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Plan Stability

How to Get Creative with SQL Plan Management and SQL Profiles (and SQL Patch)
DOAG 2017 Datenbank - Düsseldorf

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Optimizer Product Manager

ORACLE

Why Control Execution Plans?

- Get better plans without changing application code
- Reduce MTTR
- Discover better SQL execution plans
  - Proactively with SQL tuning advisor and SQL profiles
  - Strategically with SQL plan management *evolution*
- Avoid query performance regression altogether

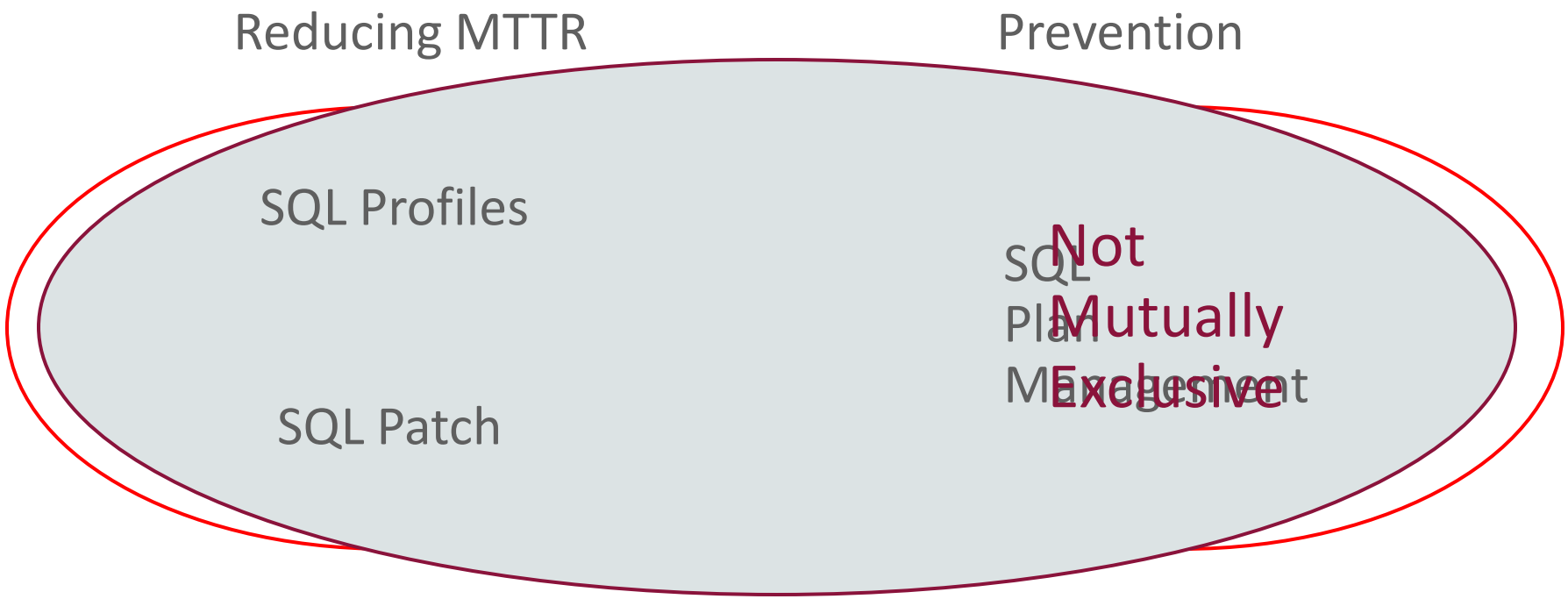
Common Questions

- Why do SQL execution plans change?
- How do I prevent execution plans from changing?
- What's the difference between SQL profiles and SQL plan baselines?
- How can I keep my SQL profiles relevant over time?
- What if I want to use SQL profiles *and* SQL plan baselines?
- Is SQL plan management practical in my environment?

Features for Controlling Execution Plans

- SQL Profiles
  - DBMS_SQLTUNE
- SQL Plan Management
  - DBMS_SPM
- SQL Patch
  - DBMS_SQLDIAG_INTERNAL
  - DBMS_SQLDIAG (Oracle Database 12c Release 2)
- Stored Outlines
  - Deprecated in Oracle Database 11g Release 1

Resolving and Preventing Issues



SQL Patch

Use SQL Patch to Hint SQL Statements

- https://blogs.oracle.com/optimizer/entry/how_can_i_hint_a

```
select num
from   tab1
where  id = 10;
```

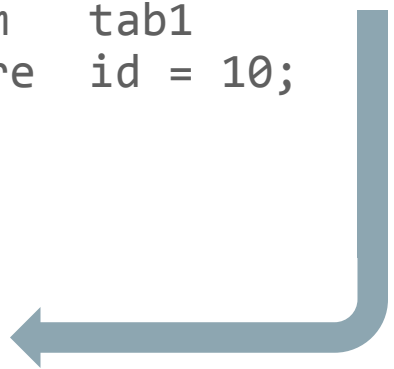
```
select /*+ FULL(tab1) */ num
from   tab1
where  id = 10;
```

Apply hints to a SQL statement using SQL Patch

sys.dbms_sqldiag_internal.i_create_patch

```
declare
   v_sql CLOB;
begin
   select sql_fulltext
   into   v_sql
   from   v$sqlarea
   where  sql_id='37090abayamah';

   sys.dbms_sqldiag_internal.i_create_patch(
      sql_text  =>v_sql,
      hint_text =>'FULL(@"SEL$1" "TAB1"@"SEL$1")',
      name      =>'q0_patch');
end;
/
```

```
select /*+ FULL(tab1) */ num
from   tab1
where  id = 10;
```



Apply hints to a SQL statement using SQL Patch

```
select /*+ FULL(tab1) */ num
from   tab1
where  id = 10;

SELECT * FROM table(DBMS_XPLAN.DISPLAY_CURSOR(FORMAT=>'OUTLINE'))

  /*+
      BEGIN_OUTLINE_DATA
      IGNORE_OPTIM_EMBEDDED_HINTS
      ...
      FULL(@"SEL$1" "TAB1"@"SEL$1")
      ...
      END_OUTLINE_DATA
  */
```

What if we want to disable hints for a SQL statement?

```
select /*+ USE_HASH(tab1 tab2) */
       sum(num)
from   tab1
where  id in
(select id
 from   tab2
 where  ty = 'T10');
```

(c) Real World Performance Group ☺

A Hint that Disables Hints

```
select /*+ USE_HASH(tab1 tab2) */
       sum(num)
from   tab1
where  id in
(select id
 from   tab2
 where  ty = 'T10');
```

```
declare
   v_sql CLOB;
begin
   select sql_fulltext
   into   v_sql
   from   v$sqlarea
   where  sql_id='bdrzvmxvcju4y';

   sys.dbms_sqldiag_internal.i_create_patch(
      sql_text  =>v_sql,
      hint_text =>'IGNORE_OPTIM_EMBEDDED_HINTS',
      name      =>'q1_patch');
end;
/
```

(c) Real World Performance Group ☺

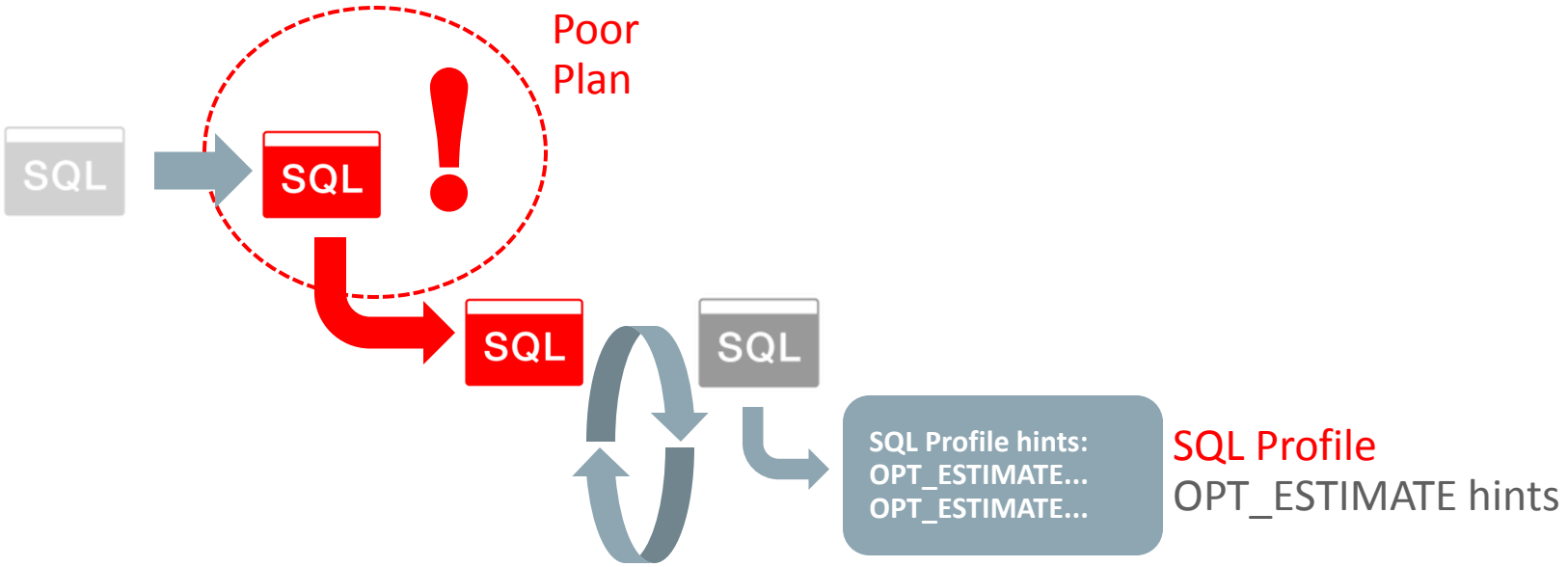
SQL Patch – Public Interface in Oracle Database 12c Release 2

