Dynamic SQL opened up some great opportunities facing today's dynamic business needs. However, the downside is that dynamic SQL by nature is difficult to manage and to control. Especially in comparison to the capabilities we have for our static world, we lost control! There is no BIND, there is no REBIND and a RUNSTATS invalidates access paths even if it doesn't touch the DB2 catalog. This presentation shows how you get back control of what happens in your environment. You get introduced to the various monitoring options that DB2 already provides out of the box, procedures you can implement to gain the same control and quality that we know from the static world and lots of hands-on tips and tricks that make your life in a dynamic world much easier.

Agenda

Dynamic SQL basics:

- What is the difference to static SQL?
- How to configure DB2 to optimally run dynamic SQL?
- What to take care of during operation?

Dynamic SQL In depth:

- How to manage and exploit the dynamic statement cache (DSC)?
- What are the differences of Dynamic SQL in a Data Sharing environment?

Dynamic SQL basics
-Get an overview about the difference to static SQL
-Learn how to configure DB2 optimal to run dynamic SQL
-Be aware of what to take care of during operation
Dynamic SQL In depth
-Get to know how to manage and exploit the dynamic statement cache (DSC)
-Understand the differences of Dynamic SQL in a Data Sharing Environment

Agenda

Dynamic SQL Best Practices:

- Become an expert on improving dynamic SQL performance
- Learn procedures protecting proven dynamic access paths
- See how you can manage dynamic SQL in a DB2 migration scenario

Tips and Tricks:

- Get an overview about cloning costs considerations
- Be aware of the Do's and Don't's

Dynamic SQL Best Practices
-Become an expert on improving dynamic SQL performance
-Learn procedures protecting proven dynamic access paths
-See how you can manage dynamic SQL in a DB2 migration scenario
Tips and Tricks
-Get an overview about cloning costs considerations
-Be aware of the Do's and Don't's

After you have joined this presentation you'll feel comfortable with dynamic SQL in your shop. You'll know how you can exploit all the benefits of dynamic SQL without losing control - and you'll learn how you can protect your dynamic SQLs performance the same level like you love from your static SQL.

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

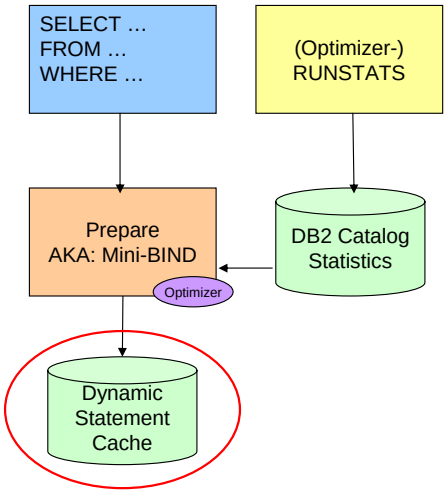
Dynamic SQL at a glance

Characteristics:

IBM Says:
"In general, an application using dynamic SQL has a higher startup (or initial) cost per SQL statement due to the need to compile the SQL statements before using them. Once compiled, the execution time for dynamic SQL compared to static SQL should be equivalent and, in some cases, faster due to better access plans being chosen by the optimizer. Each time a dynamic statement is executed, the initial compilation cost becomes less of a factor. If multiple users are running the same dynamic application with the same statements, only the first application to issue the statement realizes the cost of statement compilation."

DSC at a glance

Characteristics:



- Access Paths for dynamic SQL are determined on the fly and stored in the DSC.
- LRU, RUNSTATS, ALTER, DROP, REVOKE, DB2 RESTART invalidates and flushes the DSC for an object.

In DB2 V5 IBM introduced the DYNAMIC STATEMENT CACHE The idea was to increase efficiency of dynamic SQL
as everyone was afraid of dynamic SQL in those days.

The basics of how the cache works have not changed that much since those days.

Dynamic SQL at a glance

Characteristics:

DB2 can recycle a cached statement if

- The statement is 100% identical
  - Thus Literals usually compromise caching
    → Use parameter markers!
  - Bind rules, Special registers, Authorizations are compatible/same

If this doesn't fit to your application, you may not benefit from the dynamic statement cache at all.

