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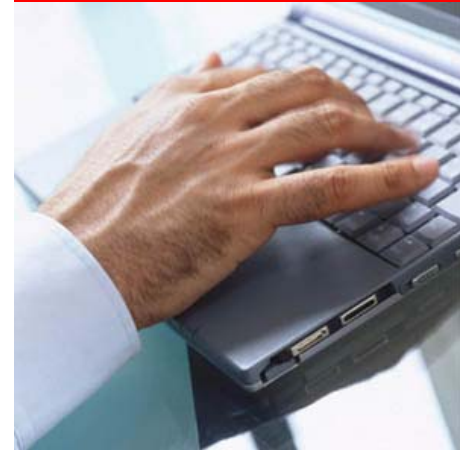
Upgrading to 11g – Best Practices

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Agenda

- Upgrade Companion
- Challenges & Best Practices
- AWR & STATSPACK
- SQL Plan Management
- Real Application Testing
- Q&A



Documentation

- [Note: 466181.1](#) Upgrade Companion 10gR2

The screenshot shows the Oracle 10g Upgrade Companion web page. At the top left is the Oracle logo followed by "10g Upgrade Companion". A navigation bar contains links: Home, Best Practices, Behavior Changes, Patches Recommended, and Documentation. The main heading is "Oracle Upgrade Companion" with "Version 2.30" and "May 13, 2008" below it. The text welcomes users and explains the companion's purpose. A red "NOTE" states it is not a replacement for the Oracle Database 10g Upgrade Guide. It mentions that the document is continually updated and provides a link to "Oracle's Upgrade Management Services" for more details. It also notes that the companion does not cover upgrading Oracle E-Business Suite or Siebel Business Applications.

ORACLE 10g Upgrade Companion

Home Best Practices Behavior Changes Patches Recommended Documentation

Oracle Upgrade Companion

Version 2.30 May 13, 2008

Welcome to the Oracle Upgrade Companion. This Upgrade Companion helps you upgrade from Oracle9i Release 2 (9.2) to Oracle Database 10g Release 2 (10.2), including guidance on pre-upgrade, upgrade, and post-upgrade steps. This web site is instructional only, and does not supply automation tools.

NOTE: This document is not a replacement for the Oracle Database 10g Upgrade Guide. It should be used as a companion document to the Oracle Database documentation.

This document is continually updated as new information becomes available. Please check back prior to your upgrade.

If advice or onsite assistance is needed during your upgrade, go to [Oracle's Upgrade Management Services](#) page for details. Oracle Upgrade Management Services is designed to simplify your unique upgrade challenges, no matter what stage you are at in the upgrade process.

The Upgrade Companion does not cover upgrading Oracle E-Business Suite or Siebel Business Applications. Please refer to your application documentation. For convenience, some common E-Business Suite and Siebel Business Application MetaLink notes are listed below. This is not a complete list.

- [Note: 601807.1](#) Upgrade Companion 11g

The screenshot shows the Oracle 11g Upgrade Companion web page. At the top left is the Oracle logo followed by "11g Upgrade Companion". A navigation bar contains links: Home, Best Practices, Behavior Changes, Patches Recommended, and Documentation. The main heading is "Oracle 11g Upgrade Companion" with "Version 1.10" and "July 2, 2008" below it. The text welcomes users and explains the companion's purpose. A red "NOTE" states it is not a replacement for the Oracle Database 11g Upgrade Guide. It mentions that the document is continually updated and provides a link to "Oracle's Upgrade Management Services" for more details. It also notes that the companion does not cover upgrading Oracle E-Business Suite or Siebel Business Applications.

ORACLE 11g Upgrade Companion

Home Best Practices Behavior Changes Patches Recommended Documentation

Oracle 11g Upgrade Companion

Version 1.10 July 2, 2008

Welcome to the Oracle 11g Upgrade Companion. This Upgrade Companion helps you upgrade from Oracle9i Release 2 (9.2) or Oracle Database 10g to Oracle Database 11g including guidance on pre-upgrade, upgrade, and post-upgrade steps. This document is instructional only, and does not supply automation tools.