- Prior to Oracle Database 12c Release 2
  - SQL patch API has limited utility because HINT_TEXT is VARCHAR2
- Beginning with Oracle Database 12c Release 2
  - Procedure becomes a function
  - HINT_TEXT is CLOB
  - **CREATE_SQL_PATCH** is new to public API: DBMS_SQLDIAG
  - New SQL_ID parameter as well as SQL_TEXT
- Patch #17203284 available for Oracle Database 12.1.0.2

```
patch_name:= dbms_sqldiag.create_sql_patch(
             sql_id    => 'wn8qqwkgarr65',
             hint_text => 'IGNORE_OPTIM_EMBEDDED_HINTS',
             name      => 'ignore_hint_patch');
```

SQL Profiles

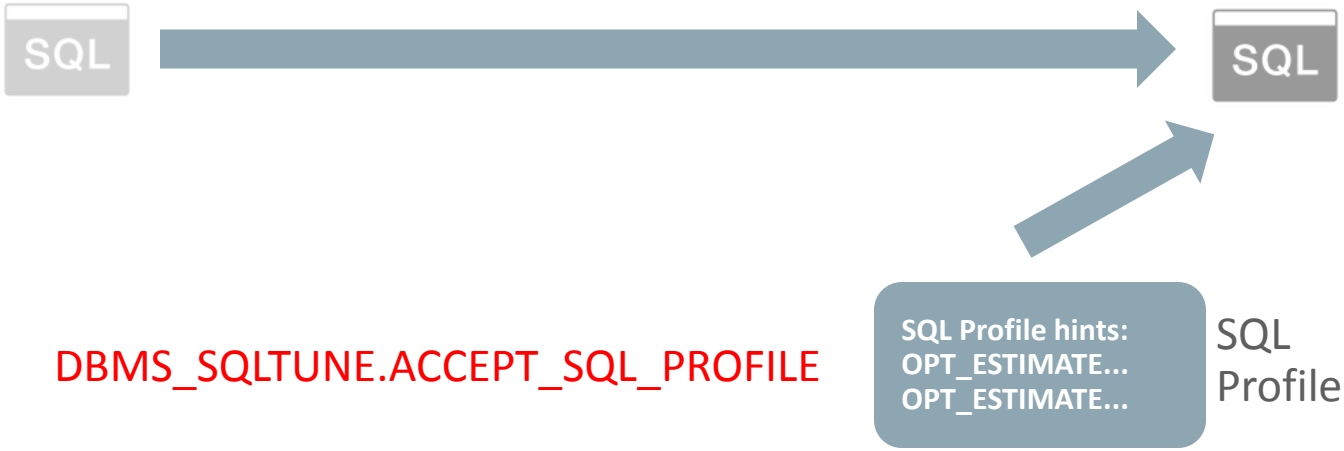
SQL Profile Example Flow



DBMS_SQLTUNE.CREATE_TUNING_TASK

SQL Tuning Advisor rest executes the query and finds a better plan

SQL Profile Example Flow



What Does a SQL Profile Look Like?

```
SELECT  extractValue(value(h),'.') AS hint
FROM    DBMSHSXP_SQL_PROFILE_ATTR dspa,
        TABLE(xmlsequence(
          extract(xmltype(dspa.comp_data),'/outline_data/hint'))) h
where   dspa.profile_name = 'SYS_SQLPROF_015a039fbe670000';


HINT
-----------------------------------------------
OPT_ESTIMATE(@"SEL$1", TABLE, "ORDERS"@"SEL$1", SCALE_ROWS=9.426849516e-06)
OPT_ESTIMATE(@"SEL$1", INDEX_SCAN, "ORDERS"@"SEL$1", "ORDERS_SHIPPED_IDX", SCALE_ROWS=6.042852254e-06)
OPTIMIZER_FEATURES_ENABLE(default)
```

SQL Profiles

What about a longer-term solution?

- The **OPT_ESTIMATE** adjustments may not be appropriate "forever"
- SQL tuning advisor is a good way to find better SQL execution plans, but the cardinality adjustments don't guarantee a plan in the long term
  - Data volume and data distribution might change
  - The physical database schema might change (e.g. adding and removing indexes)

SQL Profiles

- It is possible to FORCE match queries with literals to use a SQL profile
  - DBMS_SQLTUNE.ACCEPT_SQL_PROFILE (… force_match=>TRUE …)
- There are export/import tricks to apply arbitrary hints to SQL statements. See, for example:
  - Kerry Osborne
  - Randolf Geist

SQL Plan Management

SQL Plan Management - Terminology

"Repeatable" SQL Statement

```
SELECT a.data,
       b.data
FROM   tab1 a
JOIN tab2 b ON
        b.tab1_id = a.id
WHERE  a.code = :1
```

CURSOR_SHARING=FORCE works too

A signature is a unique SQL identifier generated from the normalized SQL text (uncased and with whitespaces removed).

Eg: **3578512732271849948**

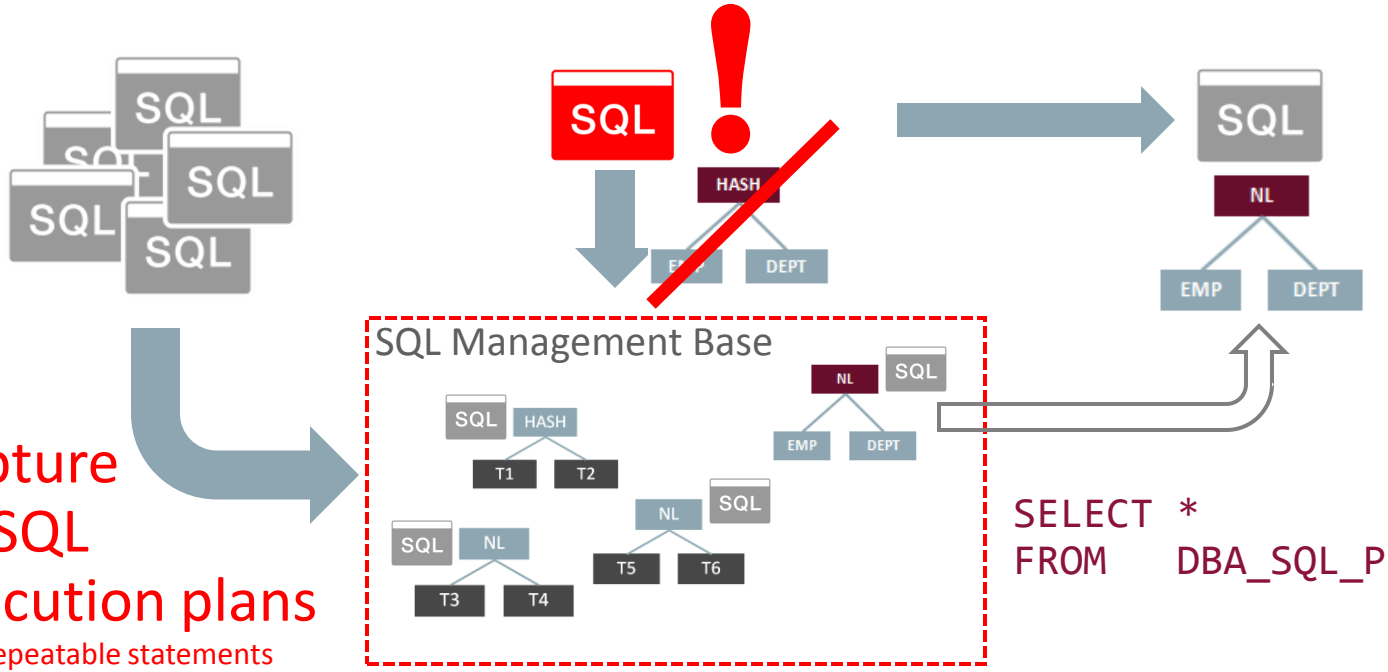
Used by SQL profiles too

```
SELECT a.data,
       b.data
FROM   TAB1 a
JOIN tab2 b
  ON b.tab1_id = a.id
WHERE  a.code = :1
```

```
select a.data,
       b.data
from   tab1 a
join   tab2 b
 on    b.tab1_id = a.id
where  a.code = :1
```

Prevent Query Regression

An automated, strategic approach



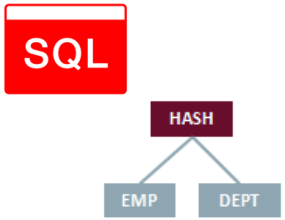
Capture *all* SQL execution plans

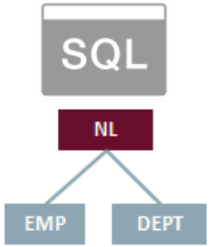
...for repeatable statements

```
SELECT *
FROM   DBA_SQL_PLAN_BASELINES;
```

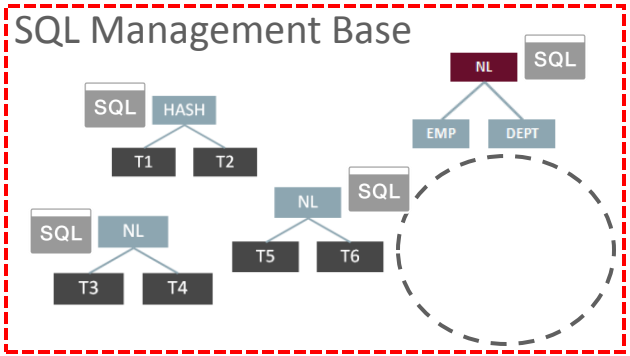
Prevent Query Regression

Validating new SQL execution plans automatically





Capture Everything!