ERP/CRM vendors like SAP use the DSC extensively and fully exploit it

Dynamic SQL at a glance

Characteristics:

The DSC is where dynamic SQL statements, and *only* Dynamic SQL statements, reside once they have been PREPAREd if certain ZPARM and/or BIND options are in use.

The next time the exact same statement is to be PREPAREd the cache is searched and, if all is valid and certain ZPARM and/or BIND options are in use, then the PREPARE is avoided

→ Thus saving **lots** of CPU time.

Ideally an SQL statement should stay in the cache forever, but the real world shows that two days of residency or latency is typical.

Dynamic SQL at a glance

Characteristics:

The DSC is in fact two areas of memory:

- The Local statement cache in the DBM1 space with a FIFO queue
  → gives you a small benefit (PREPARE once across COMMITs)

- The Global statement cache in the EDM Pool above “The Bar” with a sophisticated LRU queue
  → gives you a big benefit (allows to reuse a statement PREPAREd by another thread)

Dynamic SQL at a glance

DB2 Setup and Support:

CACHEDYN->	NO	YES
KEEP DYNAMIC	• 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
NAMSIC	• 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

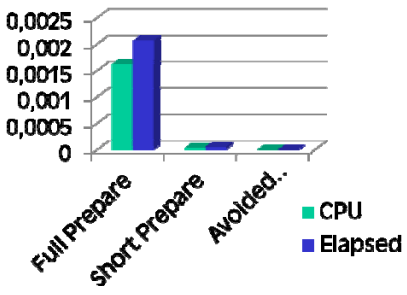
The many flavors of PREPARE:

- Full
  Skeleton copy of the SQL is not in the cache or the cache is not active. Caused by a PREPARE or EXECUTE IMMEDIATE statement.
- Short
  A skeleton copy of the PREPAREd SQL statement is copied to local storage.
- Avoided
  PREPARE avoided by using full caching. PREPAREd statement information is still in thread's local storage.
- Implicit
  Due to limits, such as MAXKEEPD, a PREPARE cannot be avoided and DB2 will issue the PREPARE on behalf of the application.

Dynamic SQL at a glance

DB2 Setup and Support:

- The right setup saves a lot of money
  - Exploit the full flavor of caching
  - MAXKEEPD>0
  - CACHEDYN=YES
  - KEEPDYNAMIC(YES)



Dynamic SQL at a glance

DB2 Setup and Support:

- Turn on the LOCAL and GLOBAL cache!
  - Bind with KEEPDYNAMIC(YES)
  - ZPARM CACHEDYN = YES
  - ZPARM MAXKEEPD >= 5000 (For large SAP start at 8000)
- Enforce the use of QUERYNO in dynamic SQL
  - It is the *only* way to be able to use HINTs
  - It is the *best* way to enable trend analysis
- Try and enforce use of parameter markers where appropriate...
  … as always with DB2 „It depends...“
- Set ZPARM EDMSTMTC to a “good” caching size
- Switch OFF the RLF for dynamic SQL unless you really need it!

Global Cache

Increase Global Cache hit Ratio (hit ratio should be above 80%)

Decrease statement pool storage shortage (statement pool full should always be zero)

Local Cache

Local Cache hit ratio depends on applications bound with keepdynamic=yes

Discarded Statements should always be zero – otherwise increase MAXKEEPD

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, or IBM will make you use it…

DSC ZPARMs through the ages

DSC relevant parameters and what they have been set to or defaulted to over the releases of DB2

Version	MAXKEEPD 0 - 65535	CACHEDYN (Yes/No)	Notes
5	5000	NO	EDMPOOL was the CACHE
6	5000	NO	If CACHEDYN „YES“ then new EDMDSPAC With valid range 1K – 2,097,152K
7	5000	NO	New EDMDSMAX with valid range 0 – 2,097,152K and default 1,048,576K
8	5000	YES	EDMDSPAC and EDMDSMAX removed. New EDMSTMTC with valid range 5,000K – 1,048,576K and new „opaque“ ZPARM CACHEDYN_FREELOCAL valid values 0 or 1 with default 0 (off)
9	5000	YES	CACHEDYN_FREELOCAL default changed to 1 (on) and EDMSTMTC default changed to 56,693K
10	5000	YES	EDMSTMTC default changed to 113,386K

