Plan Stability, Baselines, and SQL Plan Management

Arup Nanda

starwood Hotels and Resorts

About Me

- Oracle DBA for 16 years and counting
- Speak at conferences, write articles, 4 books, provides trainings
- Brought up the Global Database Group at Starwood Hotels, in White Plains, NY

ORACLE
TECHNOLOGY NETWORK
Security, Scheduling, Performance & More
Includes Oracle Database 10g
Oracle PL/SQL for DBAs
Feuerstein
RMAN Recipes for Oracle Database 11g
A Problem-Solution Approach
Oracle Database 11g
New Features

What you will learn

- What is SQL Plan Management
- What is a Baseline
- Using baselines to stabilize the plan
- How to enable/disable usage of baselines

Meet John the DBA

- John is a DBA at Acme Corp
- Honest, hardworking, highly experienced
- But not politically savvy; doesn’t beat around the bush. straight shooter
- Let’s see some scenarios he faced in the job

Third Party Tool

- Acme bought a third party gee-whiz tool
- The performance was terrible
- *John* was asked to explain why!
- He analyzed and determined the cause: bad optimizer plans
- He suggested putting hints to fix the plans
- But no, he can’t. The source code is not accessible, remember?
- Status: still unresolved and John is to blame!

Analyzer Gone Wild

- John collects optimizer stats every day
- One day performance went south, apps timed out
- On analysis he found that the plan of those queries had changed
- The plan changed b’coz of the new stats
- *John* got blamed for the fiasco

Stale Stats

- John heard somewhere that stats should not be collected everyday
- He decided to stop collecting stats
  - did so only occasionally
- One day performance went south
- Cause: Optimizer Plan was bad
- Reason: stale stats
- He was blamed!

Database Upgrade

- John wanted to upgrade a DB from 10g to 11g
- He was asked “can you guarantee that plans will not change”
- “Of course not”, he responded. “But most likely they will not”
- Upgrade completed
- Most plans were OK; some went south.
- *John* was blamed for that

Plan Changes

- A developer complains about performance
- John checks the plan and finds a bad plan
  - a full table scan, which should have been index scan or may be vice versa
- He asks the developer “is the data different”?
- “No”, comes the reply. “has been the same for 4 years”.
- John has no history of the plan
- Oracle is misbehaving – was the “root cause”
- *Who* do you think was blamed?

Optimizer Misbehaves

- Oracle Cost Based Optimizer sometimes does not produce most optimal plan
- Difficult to debug
- Well, John takes the blame for that as well!

Stored Outlines

- For inefficient plans, John does have a solution
- Outlines make a plan for a query *fixed*
  - The optimizer will pick up the fixed plan every time
- Problem:
  - Based on the bind variable value, data distribution, etc. specific plan may change
  - A fixed plan may actually be worse

The Problem

- If optimizer calculates execution plans, it may produce inefficient ones
- If you use stored outlines, a fixed plan may be as inefficient as to be noticeable
- Can you have the best of both words?
  - Have plan fixed by outlines
  - But calculate the new plan anyway for comparison and use if appropriate
- *Baselines* do exactly that … and more

Quick Primer on Parsing

- When a query is submitted, Oracle performs the following:
  - Determines if there is a parsed statement
  - Parses query
    - Determines the objects being accessed
    - e.g. is EMP a table or a synonym
    - Determines if the user has privs on that object
    - Calculates the optimal execution plan
  - Binds the values to the variables
  - Stores the parsed statement in library cache