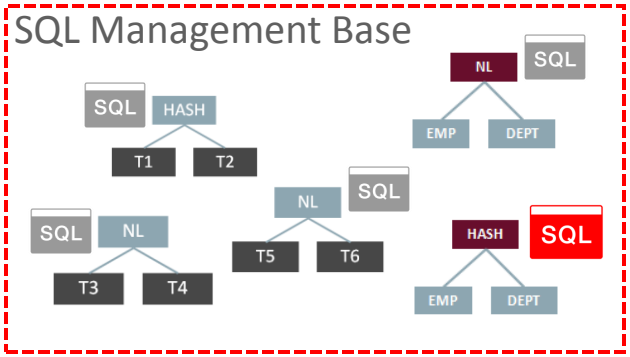


Is this plan better?

Evolve

Prevent Query Regression

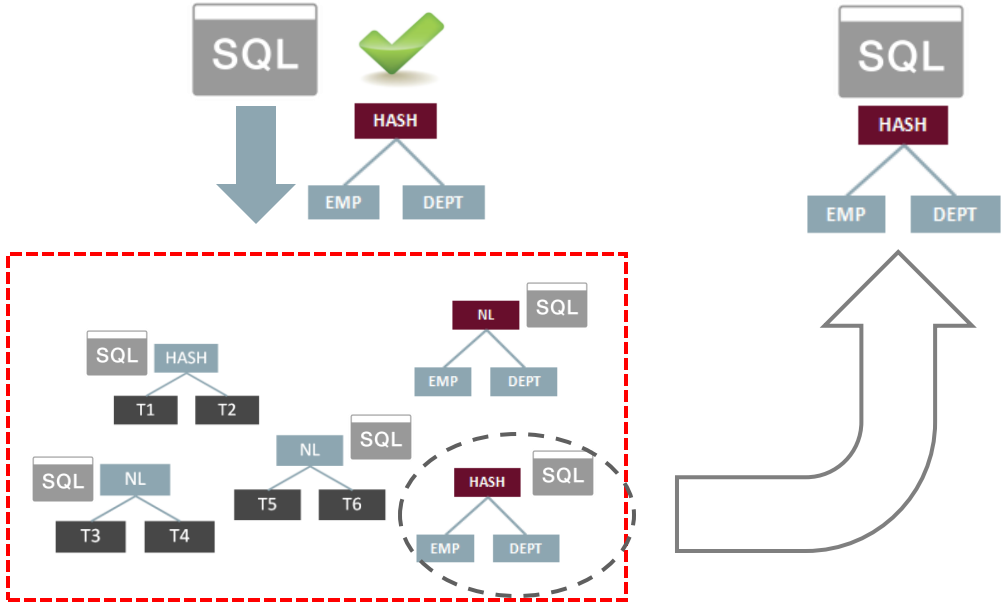
Validating new SQL execution plans automatically




```
DBMS_SPM.EVOLVE_SQL_PLAN_BASELINE();

DBMS_SPM.EXECUTE_EVOLVE_TASK();
```

Prevent Query Regression

Use the improved SQL execution plan



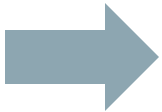
What Does a SQL Plan Baseline Look Like?

```
select plan_table_output
from   table(dbms_xplan.display_sql_plan_baseline('SQL_6c0757fcfdf7ec80','SQL_PLAN_6s1urzmyzgv402db27268'));

Plan hash value: 358968005

-----------------------------------------------------------------------------------------------
| Id  | Operation                             | Name  | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                      |       |       |       |     2 (100)|          |
|   1 |  SORT AGGREGATE                       |       |     1 |     9 |     0   (0)|          |
|   2 |   TABLE ACCESS BY INDEX ROWID BATCHED| SALES |     1 |     9 |     2   (0)| 00:00:01 |
|*  3 |    INDEX RANGE SCAN                   | SI    |     1 |       |     1   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------------
```

What Does a SQL Plan Baseline *Really* Look Like?

```
SELECT  extractValue(value(h),'.') AS hint
FROM    sys.sqlobj$plan od,
        TABLE(xmlsequence(
          extract(xmltype(od.other_xml),'/*/outline_data/hint'))) h
WHERE   od.other_xml is not null
AND     (signature,category,obj_type,plan_id) = (select signature,
                                                        category,
                                                        obj_type,
                                                        plan_id
                                                from    sys.sqlobj$ so
                                                where   so.name = 'SQL_PLAN_6s1urzmyzgv402db27268');
```

```
IGNORE_OPTIM_EMBEDDED_HINTS
OPTIMIZER_FEATURES_ENABLE('12.1.0.2')
DB_VERSION('12.1.0.2')
ALL_ROWS
OUTLINE_LEAF(@"SEL$1")
INDEX_RS_ASC(@"SEL$1" "SALES"@"SEL$1" ("SALES"."ID"))
BATCH_TABLE_ACCESS_BY_ROWID(@"SEL$1" "SALES"@"SEL$1")
```



```
-----------------------------------------------------
| Id  | Operation                          | Name  |
-----------------------------------------------------
|   0 | SELECT STATEMENT                   |       |
|   1 |  SORT AGGREGATE                    |       |
|   2 |   TABLE ACCESS BY INDEX ROWID BATCHED| SALES |
|*  3 |    INDEX RANGE SCAN                | SI    |
-----------------------------------------------------
```

Capture "Everything"

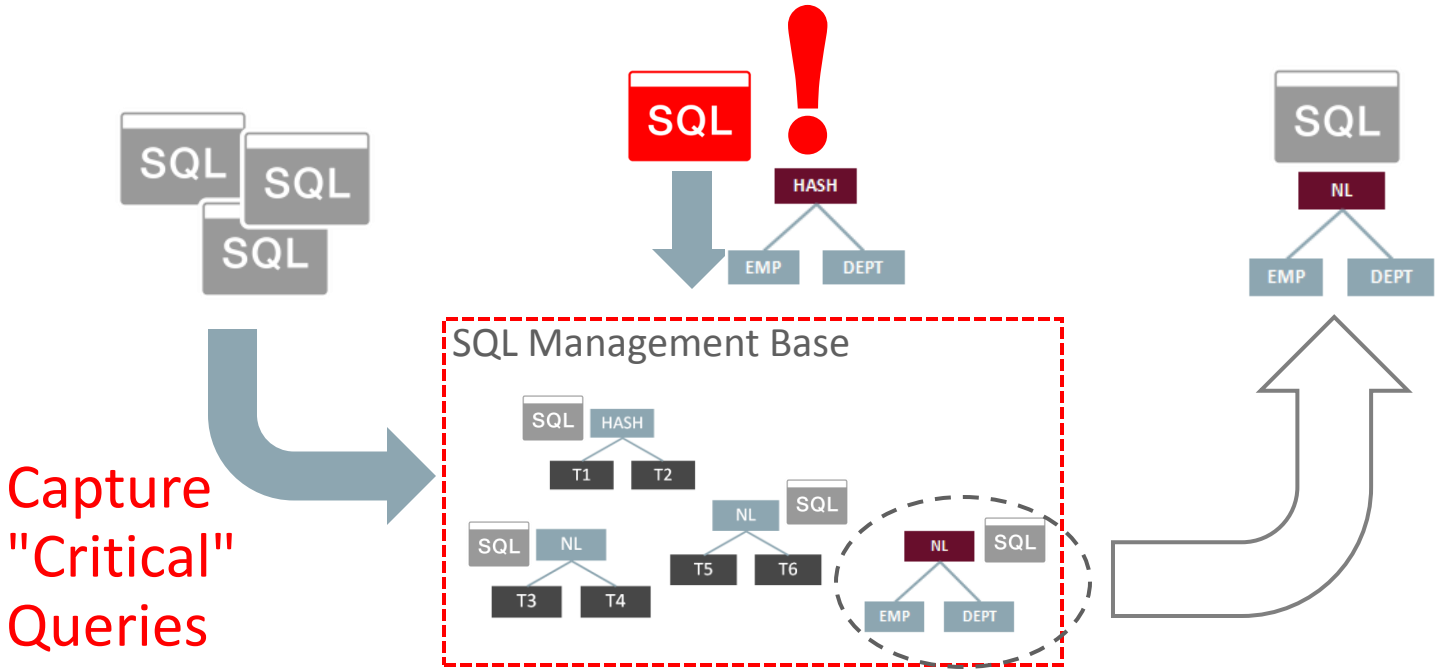
- Capture repeatable SQL statements:
  - `optimizer_capture_sql_plan_baselines=TRUE`
  - Filter is available in Oracle Database 12c Release 2
    - SQL Text, Parsing Schema, Module, Action
- Periodically capture everything from the cursor cache
  - Repeat:
    - `dbms_spm.load_plans_from_cursor_cache(enabled=>'YES');`
  - Filter has been available since Oracle Database 11g
  - Duplicates are not stored

Other Capture Sources

- From SQL tuning sets
  - Filtering is very easy
- From AWR repository in Oracle Database 12c Release 2
  - Between start and end snapshots