Here it can be seen how keen IBM are on the DSC – The Local cache limit has never changed default but the Global has gone from strength to strength

KEEPDYNAMIC bind option has always been default NO

CACHEDYN_FREELOCAL allows DB2 to free DBM1 belwo the bar storage when it starts to get „high use...and grown to a certain size“ – This is only for local and so of interest for KEEPDYNAMIC(YES) systems

Dynamic SQL at a glance

DB2 Commands and Features:

Apart from the obvious DB2 group restart or IPL any type of RUNSTATS is poison to the DSC!

- RUNSTATS TABLESPACE will delete any statements that use any object within the TABLESPACE regardless of any TABLE (xxx.yyy) syntax.
- RUNSTATS INDEX will delete statements that use that index.

REOPT causes re-optimization of an access path

- ALWAYS → creates a fresh AP at each execution (no caching!)
- ONCE → creates AP at first execution and stores it in the DSC
- AUTO → DB2 decides whether a new AP is beneficial based on the parameter values
  - (Should) combine the advantages of REOPT(ALWAYS) and REOPT(ONCE)

Use of REOPT(ONCE) in DB2 V8

This is a very interesting addition to DB2 V8 as it enables DB2 to do its dynamic SQL mini-bind only once. This can be very good for performance… or not…

If you are a SAP customer then the change that SAP did in ecc5 to use the REOPT(ONCE) could be a CPU killer! The problem is that the first run SQL might not actually reflect the normal SQL that is executed over the day.

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!

See the possibilities

How to exploit dynamic SQL successfully:

The DSC gives you insight:

- Memory resident storage of prepared dynamic SQL statements
- SQL text
- Statement ID
- Date/time, current status
- Resource consumption

→ Start IFCID traces 316, 317 (318) to access the data

…once the data is gathered, decide on what you want to analyze…

See the possibilities

How to exploit dynamic SQL successfully:

...if you want/need to see everything:

EXPLAIN STMTCACHE ALL

- Externalizes all statements in the dynamic statement cache
  - <current sqlid>. DSN_STATEMENT_CACHE _TABLE
  - one row for each cached statement
- Uses LOBs (STMT_TEXT is a 2M CLOB so be careful with that)
- Needs to run against all members in a data sharing environment

  → The data externalized is mostly identical to IFCID 316, 317

See the possbilities

How to exploit dynamic SQL successfully:
...if you want/need to see details on a single statement:

EXPLAIN STMTCACHE STMTID

- Externalizes more details on the specified statement ID
  - The ID is an integer that uniquely identifies a statement in the dynamic statement cache.
  - E.g. from DSN_STATEMENT_CACHE_TABLE STMT_ID column
  - E.g. through IFI monitor facilities from IFCID 316 or 124
  - E.g. from diagnostic IFCID trace records such as 172, 196, and 337.
- Inserts data into PLAN, DSN_DYNAMIC_STATEMNT, DSN_STATEMENT, and DSN_FUNCTION tables

See the possbilities

How to exploit dynamic SQL successfully:

...if you want/need to see details on a group of statements:

EXPLAIN STMTCACHE STMTTOKEN

- Externalizes more details on all cached statements associated with the specified token
- STMTTOKEN has to be set by the application program
  - RRSAF SET_ID
  - sqleseti API

- Inserts data into PLAN, DSN_DYNAMIC_STATEMNT, DSN_STATEMENT, and DSN_FUNCTION tables

See the possibilities

```
Analyze for DB2 z/OS --- Dynamic Statement Cache (1/8) -- Statement 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