Statement Versions

SCOTT

SELECT * FROM EMP
WHERE SAL>1000

EMP table in
SCOTT schema

No index on
SAL column

Will
Generate a
Full table scan

ARUP

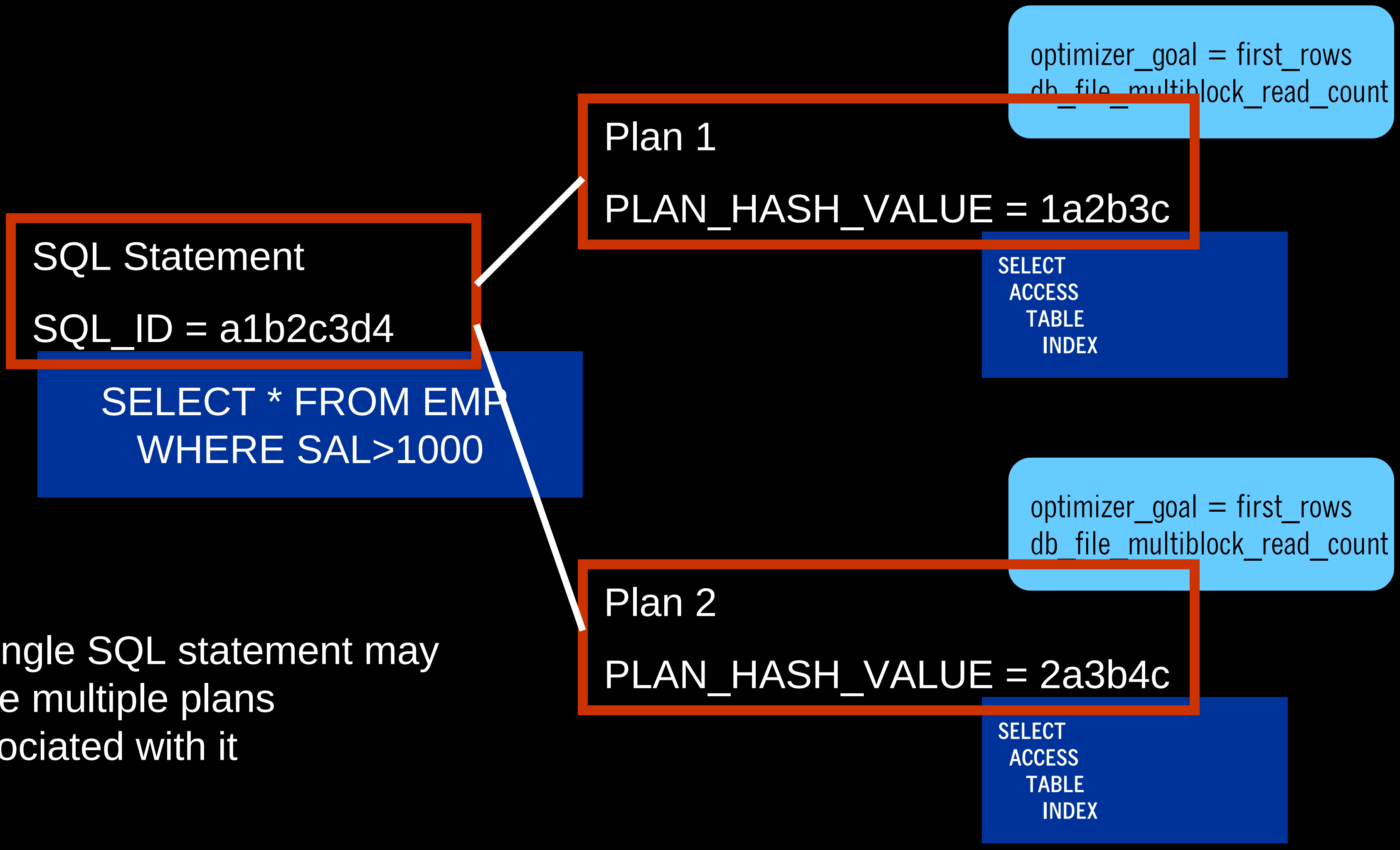
SELECT * FROM EMP
WHERE SAL>1000

EMP table in
ARUP schema