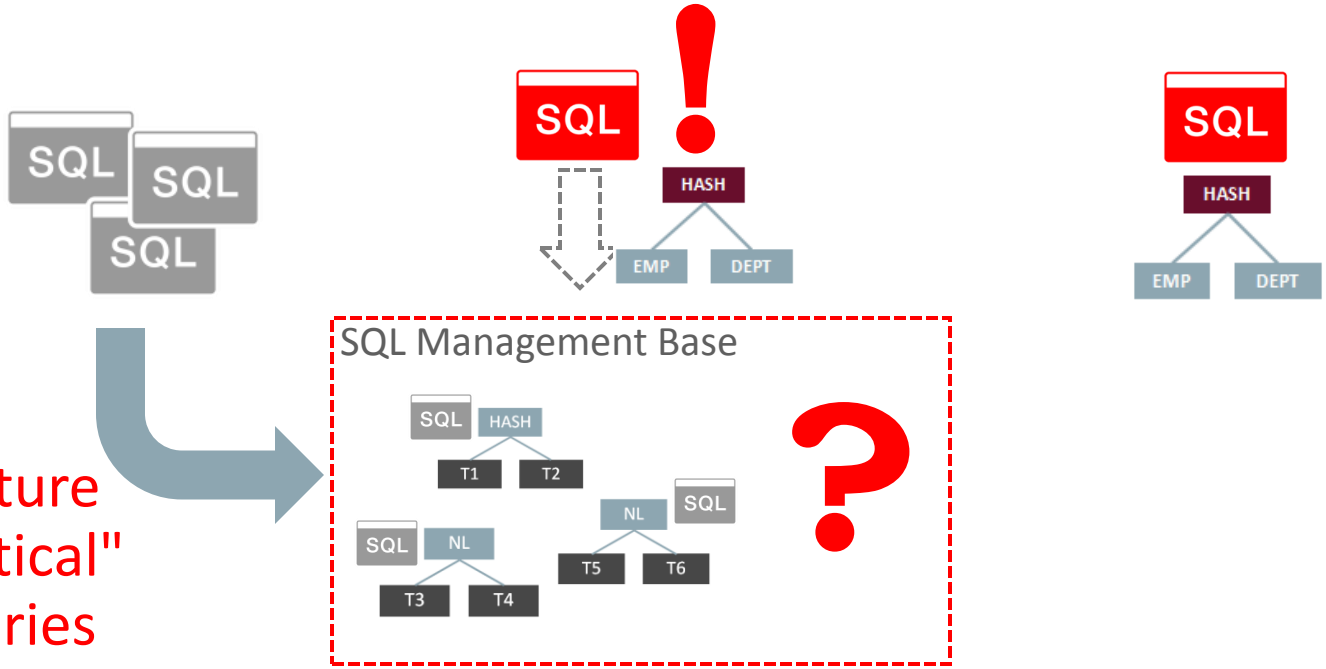
A Tactical Approach

Capture a subset of queries



Tactical Approach

Regression is still possible



Creative Capture

For example: tactical capture

```
for rec in (select sql_id
            from   v$sqlarea
            where  executions > 10000
            and    parsing_schema_name not in ('SYS','SYSTEM'))
loop
   ret := dbms_spm.load_plans_from_cursor_cache(
               sql_id   => rec.sql_id,
               enabled  => 'YES');
end loop;
```

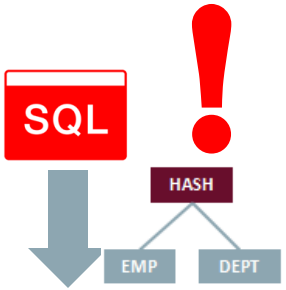
Creative Capture

You can choose to enable SQL plan baselines later

```
for rec in (select sql_id
            from   v$sqlarea
            where  executions > 10000
            and    parsing_schema_name not in ('SYS','SYSTEM'))
loop
   ret := dbms_spm.load_plans_from_cursor_cache(
               sql_id=>rec.sql_id,
               enabled=>'NO');
end loop;
```

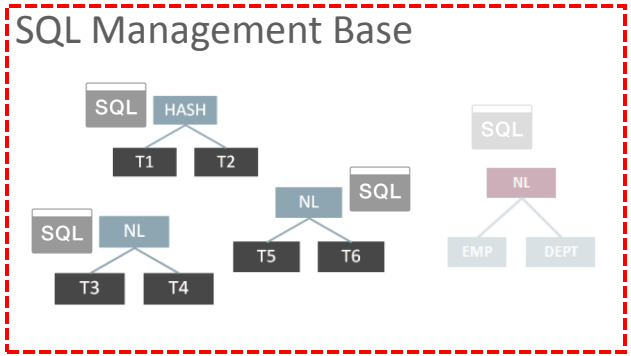
Tactical Approach

Maybe a better plan is already available but not enabled



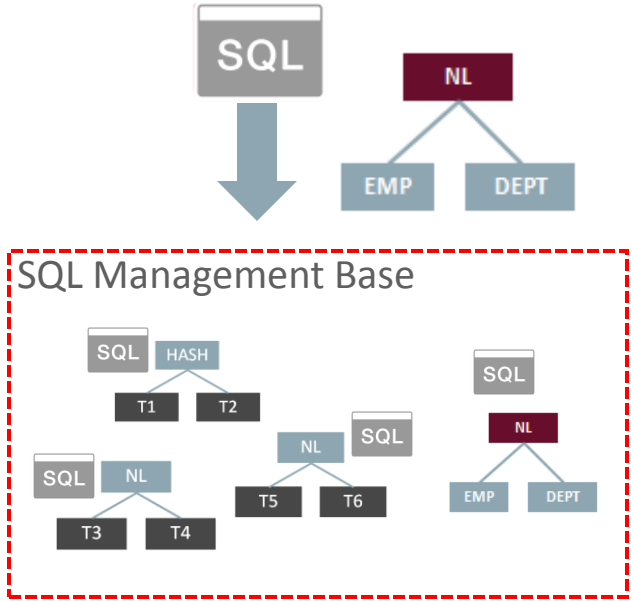
SQL plan baselines don't *have to* be enabled immediately:

```
dbms_spm.load_plans_from_cursor_cache(...
                                enabled=>'NO');
```



Tactical Approach

Enable it – low MTTR




```
dbms_spm.alter_sql_plan_baseline(
        ...
        attribute_name  =>'enabled',
        attribute_value =>'YES');
```

Automation in Oracle Database 12c

Controlling SPM evolution

```
SELECT PARAMETER_NAME, PARAMETER_VALUE AS VALUE
FROM   DBA_ADVISOR_PARAMETERS WHERE
( (TASK_NAME = 'SYS_AUTO_SPM_EVOLVE_TASK') AND
( (PARAMETER_NAME = 'ACCEPT_PLANS') OR
  (PARAMETER_NAME = 'TIME_LIMIT') ) );


PARAMETER_NAME            VALUE
------------------------- ----------
ACCEPT_PLANS              TRUE
TIME_LIMIT                3600

BEGIN
   DBMS_AUTO_TASK_ADMIN.ENABLE (
   client_name => 'sql tuning advisor‘
   ,   operation   => NULL
   ,   window_name => NULL);
END;
```

```
BEGIN
   DBMS_SPM.SET_EVOLVE_TASK_PARAMETER(
      task_name => 'SYS_AUTO_SPM_EVOLVE_TASK' ,
      parameter => 'ACCEPT_PLANS',
      value => 'FALSE');
END;
/
```

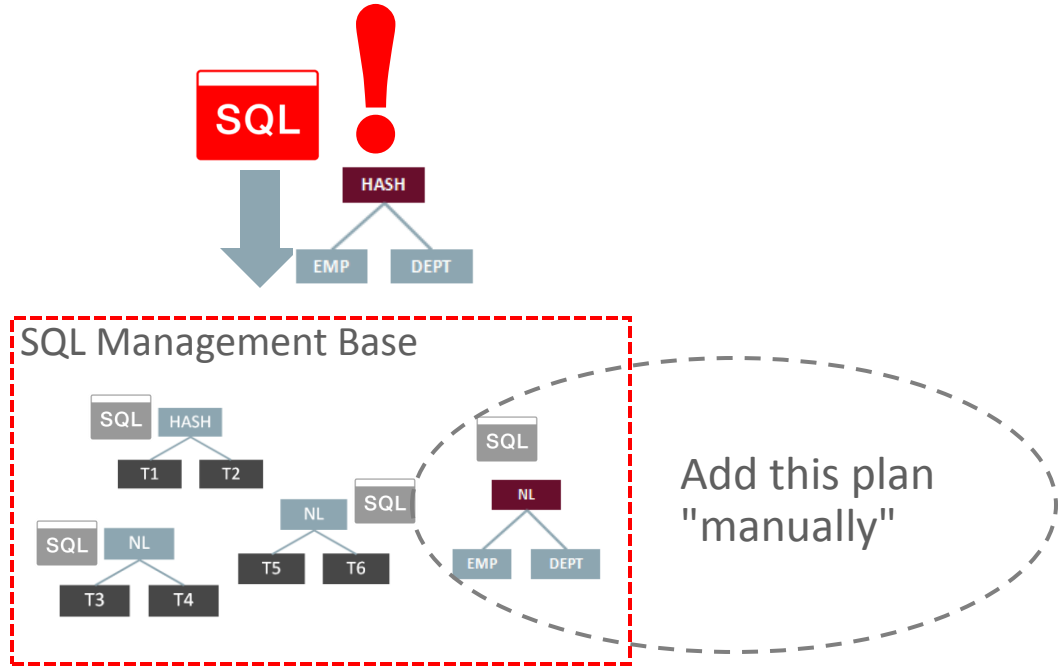
Execution plans are validate but they are *not* accepted automatically.