```
Analyze for DB2 z/OS --- Dynamic Statement Cache (4/8) -- Statement 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

```
Analyze for DB2 z/OS --- Dynamic Statement Cache (6/8) -- Statement 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

How to manage dynamic SQL reliably:

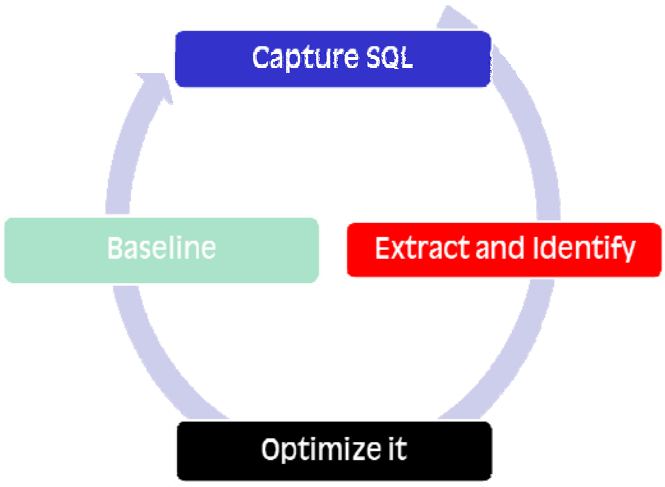
Dynamic SQL can be managed …. but it takes some work:

- Analyze dynamic SQL now and over time
- Tune dynamic SQL now and over time

- Keep it simple and do it the familiar way – like your static
  - Find the candidates
  - Analyze and understand it
  - Optimize it
  - Create a baseline to understand trends and changes

See the possibilities

How to manage dynamic SQL reliably:



See the possibilities

How to manage dynamic SQL reliably:

Step 1 – Find the candidates:

Capture SQL

DSC Capture:
- ❑ Online extraction
- ❑ Batch extraction

Threshold based SQL extract and SQL filtering

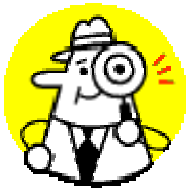
Sort statements by
CPU utilization, frequency, timestamps

See the possibilities

How to manage dynamic SQL reliably:

Step 1 – Find the candidates:

- Keep in mind, there are no DBRMs, packages, (source code)
  - → Use your DB2 monitor
  - → Grab the data from the DSC



- Find a starting point
  - → E.g. get the top ten bad ones
  - → Sort statements by
    - CPU utilization
    - Execution frequency
    - Timestamp

See the possibilities

```
Analyze 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

```
Analyze for DB2 z/OS ----- Filter Dynamic Statement Cache --------------------
Command ===> _____________________________________________________ DB2: Q91A

Primary cmd: END

FIRST TABLE : ____________________________________________________________
CREATOR       ____________________________________________________________

FIRST TABLE : ____________________________________________________________
NAME          ____________________________________________________________

QUALIFIER   : ____________________________________________________________

PRIMARY     : ____________________________________________________________
AUTHID        ____________________________________________________________

SELECT  X     CURRENT USERS   between _________ and _________ (Integer)
INSERT  X     STMT COUNT      between _________ and _________ (Integer)
UPDATE  X     AVG CPU TIME    between _________ and _________ (MM:SS.TTT)
DELETE  X     AVG ELAPSE TIME between _________ and _________ (MM:SS.TTT)
              AVG GETPAGES    between _________ and _________ (Integer)
Total stmts         104
OUTPUT LIMIT:     10000   0 - 25000 Max number of statements to be displayed
```

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
…			

SQL Aggregation is the ability to set four different levels of “sameness of SQL” which the tool will then check and aggregate the SQl accordingly. Here you can see that the SQL is effectively the same as the only difference is the COL value. Now of course depending on your statistics and your host variable definition the access paths could be the same or different the aggregation feature is just “another arrow in the quiver” to enable you to see the DSC in a different possibly very interesting light

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

How to manage dynamic SQL reliably:

Step 2 – Analyze and understand it:

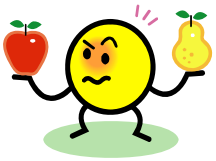
- Extract and Identify
  - Sort statements by CPU utilization, frequency, timestamps
  - Identify bad statements with dynamic explain

