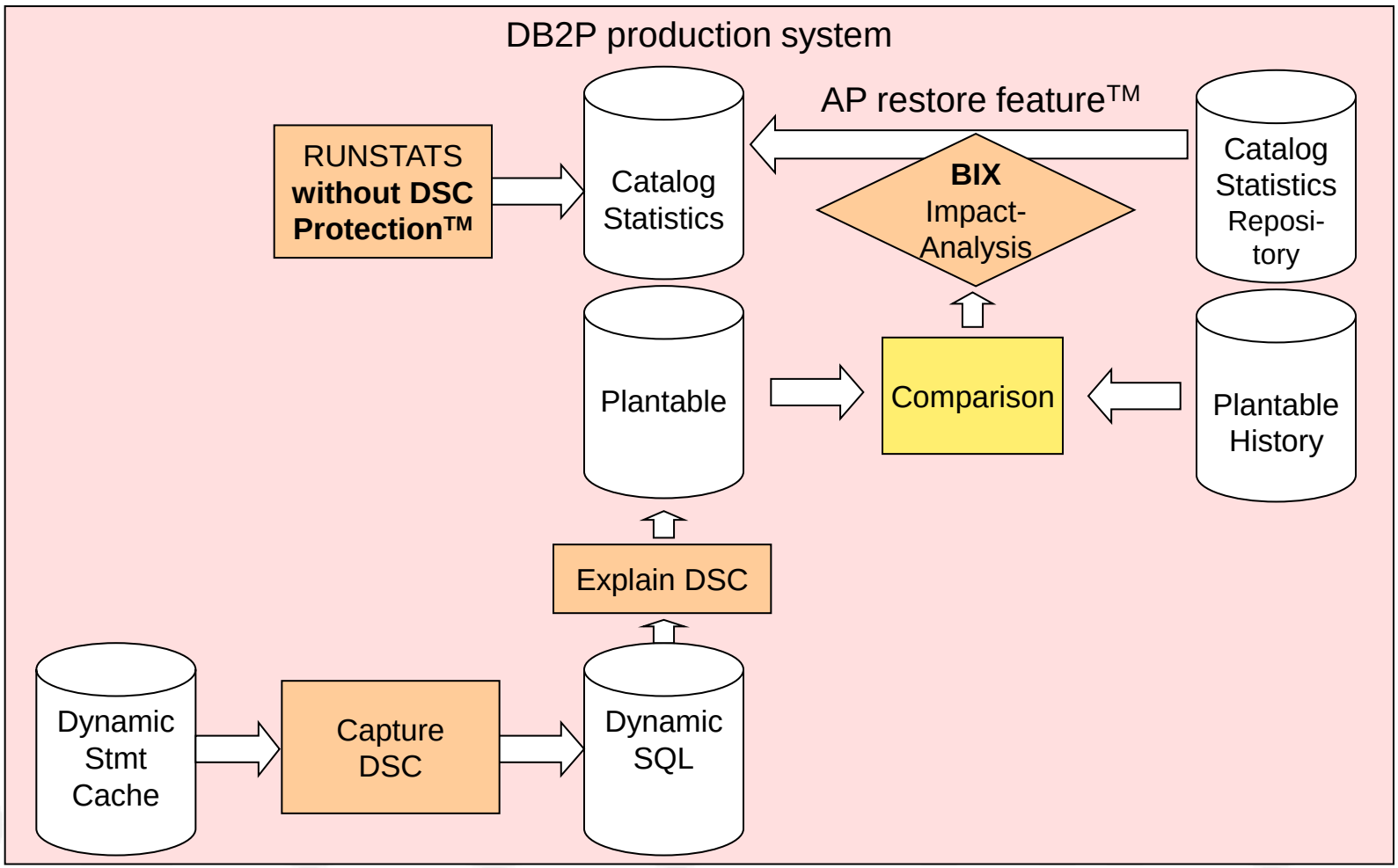


```
ImpactExpert for DB2 z/OS ----- Access Paths ------- LINE 00000001 COL 001 080
Command ===> _____________________________________________ Scroll ===> CSR
Mode: DSC PROTECTION                                          DB2: Q91A
Primary cmd: END, C(atalog data), D(etails on/off), S(tatement text)

RunID old . TEST-TSPCE                 RunID new . TEST-TSPC
Created TS. 2010-07-26-17.51.57.257322 Created TS. 2010-07-26-17.51.57.257322
StmtID old. 93                         StmtID new. 93
ExplainID . 1                          ExplainID . 2

Access path OLD ----------------------| Access path NEW ----------------------
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
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
IQATB003           1  1 I   1      N  | IQATB003           1  1 I   1      N
  IQAXB0031                           |   IQAXB0031
IQATB005           1  2 I   0  1   N  | IQATB005           1  2 I   1  1   N  L
  IQAXB0051                           |   IQAXB0053
IQATH001           1  3 I   2  1   N  | IQATH001           1  3 I   2  1   N
  IQAXH0011                           |   IQAXH0011
                                      |                    1  4     0  3   N
                                      |
Milliseconds:            1            | Milliseconds:            3
Serviceunits:            2            | Serviceunits:            5
```