You Can "Capture Only"

- Capture repeatable SQL statements:
  - `optimizer_capture_sql_plan_baselines=TRUE`
  - `optimizer_use_sql_plan_baselines=FALSE`
- Periodically capture everything from the cursor cache
  - Repeat:
    - `dbms_spm.load_plans_from_cursor_cache(enabled=>'NO');`

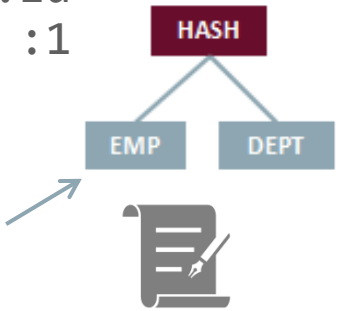
Tactical Approach

Supply a better plan

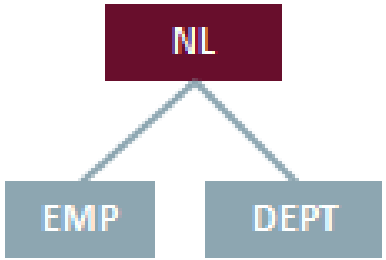


Correcting Poor SQL Execution Plans

```
SELECT a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```



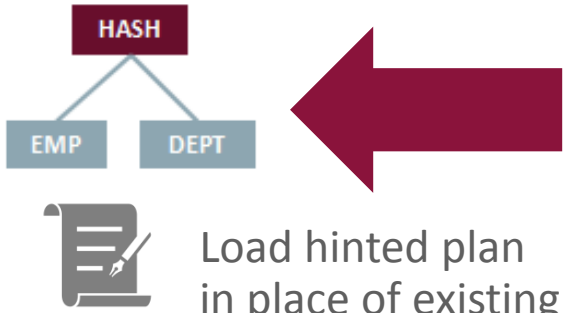
Create SQL plan baseline



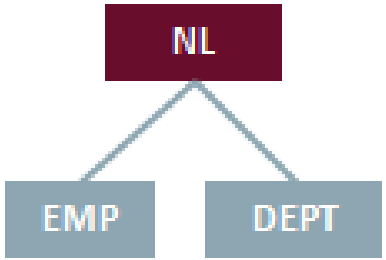

```
SELECT /*+ USE_NL(a b) */
       a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```

Correcting Poor SQL Execution Plans

```
SELECT a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```



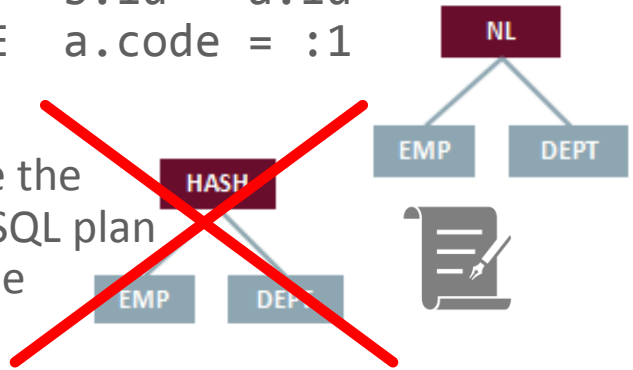
Load hinted plan
in place of existing
SQL plan baseline



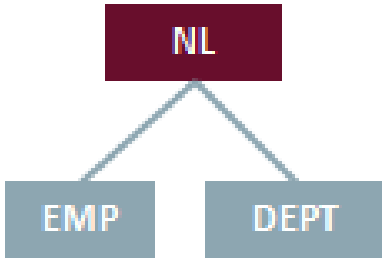

```
SELECT /*+ USE_NL(a b) */
       a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```

Correcting Poor SQL Execution Plans

```
SELECT a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```



Disable the "bad" SQL plan baseline

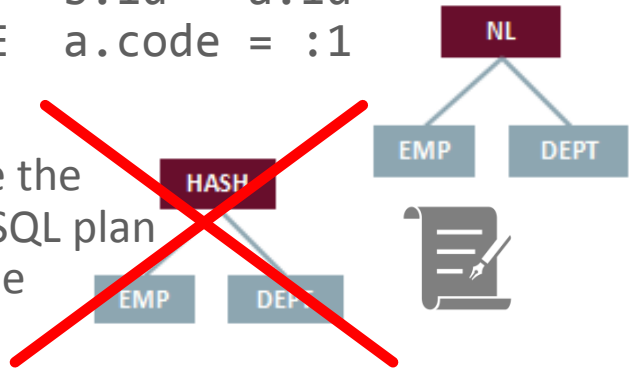



```
SELECT /*+ USE_NL(a b) */
       a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```

Correcting Poor SQL Execution Plans

```
SELECT a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```

Disable the "bad" SQL plan baseline



See white paper:

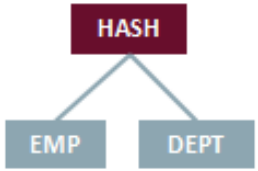
SQL Plan Management with Oracle Database 12c Release 2

Using SPM to Correct Regressed SQL Statements

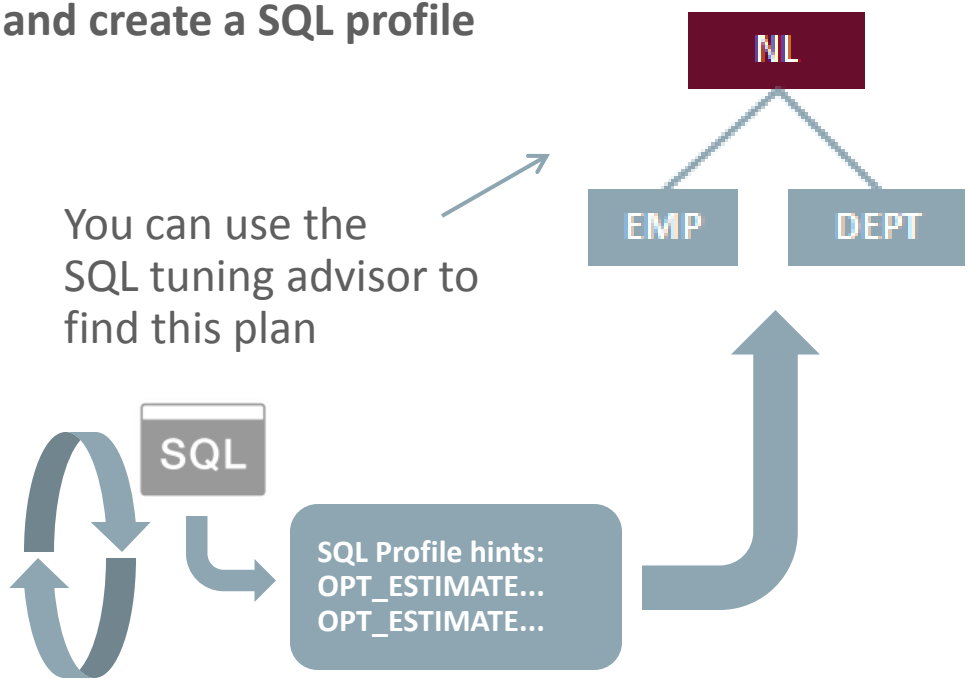
Use SQL Tuning Advisor and SQL Plan Management

Let STA find a better plan and create a SQL profile

```
SELECT a.data,
       b.data
FROM   emp  a
JOIN   dept b ON
       b.id = a.id
WHERE  a.code = :1
```



You can use the SQL tuning advisor to find this plan



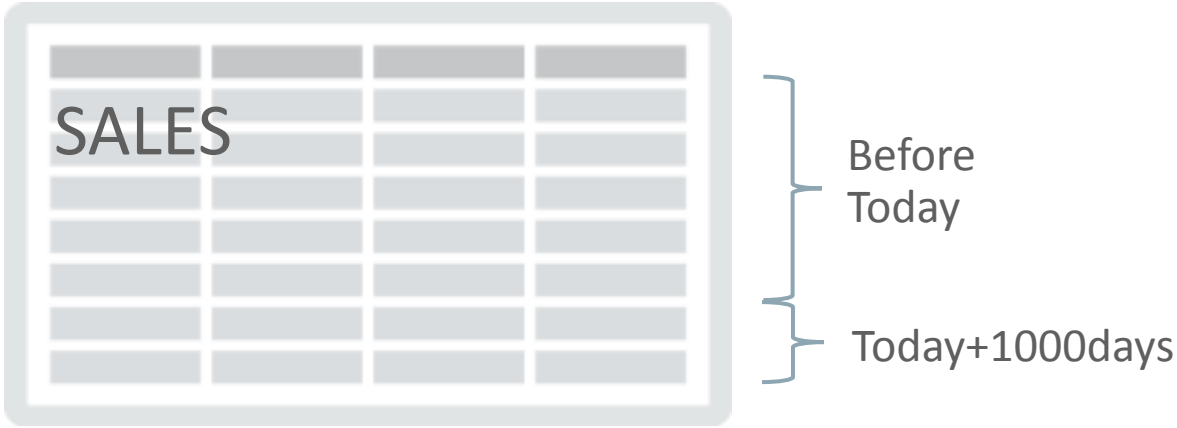
DBMS_SQLTUNE.CREATE_TUNING_TASK

Demo

SQL Profile workflow, followed by SQL plan baseline creation and evolution

A Challenging Data Distribution

Table with index and data column with range skew



SQL Profiles and SQL Plan Management

Poorly performing query

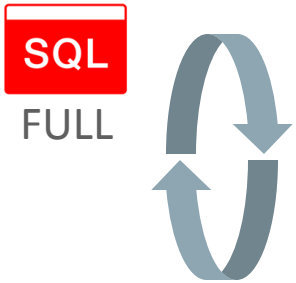
FULL

Actually returns a
few hundred rows

```
-------------------------------------------------------------------------------
| Id  | Operation          | Name  | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |       |       |       |   351 (100)|          |
|*  1 |  TABLE ACCESS FULL| SALES |   333K|  4233K|   351   (3)| 00:00:01 |
-------------------------------------------------------------------------------
```

SQL Profiles and SQL Plan Management

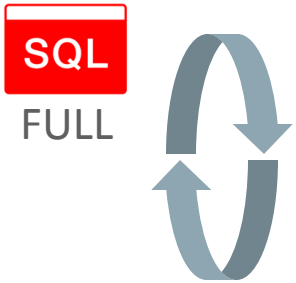
Use SQL tuning advisor to find a better plan – e.g. Index access method




```
dbms_sqltune.create_tuning_task(sql_id=>...

dbms_sqltune.execute_tuning_task
```

SQL Profiles and SQL Plan Management

Use SQL tuning advisor to find a better plan – e.g. Index access method

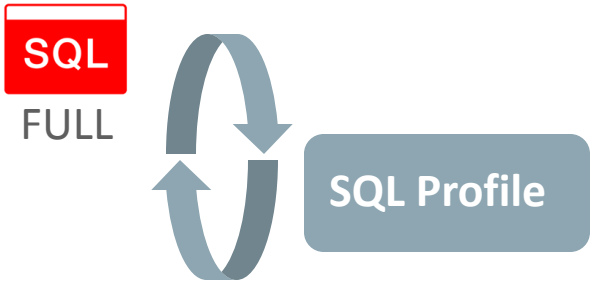


dbms_sqltune.
report_tuning_task

```
Recommendation (estimated benefit: 99.52%)
 ----------------------------------------
 - Consider accepting the recommended SQL profile.
   execute dbms_sqltune.accept_sql_profile(task_name => 'TASK_632',
           task_owner => 'ADHOC', replace => TRUE);

 Validation results
 ------------------
 The SQL profile was tested by executing both its plan and the original plan
 and measuring their respective execution statistics. A plan may have been
 only partially executed if the other could be run to completion in less time.