See the possibilities

How to manage dynamic SQL reliably:

- Step 2 – Analyze and understand it:
  - Run EXPLAIN STMTCACHE STMTID
    - SQLCODE -20248 if statement no longer exists in the cache
  - Match the column STMT_TOKEN in your PLAN_TABLE to the statement token of the statement
  - COLLID Column contains “DSNDYNAMICSQLCACHE”
  - Consider **all** the relevant factors
    - Schema
    - Object maintenance status
    - Statistics
    - SQL

See the possibilities



How to manage dynamic SQL reliably:

Step 2 – Analyze and understand it:

Match all information:

PLAN_TABLE	DSN_STATEMENT_CACHE_TABLE	
QUERYNO	STMT_ID	- Statement Identifier
STMT_TOKEN	STMT_TOKEN	- Identification Token
COLLID	COLLID	-“DSNDYNAMICSQLCACHE“
BIND_TIME	CACHED_TS	- Cache TS of the stmt

See the possibilities

```
Analyze 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

```
Analyze for DB2 z/OS ----- Index Overview -------------------- Index 1 from 3
Command ===> _____________________________________________ Scroll ===> CSR
                                                            DB2: Q91A
Primary cmd: END, CAN(cel), SE(tup), Z(oom), L(ocate) creator
Line    cmd: C(olumns), D(atabase), K(PacKages), P(artitions), T(able), Z(oom)

    IX Creator  IX Name              Created by  Created timestamp
    TB Creator  TB Name              Database    Statstime
                                     Indexspace
    ------------------------------------------------------------------------
_   SYSIBM      DSNDTX01             SYSIBM      0001-01-01-00.00.00.000000
    SYSIBM      SYSTABLES            DSNDB06     0001-01-01-00.00.00.000000
                                     DSNDTX01
    ------------------------------------------------------------------------
_   SYSIBM      DSNDTX02             SYSIBM      0001-01-01-00.00.00.000000
    SYSIBM      SYSTABLES            DSNDB06     0001-01-01-00.00.00.000000
                                     DSNDTX02
    ------------------------------------------------------------------------
_   SYSIBM      DSNDTX03             SYSIBM      2003-09-21-23.27.05.275288
    SYSIBM      SYSTABLES            DSNDB06     0001-01-01-00.00.00.000000
                                     DSNDTX03
    ------------------------------------------------------------------------
```

See the possibilities

How to manage dynamic SQL reliably:

Step 3 – Optimize it:

Optimize it

Apply rules based system to identify SQL problems
- ❑ Online
- ❑ Batch for mass analysis

Dynamically Explain SQL Statement

See the possibilities

How to manage dynamic SQL reliably:
Step 3 – Optimize it:

- Apply the traditional SQL tuning practices
  - Add or adjust indexes
  - Run REORG to improve index or tablespace processing
  - Run RUNSTATS to update catalog statistics
  - Improve the query (or talk to your application vendor)

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 to manage dynamic SQL reliably:

Step 4 – Create a Baseline

Baseline

- Store plan table entry for dynamic SQL statement
- Apply the way of analysis of static SQL
- Do comparison over time, to speed up statement analysis
- Match SQL statement across application version

See the possibilities

How to manage dynamic SQL reliably:

- Step 4 – 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

See the possibilities

How to manage dynamic SQL reliably:

- Dynamic SQL management and protection:
- Protecting your production environment from unforeseen performance degradations requires quality assurance.
- A trend analysis system 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
      - ANY RUNSTATS INVALIDATES THE AP IN THE DSC INCLUDING

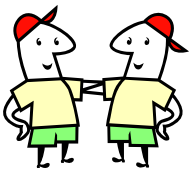
        RUNSTATS UPDATE(NONE)
        HISTORY(NO)
        REPORT(NO)

See the possbilities

How to manage dynamic SQL reliably:

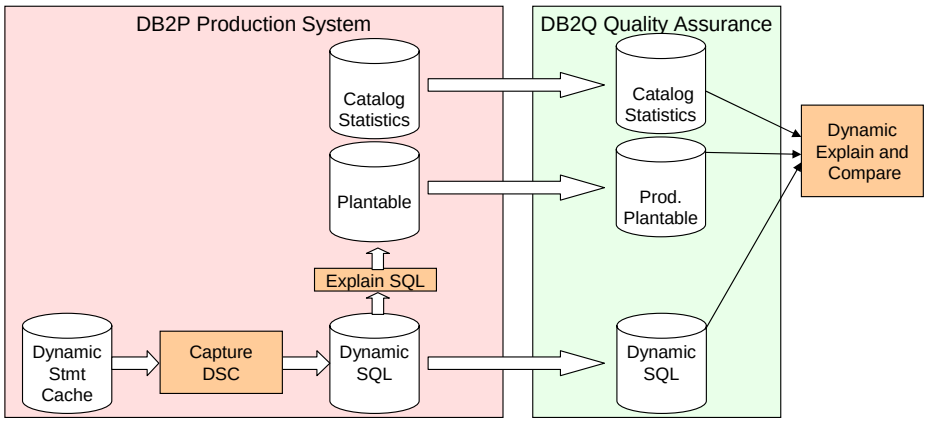
- Dynamic SQL management and protection: setting up QA
  - DB2P: Production
    - Take a snapshot of the Dynamic Statement Cache
    - Explain of all captured statements to central PLAN_TABLE
  - DB2Q: Quality Assurance
    - Homogeneous System Copy (or Catalog Statistics) of DB2P
    - Import the snapshot of the Dynamic Statement Cache
    - Explain all statements (needed)
    - Compare original and new

    → Allows to pre-check in a QA environment



See the possibilities

How to manage dynamic SQL reliably:
Dynamic SQL management and protection: setting up QA



See the possibilities