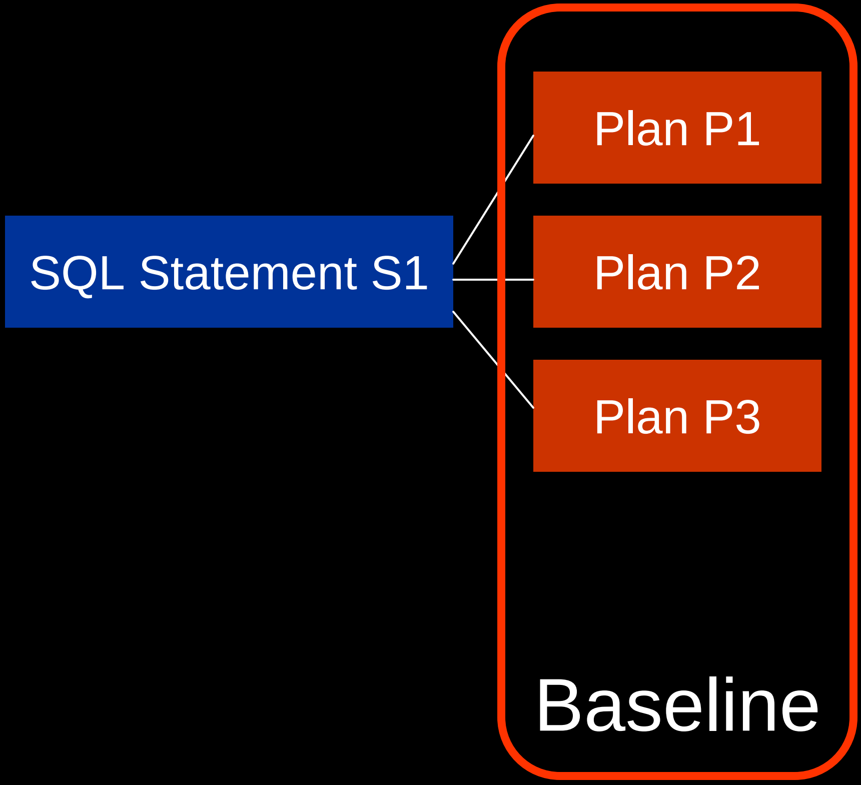
Index on
SAL column

Will probably
generate an
index scan

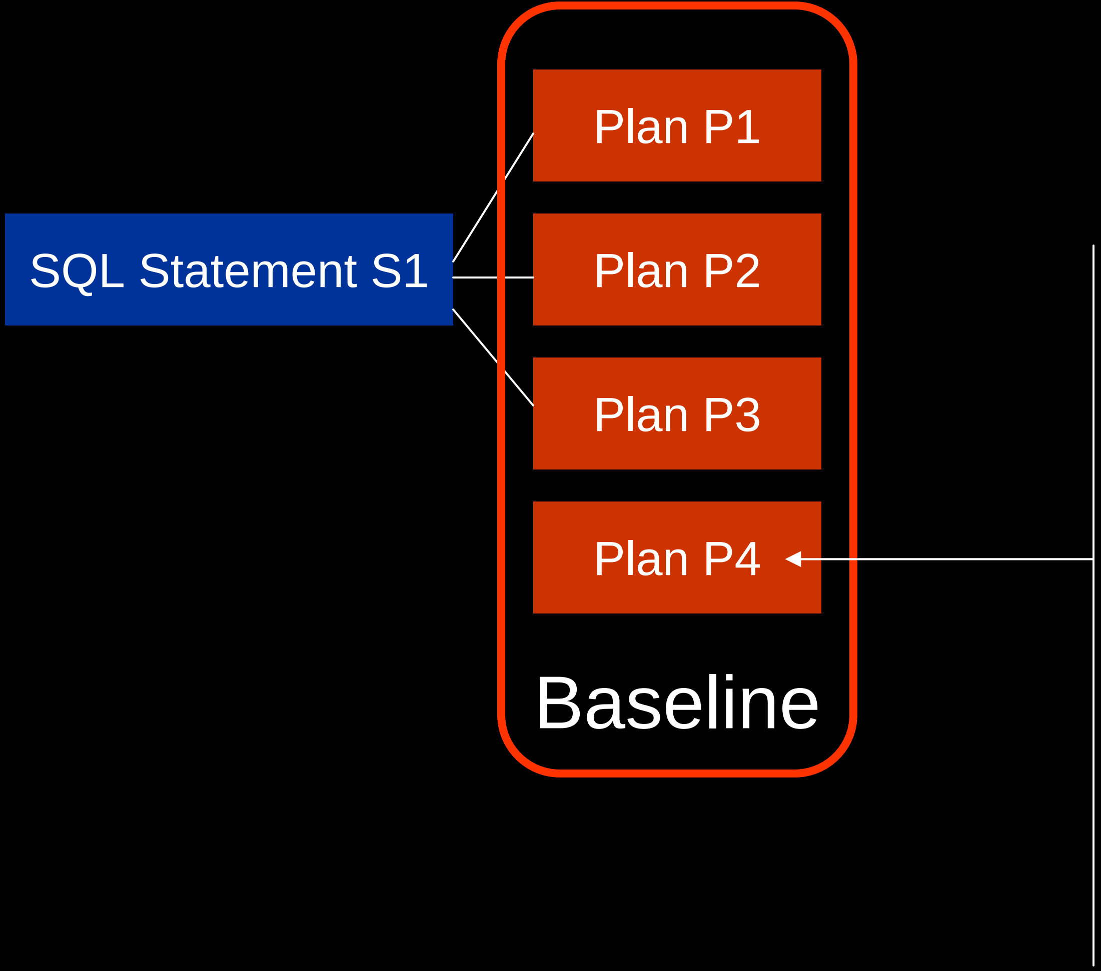
Demo:
cur_test.sql



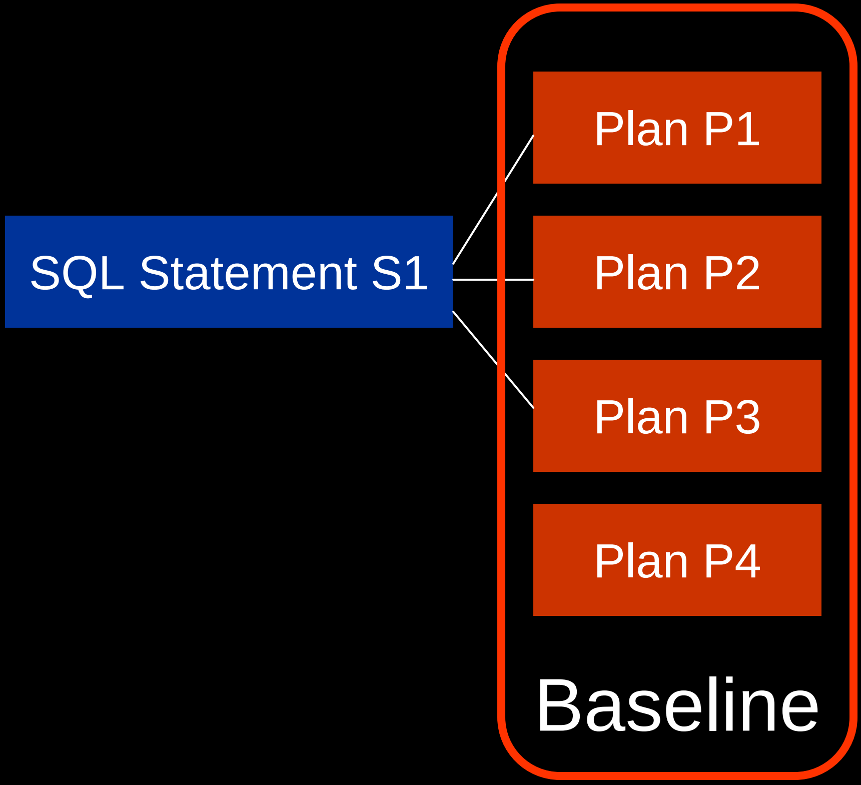
A single SQL statement may have multiple plans associated with it