                              Original Plan  With SQL Profile  % Improved
                              -------------  ----------------  ----------
 Completion Status:                COMPLETE          COMPLETE
 Elapsed Time (s):                 .015779          .000079      99.49 %
 CPU Time (s):                     .014097                0        100 %
 User I/O Time (s):                      0                0
```

SQL Profiles and SQL Plan Management

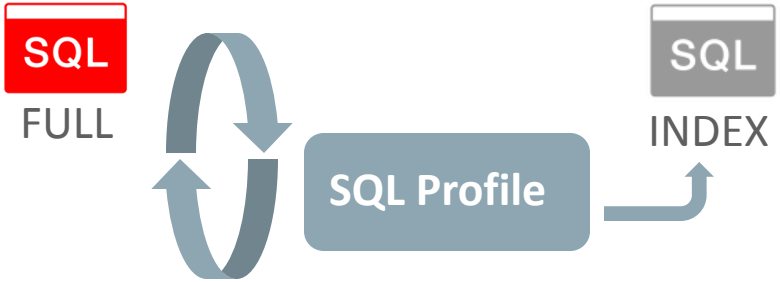
Use SQL tuning advisor to find a better plan – e.g. Index access method




```
dbms_sqltune.accept_sql_profile
```

SQL Profiles and SQL Plan Management

Use SQL tuning advisor to find a better plan – e.g. Index access method

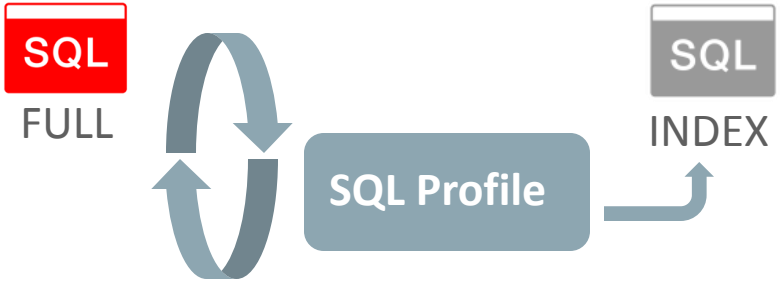



```
-------------------------------------------------------------------------------------------
| Id  | Operation                    | Name   | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |        |       |       |     6 (100)|          |
|   1 |  TABLE ACCESS BY INDEX ROWID| SALES  |   454 |  5902 |     6   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN           | SALESI |   724 |       |     4   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------
```

SQL profile SYS_SQLPROF_015c1c35866c0017 used for this statement

SQL Profiles and SQL Plan Management

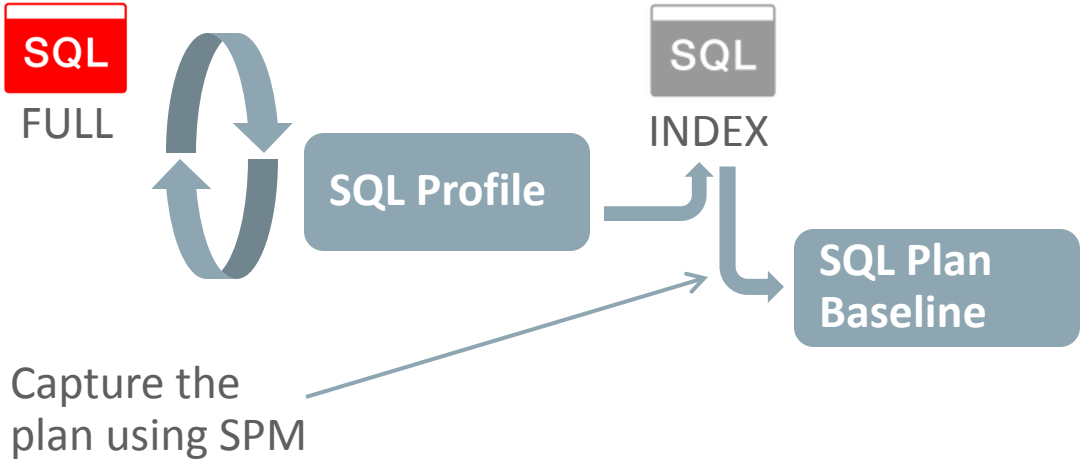
Use SQL tuning advisor to find a better plan – e.g. Index access method




```
select sql_id,exact_matching_signature,sql_profile
from   v$sqlarea
where  sql_text like '%PROFTEST%'
and    sql_profile is not null
order by sql_profile desc;

SQL_ID         EXACT_MATCHING_SIGNATURE  SQL_PROFILE
-------------- ------------------------- ---------------------------------------
G6y6gpnzww95b  10496852328441737191      SYS_SQLPROF_015c1c35866c0017
```

SQL Profiles and SQL Plan Management

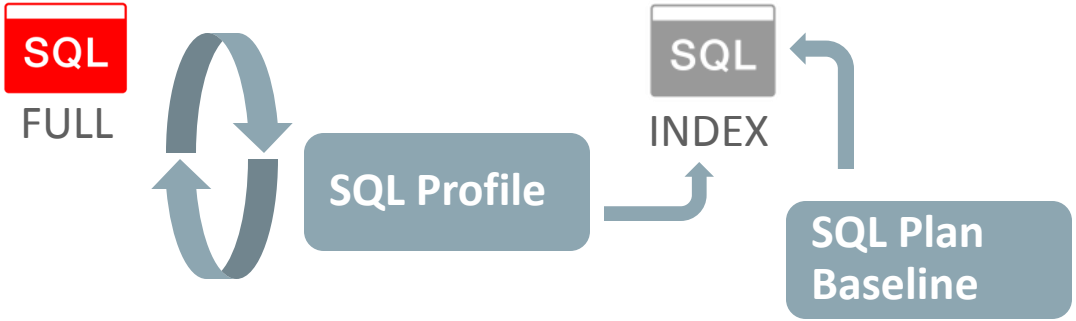
Capture the plan using SQL plan management




```
dbms_spm.load_plans_from_cursor_cache(
                    sql_id  =>'328yfewhu8732',
                    enabled =>'YES');
```

SQL Profiles and SQL Plan Management

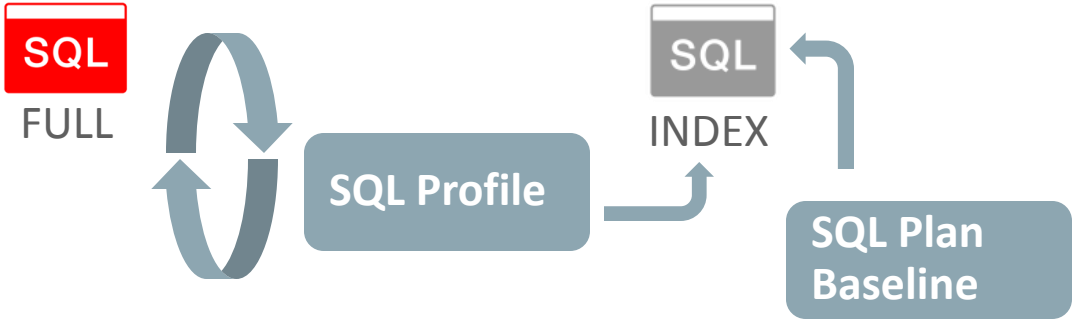
The SQL plan baseline enforces the plan even if SQL profile exists




```
-------------------------------------------------------------------------------------
| Id  | Operation                    | Name   | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |        |       |       |     6 (100)|          |
|   1 |  TABLE ACCESS BY INDEX ROWID| SALES  |   404 |  5252 |     6   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN           | SALESI |   691 |       |     4   (0)| 00:00:01 |
-------------------------------------------------------------------------------------

Note
-----
   - SQL profile SYS_SQLPROF_015c1c35866c0017 used for this statement
   - SQL plan baseline SQL_PLAN_93b2gkgw80vz7f244f78f used for this statement
```

SQL Profiles and SQL Plan Management

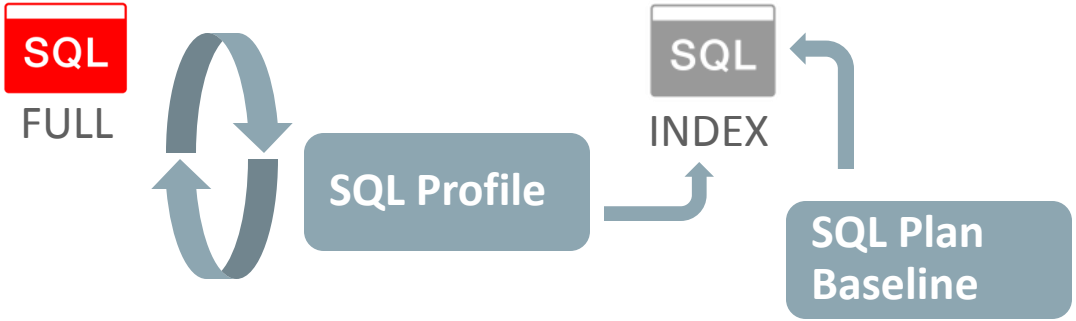
The SQL plan baseline enforces the plan even if SQL profile exists