```
ImpactExpert for DB2 z/OS ----- Comparison --------- LINE 00000001 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

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
- - - - - - - - - - - - - - - - - - - - ! - - - - - - - - - - - - - - - - - - -
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
-------------------------------------------------------------------------------
```

Verify the access path changes

See the possibilities

How to manage dynamic SQL reliably:

- If you have difficulties finding the initiator of performance problems:
  - Often dynamic SQL gets executed by an application server/common authorization ID
  - Middleware usually connects to DB2 using common authorization/RACF ID
  - The IP address may only show your DB2 Connect gateway
  - User requires access to all objects (there is no package execution)

  → Identifying the user performing a dynamic SQL can be challenging

See the possibilities

- Since DB2 V8 there are client identification registers
  - CURRENT CLIENT_USERID
  - CURRENT CLIENT_WRKSTNNAME
  - CURRENT CLIENT_APPLNAME
  - CURRENT CLIENT_ACCTNG

See the possibilities

How to manage dynamic SQL reliably:

- DRDA Applications can use EXCSQLSET
  - SET CLIENT USERID „userid”
  - SET CLIENT WRKSTNNAME „wrkstn‟
  - SET CLIENT APPLNAME „applname”
  - SET CLIENT ACCTNG „accounting‟

- Web Application Server provides –setClientInformation API
  - WSConnection.CLIENT_ID
  - WSConnection.CLIENT_LOCATION
  - WSConnection.CLIENT_APPLICATION_NAM
  - WSConnection.CLIENT_ACCOUNTING_INFO

See the possibilities

Conclusion:

- Dynamic SQL is more difficult to manage than static SQL
- Using the Dynamic Statement Cache can be a performance boost
- Access paths can get lost without changing anything
- Well known QA procedures for static SQL fit for dynamic SQL, but require adjustments
- Protecting dynamic environments is *just* more complex
- Security and authorization for dynamic SQL requires special considerations and adjustments

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


IDUG
The Worldwide
DB2 User Community
DB2 Tech Conference | Prague, Czech Republic
Ulf Heinrich
SEGUS
u.heinrich@segus.com
Session E12
Can I control a dynamic world?
Dynamic SQL Management for
DB2 z/OS