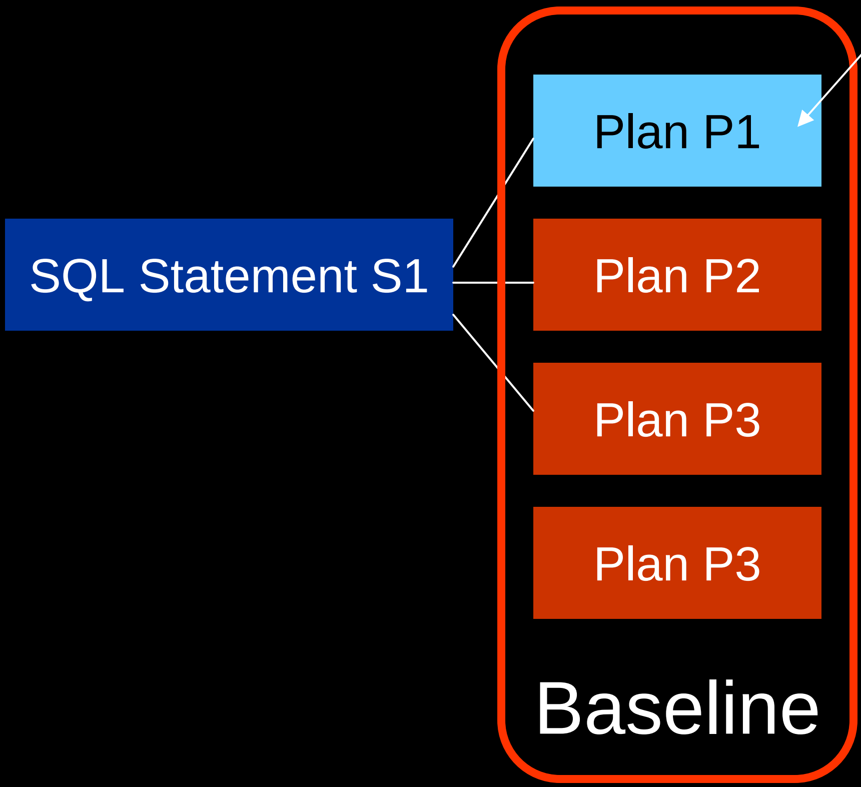
A baseline is a collection of plans for a specific SQL statement



A new plan was generated as a result of some change, e.g. the optimizer parameters were changed. This plan is added to the baseline