```
select sql_id,sql_plan_baseline,sql_profile
from   v$sqlarea
where  sql_text like '%PROFTEST%'
and    sql_profile is not null
order by sql_profile desc;

SQL_ID         SQL_PLAN_BASELINE              SQL_PROFILE
-------------- ------------------------------ ----------------------------------------
G6y6gpnzww95b SQL_PLAN_93b2gkgw80vz7f244f78f SYS_SQLPROF_015c1c35866c0017
```

SQL Profiles and SQL Plan Management

The SQL plan baseline enforces the plan even if SQL profile exists

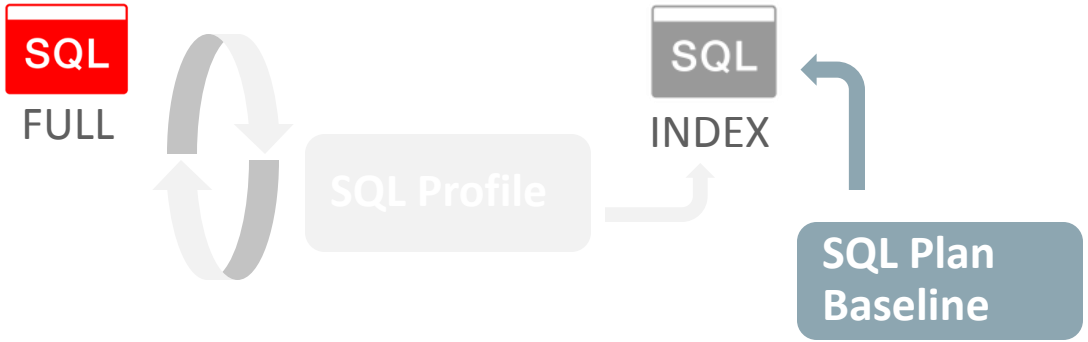



```
SELECT signature,sql_handle,plan_name,accepted
FROM   dba_sql_plan_baselines
WHERE  sql_text LIKE '%PROFTEST%';
```

```
SIGNATURE            SQL_HANDLE                     PLAN_NAME                      ACCEPTED
---------            ------------------------       -------------                  ----------------
10496852328441737191 SQL_91ac4f93f8806fe7           SQL_PLAN_93b2gkgw80vz7f244f78f YES
```

SQL Profiles and SQL Plan Management

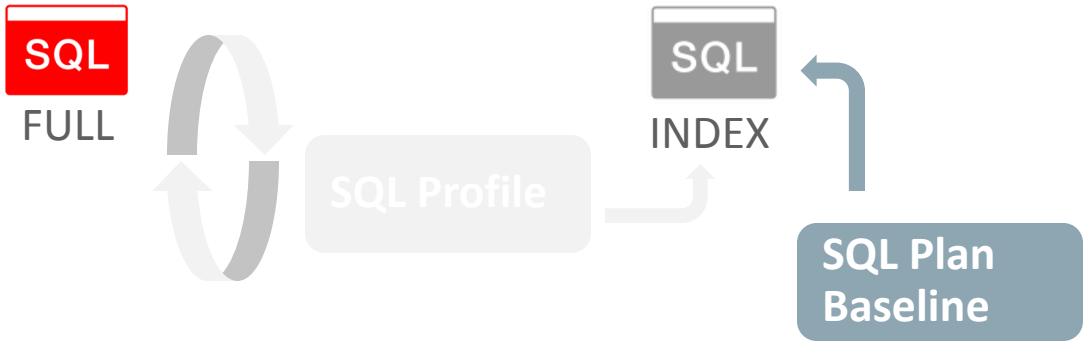
The SQL profile can be disabled




```
dbms_sqltune.alter_sql_profile(
                    name           =>'SYS_SQLPROF_015c1c35866c0017',
                    attribute_name =>'STATUS',
                    value          =>'DISABLED');
```

SQL Profiles and SQL Plan Management

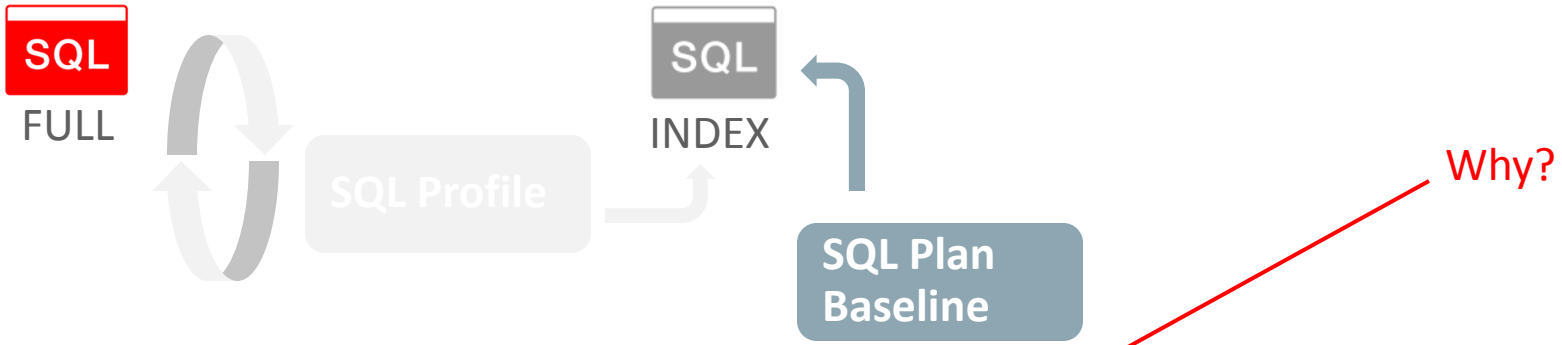
The SQL profile can be disabled




```
-------------------------------------------------------------------------------------------
| Id  | Operation                    | Name    | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |         |       |       |  1720 (100)|          |
|   1 |  TABLE ACCESS BY INDEX ROWID| SALES   |   333K|  4233K|  1720   (1)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN           | SALESI  |   333K|       |   890   (1)| 00:00:01 |
-------------------------------------------------------------------------------------------

Note
-----
   - SQL plan baseline SQL_PLAN_93b2gkgw80vz7f244f78f used for this statement
```

SQL Profiles and SQL Plan Management

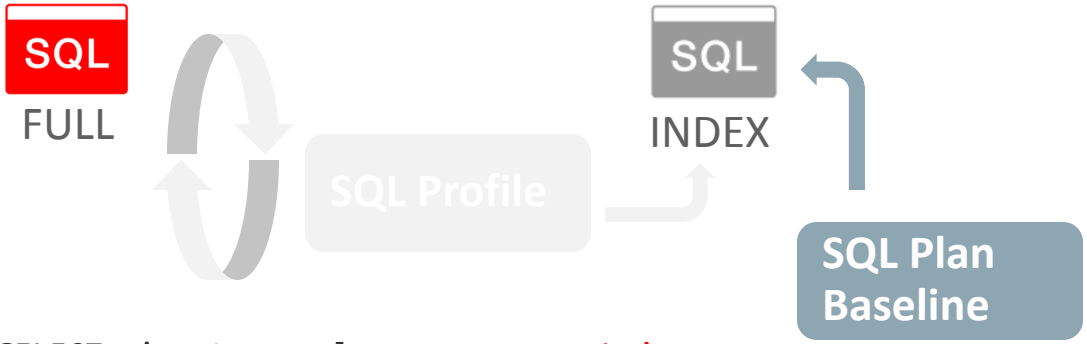
The SQL profile can be disabled




```
-------------------------------------------------------------------------------------
| Id  | Operation                    | Name   | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |        |       |       |  1720 (100)|          |
|   1 |  TABLE ACCESS BY INDEX ROWID| SALES  |   333K|  4233K|  1720   (1)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN           | SALESI |   333K|       |   890   (1)| 00:00:01 |
-------------------------------------------------------------------------------------

Note
-----
   - SQL plan baseline SQL_PLAN_93b2gkgw80vz7f244f78f used for this statement
```

SQL Profiles and SQL Plan Management

Once the SQL profile has been disabled, new plans might be found

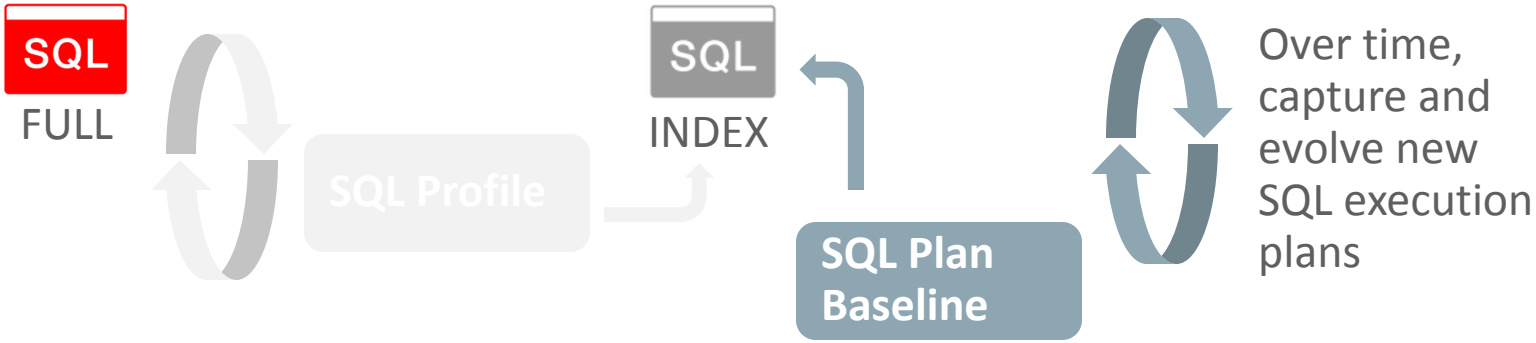