See the possibilities

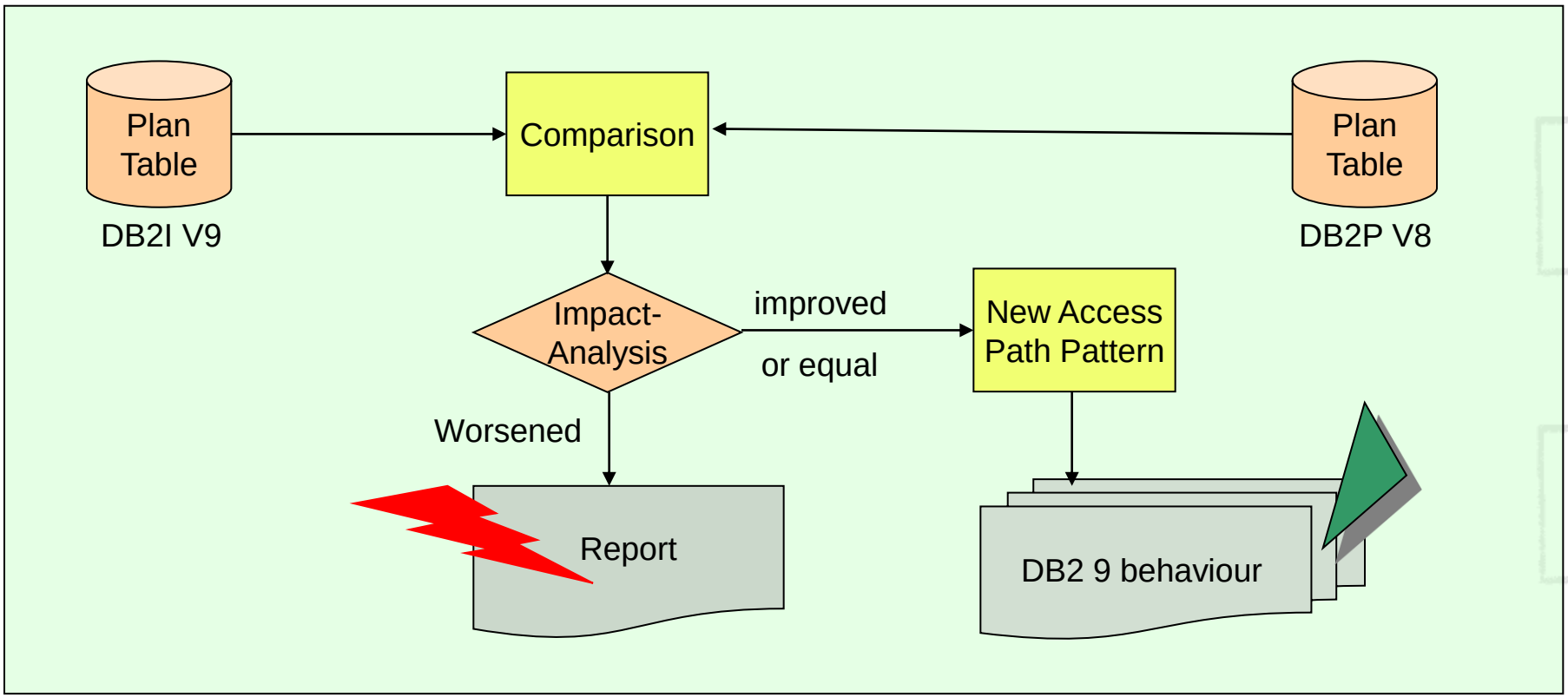
How SEGUS manages dynamic SQL reliably:

Dynamic SQL management and protection: Reactive QA



See the possibilities

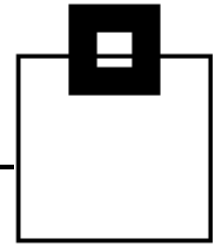
BIX – Version Migration control (**EarlyPrecheck**™)



See the possibilities

What can you expect from **Bind ImpactExpert**:

- Flexibility in developing and running your applications
- Same level of insight & protection like in your static world
- Proactive and/or reactive procedures following your needs
- Cost efficiency in development and operations



Questions?

Roy Boxwell: r.boxwell@seg.de

Ulf Heinrich : u.heinrich@segus.com