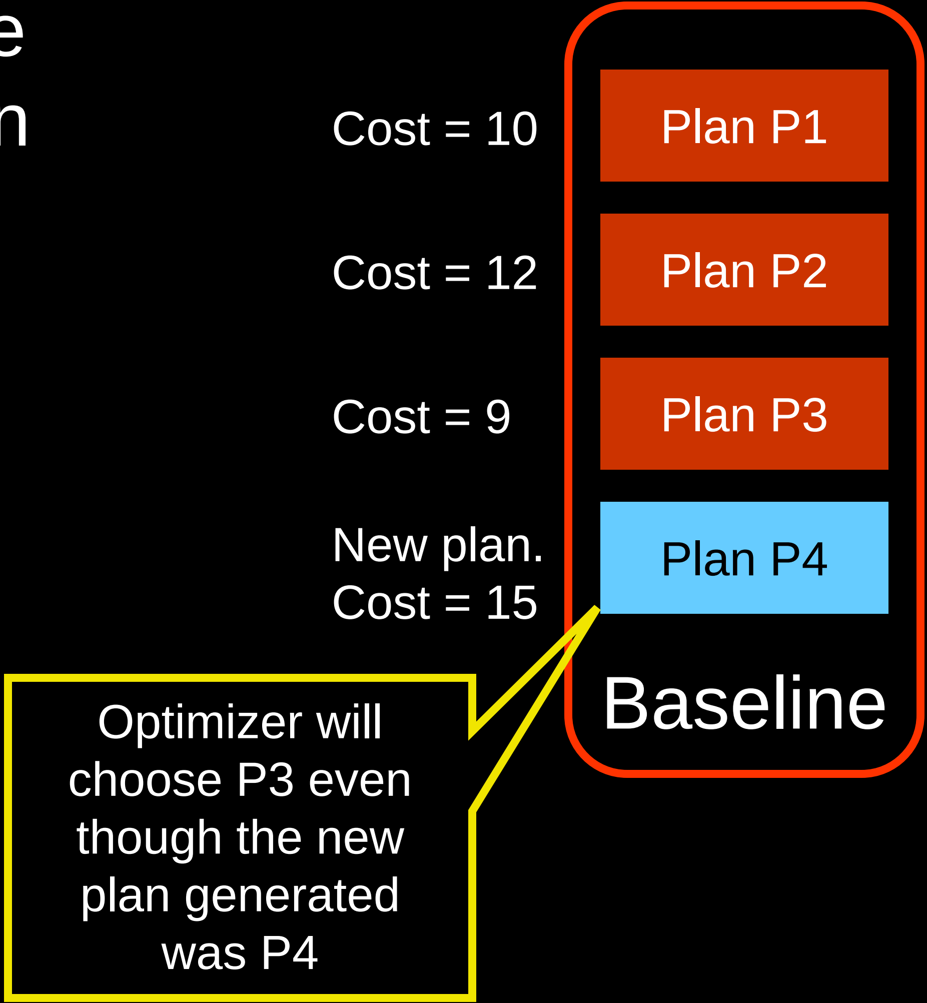
When a SQL is reparsed, the optimizer compares the plan to the list of plans in the baseline, but **not the newly generated plan** as it is not "accepted".



A plan is no longer valid, e.g. it had an index scan; but the index was later dropped. It is marked as such.