```
SELECT signature, plan_name, accepted
FROM   dba_sql_plan_baselines
WHERE  sql_text LIKE '%PROFTEST%';

                    SIGNATURE PLAN_NAME                      ACC
------------------------------ ------------------------------ ---
        10496852328441737191 SQL_PLAN_93b2gkgw80vz797367831 NO
        10496852328441737191 SQL_PLAN_93b2gkgw80vz7f244f78f YES
```

FULL plan

Example Flow

The SQL execution plan is managed in the long term

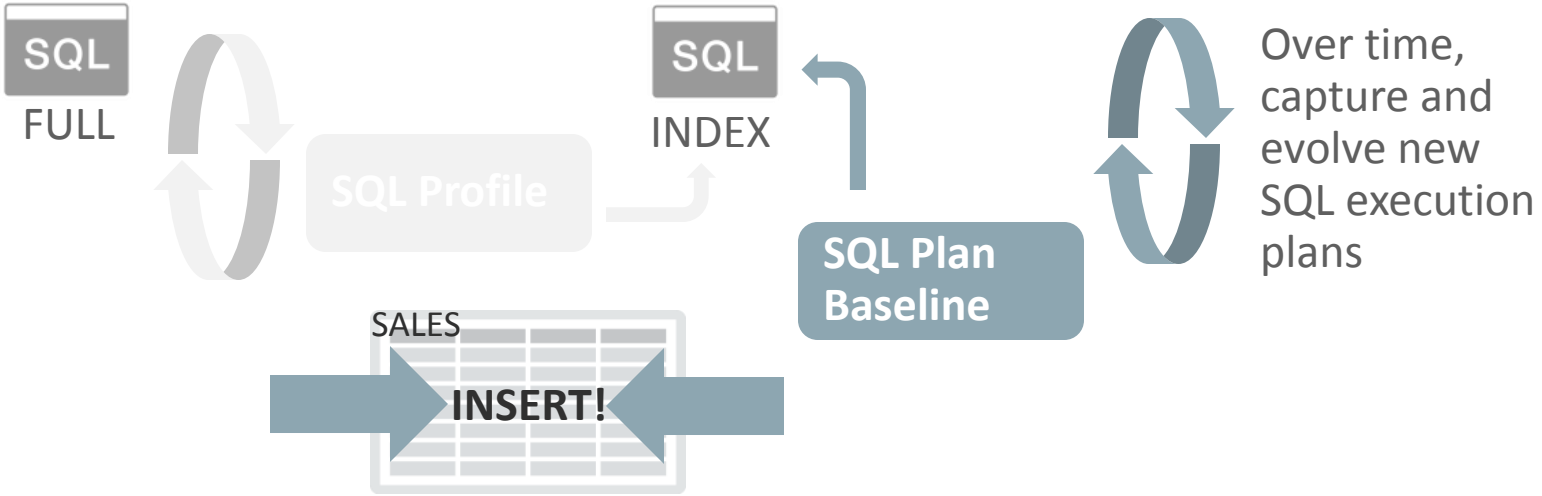



```
exec :report := dbms_spm.evolve_sql_plan_baseline();
```

Note: Automated in Oracle Database 12c

Example Flow

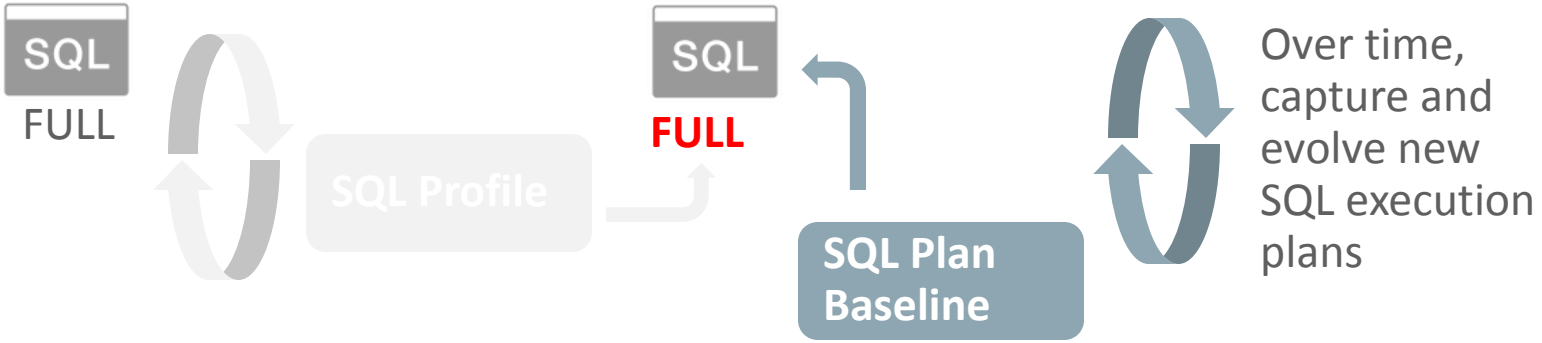
Data changes in the underlying tables...




```
exec :report := dbms_spm.evolve_sql_plan_baseline();
```

Example Flow

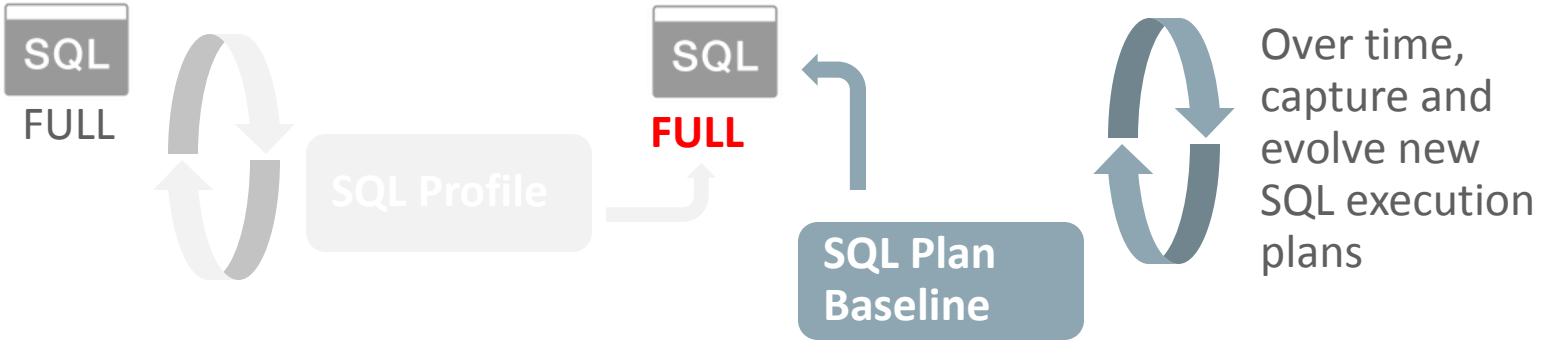
The full table scan plan is more appropriate now – it is verified before use




```
SELECT signature, plan_name, accepted
FROM   dba_sql_plan_baselines
WHERE  sql_text LIKE '%PROFTEST%';

                    SIGNATURE PLAN_NAME                          ACC
----------------------------- ------------------------------ ---
        10496852328441737191 SQL_PLAN_93b2gkgw80vz797367831 YES
        10496852328441737191 SQL_PLAN_93b2gkgw80vz7f244f78f YES
```

Example Flow

The full table scan plan is more appropriate now – it is verified before use




```
Plan hash value: 781590677

-------------------------------------------------------------------------------
| Id  | Operation          | Name  | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |       |       |       |  1053 (100)|          |
|*  1 |  TABLE ACCESS FULL| SALES |  1000K|    12M|  1053   (3)| 00:00:01 |
-------------------------------------------------------------------------------
```

Create SQL Plan Baselines for queries using SQL Profiles!

```
for rec in (select sql_id, sql_profile
            from   v$sqlarea
            where  sql_profile is not null
            and    sql_plan_baseline is null)
loop
   -- Note: loads all plans for given SQL statement

   ret := dbms_spm.load_plans_from_cursor_cache(
                                          sql_id  => rec.sql_id,
                                          enabled => 'YES');
end loop;
```

```
Note
-----
   - SQL profile SYS_SQLPROF_015a039fbe670000 used for this statement
   - SQL plan baseline SQL_PLAN_6bpdv812t0ckxea78bc40 used for this statement
```

Disable SQL Profile where a SQL Plan Baseline Exists

```
  for rec in (select sql_profile
              from   v$sqlarea
              where  sql_profile       is not null
              and    sql_plan_baseline is not null)
  loop
     dbms_sqltune.alter_sql_profile(
                             name           => rec.sql_profile,
                             attribute_name => 'STATUS',
                             value          => 'DISABLED');
  end loop;

Note
-----
   - SQL plan baseline SQL_PLAN_6bpdv812t0ckxea78bc40 used for this statement
```

Summary

- You can use SQL patch to apply hints in an ad-hoc manner
  - SE and EE
  - A reactive approach
- You can use SQL profiles and SQL plan baselines together
  - SQL profiles particularly good for finding better plans **reactively**
  - You can "hand over" plans controlled by SQL profiles to be managed by SQL plan management
- Gain experience in SQL plan baselines
  - Take a look at using this feature **strategically**

More Information

- GitHub
  - Go to https://github.com/oracle/oracle-db-examples
    ... look for *optimizer*, *creative_w_plans*…
- Blogs
  - http://blogs.oracle.com/optimizer
  - https://MikeDietrichDE.com (upgrading)

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