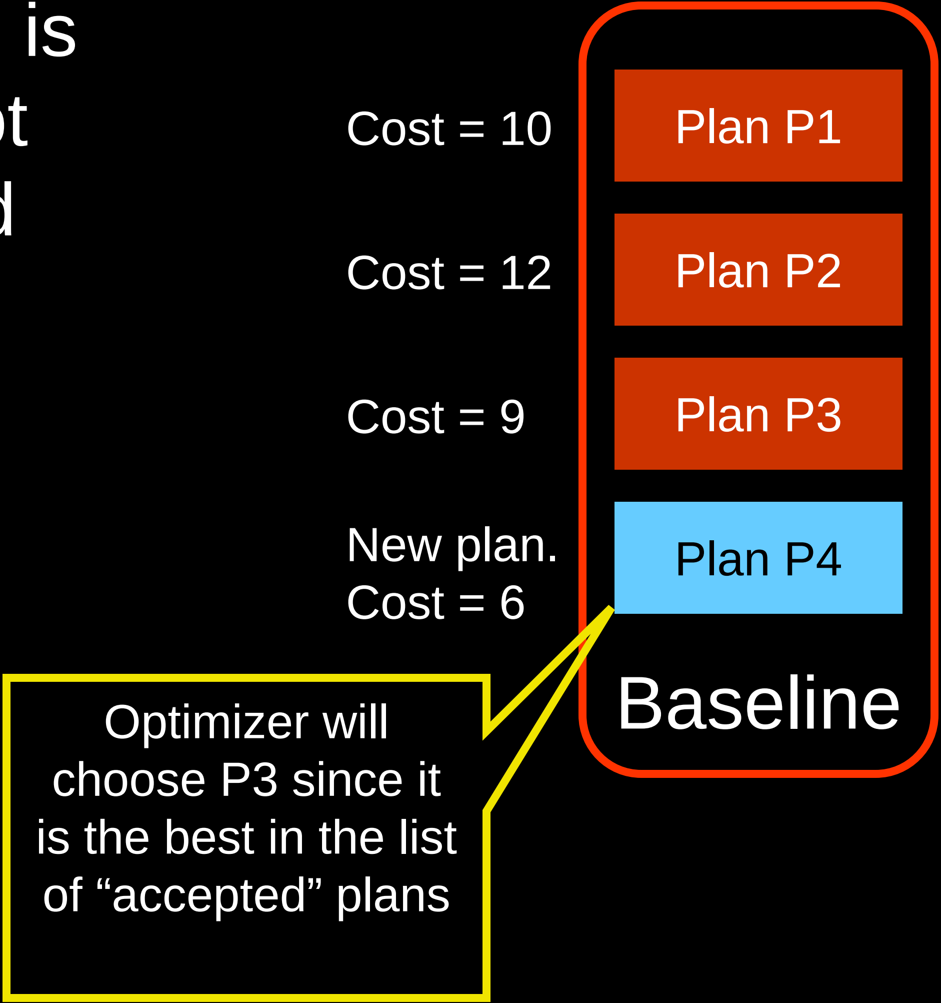
New Plan is Worse

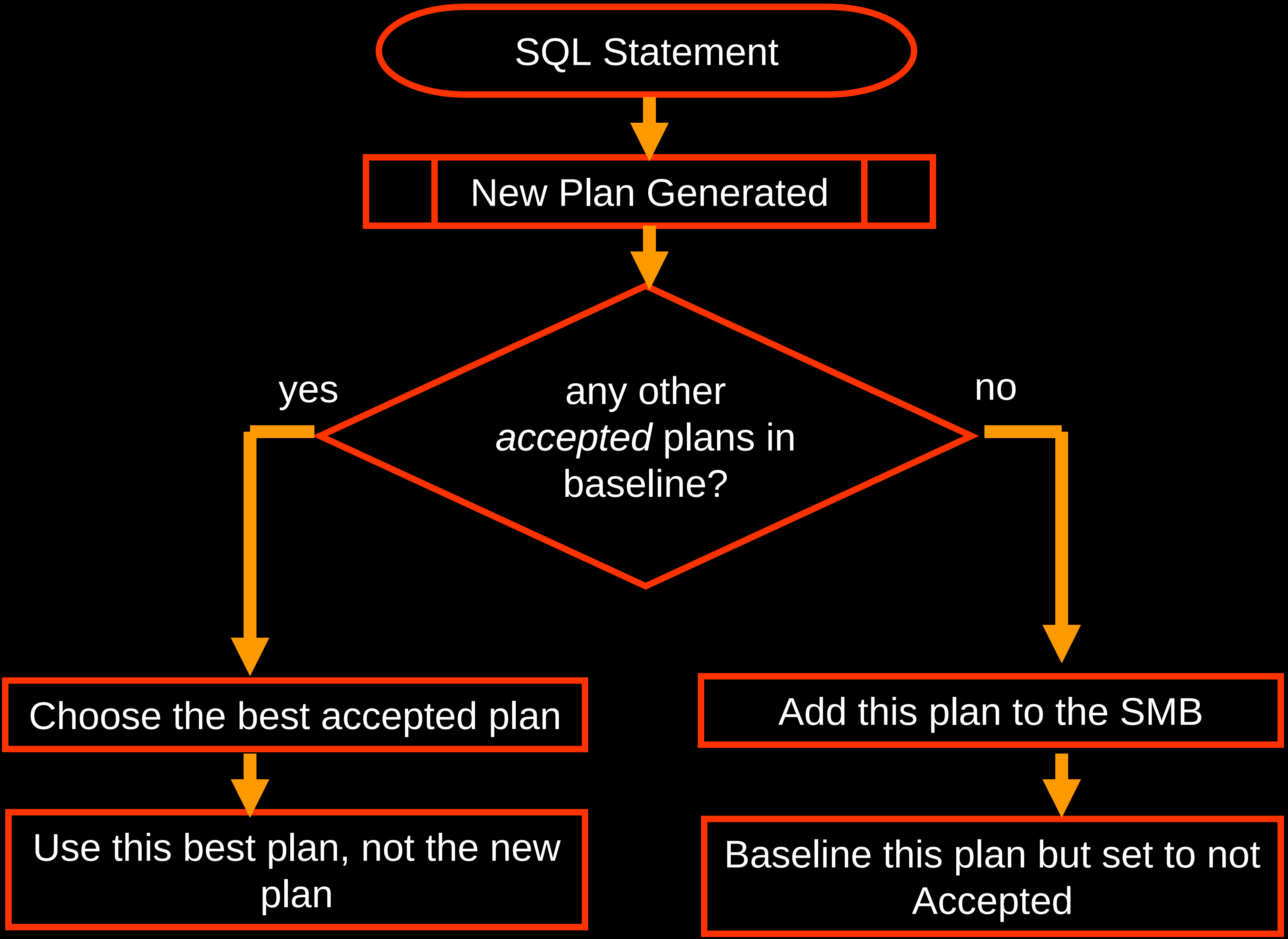
- Baselines contain the history of plans for an SQL statement
- If there was a good plan ever, it will be there in the baseline
- So the optimizer can choose the plan with the lowest cost



New Plan is the Best

- Even if the new plan is the best, it will be not be immediately used
- The DBA can later made the plan fit for consideration by "evolving" it!




SQL Statement
New Plan Generated
any other *accepted* plans in baseline?
yes
no
Choose the best accepted plan
Use this best plan, not the new plan
Add this plan to the SMB
Baseline this plan but set to not Accepted

SQL Management Base

- A repository where the following are stored
  - Statements
  - Plan histories
  - Baselines
  - SQL profiles
- Stored in SYSAUX tablespace

Configuring SMB

To Check

```
select parameter_name, parameter_value
from dba_sql_management_config;
PARAMETER_NAME                 PAMETER_VALUE
------------------------------ -------------
SPACE_BUDGET_PERCENT                10
PLAN_RETENTION_WEEKS                53
```

To Change:

```
BEGIN
  DBMS_SPM.CONFIGURE(
    'PLAN_RETENTION_WEEKS',100);
END;
```

DBA_SQL_PLAN_BASELINES

SIGNATURE	Unique identifier for the SQL, a number, e.g. 10925882130361959529
SQL_HANDLE	Unique ID in text form, e.g. SYS_SQL_97a087e8e6034469
SQL_TEXT	
PLAN_NAME	Unique plan identifier, in text, e.g. SYS_SQL_PLAN_e603446911df68d0
ENABLED	NO - Disabled YES – Enabled
ACCEPTED	
FIXED	
AUTOPURGE	
OPTIMIZER_COST	Cost when the baseline was created

More about baselines

- Plans in baselines stay even after the SQL is flushed from the shared pool

To Check Baselines

- Enterprise Manager
- Click on Server Tab
- Click on Plan Management
- Enter a Search String for the SQL and click Go

Baselines Demo

- Setup: spm_test1
- Table:

```
SQL> select status, temporary, count(1)
  2  from accounts
  3  group by status, temporary;
STATUS  T   COUNT(1)
------- - ----------
VALID   N      68416
INVALID N          1
VALID   Y        138
```

- Query:

```
select /* SPM_TEST */ * from accounts where status =
  'INVALID' and temporary = 'Y'
```

To check for Plans in the baseline

```
select SQL_HANDLE, PLAN_NAME
from dba_sql_plan_baselines
where SQL_TEXT like '%SPM_TEST%'
/

SQL_HANDLE                     PLAN_NAME
------------------------------ ------------------------------
SYS_SQL_4602aed1563f4540       SYS_SQL_PLAN_563f454011df68d0
SYS_SQL_4602aed1563f4540       SYS_SQL_PLAN_563f454054bc8843
```

SQL Handle is the same since it's the same SQL; but there are two plans

Checking Plans Being Used

```
Execution Plan
----------------------------------------------------------
Plan hash value: 2329019749

-----------------------------------------------------------------------------------------------
| Id  | Operation                   | Name            | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT            |                 | 17139 |  1690K|   588   (1)| 00:00:08 |
|*  1 |  TABLE ACCESS BY INDEX ROWID| ACCOUNTS        | 17139 |  1690K|   588   (1)| 00:00:08 |
|*  2 |   INDEX RANGE SCAN          | IN_ACCOUNTS_01  | 34278 |       |    82   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter("TEMPORARY"='Y')
   2 - access("STATUS"='INVALID')

Note
-----
   - SQL plan baseline "SYS_SQL_PLAN_51f8575d04eca402" used for this statement
```

This shows that a SQL Plan Baseline is being used.

To See Plan Steps in Baseline

- Package DBMS_XPLAN has a new function called display_sql_plan_baseline:

```
select * from table (
    dbms_xplan.display_sql_plan_baseline (
        sql_handle=>'SYS_SQL_4602aed1563f4540',
        format=>'basic note')
    )
```

Demo: Adding Baselined Plans

- Demo: spm_test2

```
alter session set
  optimizer_capture_sql_plan_baselines = true
/
… execute the query at least 2 times
alter session set
  optimizer_capture_sql_plan_baselines =
  false
/
```

- A plan is baselined when a SQL is executed more than once

Adding more plans

- Demo: spm_test3
- Change the optimizer parameter so that a new plan is generated

```
alter session set
  optimizer_mode=first_rows
```

- Capture the plans for the baseline
- The new plan is stored in baseline but not “accepted”; so it will not be used by the optimizer

Evolve a Plan

- Make a plan as acceptable (only if it is better)

```
variable rep CLOB
begin
 :rep :=
   dbms_spm.evolve_sql_plan_baseline (
    sql_handle => 'SYS_SQL_5a8b6da051f8575d'
    , verify  => ‘YES'
   );
end;
/
```

- Variable REP shows the analysis.
- Demo: spm_test4.sql

Check the use of new plan

- Demo: spm_test5

```
alter session set
  optimizer_use_sql_plan_baselines = false
```

  – Check plan

```
alter session set
  optimizer_use_sql_plan_baselines = true
```

  – Check plan

Fixing a Plan

spm_test6.sql

- A plan can be fixed by:

```
dbms_spm.alter_sql_plan_baseline (
    sql_handle => ‘SYS_SQL_5a8b6da051f8575d',
    plan_name => 'SYS_SQL_PLAN_51f8575d04eca402',
    attribute_name => 'fixed',
    attribute_value => 'YES'
)
```

- Once fixed, the plan will be given priority
- More than one plan can be fixed
- In that case optimizer chooses the best from them
- To “unfix”, use `attribute_value => ‘NO'`

Capturing Baselines in Bulk

- Setting system parameter

```
alter system set
  optimizer_capture_sql_plan_baselin
  es = true
```

- Capture from Cursor Cache
- Capture form SQL Tuning Set (STS)
- Convert from Stored Outlines (11gR2)

Capturing from Cursor Cache

```
declare
  cnt number;
begin
  cnt := dbms_spm.load_plans_from_cursor_cache
     (sql_id => '003vmga5rcrs4');
  cnt := dbms_spm.load_plans_from_cursor_cache
     (sql_id => '005nuc1nd7u93');
  cnt := dbms_spm.load_plans_from_cursor_cache
     (sql_id => '009su850aqyha');
end;
```

Capturing from Cursor Cache

```
declare
  cnt  number;
begin
  cnt :=
    dbms_spm.load_plans_from_cursor_cache(
       attribute_name => 'sql_text',
       attribute_value => '%SPM_TEST%'
    );
end;
```

Capturing from STS

```
declare
  cnt  number;
begin
  cnt :=  dbms_spm.load_plans_from_sqlset(
    sqlset_owner => 'SYS',
    sqlset_name  => 'TEST_STS',
    basic_filter => '%SPM_TEST%'
  );
end;
```

Create STS

```
declare
  l_task_name varchar2(2000);
begin
   l_task_name :=
      dbms_sqltune.create_tuning_task (
         sql_id => '7zpphmzu2m1j6'
   );
end;
/
```

How else can you tune a query

You can also use SQL Tuning Advisor

1. Create a tuning task

```
variable l_task varchar2(2000)
exec :l_task :=
   dbms_sqltune.create_tuning_task(
      sql_id => 'cbynbmssqudbx');
```

2. Execute the task

```
exec dbms_sqltune.execute_tuning_task(
   task_name => :l_task)
```

3. Check for recommendations

```
select dbms_sqltune.report_tuning_task(
   :l_task, 'TEXT', 'BASIC') FROM dual;
```

4. If there is a SQL Profile, accept it

```
exec dbms_sqltune.accept_sql_profile(
   task_name => :l_task);
```

This will add the tuned plan as per SQL Profile to the baseline as well.

- So you can use either Evolve or STA for creating baselined plans

Use of Baselines

- Fixing Plan for Third Party Applications
- Database Upgrades
  - Both within 11g and 10g->11g
  - Capture SQLs into STS then move the STS to 11g
- Database Changes
  - Parameters, Tablespace layout, etc.
  - Fix first; then gradually unfix them

Use of SMB

- SQL Management Base is a historical repository of SQLs and associated plans
- The plan exists even though SQL is flushed out of memory

Let’s Revisit John’s Issues

Issue	Solution
Bad plans in 3rd-party apps	Change opt. env.; generate new baselines and fix them
Optimizer misbehaving	Won’t happen since the bad plans will not be in baseline
Stats collection causing bad plans	But he can check them later and evolve them if good
Upgrade breaking good plans	Get all the plans in STS and accept all of them
Developers not aware of plan changes	Query the SQL Management Base

감사합니다 Obrigado

Спасибо धन्यवाद

Danke תודה רבה

Thank you!

多謝 Grazie

Thank You

Merci

شكرا

ขอบคุณ நன்றி

Gracias

ありがとうございました