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Documentation

- [Note: 601807.1](#) Upgrade Companion 11g

ORACLE 11g Upgrade Companion

HomeBest PracticesBehavior ChangesPatches RecommendedDocumentation

Best Practices

Upgrade Best Practices

Introduction → Upgrade Planning → **Prepare and Preserve** → Upgrade → Post Upgrade

◀ PreviousNext ▶

Best Practices > Prepare and Preserve

Defining, implementing and managing a contingency plan is extremely important step during the upgrade process. Mission critical enterprises require a return to normal operations more quickly today than ever before. Accordingly, system availability is dependent on how well you prepare for outages. Planning and practicing for the unexpected issues helps to ensure the upgrade to the new Oracle Database 11g will be successful.

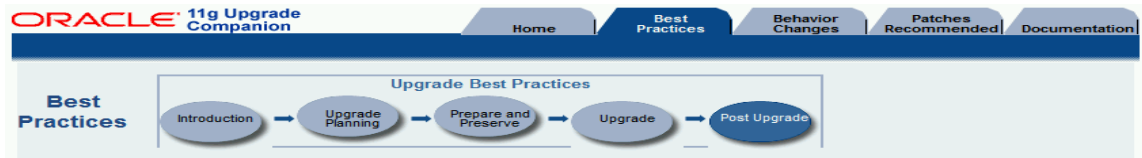
Prepare

Preparing the database before the upgrade begins will help reduce any unforeseen errors or circumstances that prevent the upgrade from completing, such as out of space errors. There are a number of things to consider before the upgrade begins, including fallback planning, compatible parameter setting considerations and database configuration settings.

- + **Execute the Pre-Upgrade Information Tool**
- + **COMPATIBLE Initialization Parameter**
- + **Review Non-Default Initialization Parameters**
- + **When to Fallback**
- + **Recommendations to Avoid Common Pitfalls**

Documentation

• Note: 601807.1



Database Performance

□ Perform Post-Upgrade Cost-Based Optimizer (CBO) Management Tasks

It is **critical** to properly manage CBO statistics after an upgrade to Oracle Database 11g. There are changes in Oracle Database 11g with regard to the CBO and having proper statistics gathered is essential to getting good performance.

See [Managing CBO Stats during an upgrade 10g or 11g](#) after upgrading from Oracle 9i or Oracle Database 10g to Oracle Database 11g to determine what should be done with statistics.

After you have addressed the CBO statistics, you are ready to begin validating the performance of the test system, or in the case of production, to begin monitoring production to catch any regressions that might have occurred.

□ Checking Database Performance

It is very important to check the performance of the database after upgrading the test and production databases. In TEST, this is accomplished by repeating the unit tests and load tests that were defined and executed before the upgrade (and discussed in the Best Practices > Preserve section). The unit tests should be done first so that any regressions can be addressed before going further.

After the unit tests are successful, the load tests should be performed and compared to the results of the load tests performed before the upgrade. Any regressions should be addressed before going further. **The production database should not be upgraded until performance regressions found in TEST are understood and resolved.**

See the following sections for additional details.

- ⊕ 1. *Checking the Performance of the TEST System with Unit Testing*
- ⊕ 2. *Checking the Performance of the TEST System with Load Testing*
- ⊕ 3. *Checking the Performance of the PRODUCTION System After an Upgrade*

□ Resolving Performance Regressions

The suggestions in this section may be used when resolving performance problems after upgrading test or production.

- ⊕ 1. *Overall Approach*
- ⊕ 2. *If Regression is Due to a SQL Execution Plan Change...*
- ⊕ 3. *If Regression is Due to Something Else*

Case Studies

- [Resolving High CPU Usage on Oracle Servers](#)

Documentation

- [Oracle Database 11g Upgrade Guide > Ch. 4: After Upgrading](#)
- [Oracle Performance Tuning Guide, SQL Tuning Overview](#)
- [SQL Tuning Advisor](#)

How-To

- [Recommended Method for Obtaining 10046 trace for Tuning](#)
- [How to Identify Resource Intensive SQL for Tuning](#)
- [Managing CBO Stats during an upgrade to 10g or 11g](#)
- [Recording Explain Plans on 9i before an upgrade to 10g or 11g](#)
- [Oracle Performance Diagnostic Guide, Query Tuning](#)

Notes

- [Knowledge Browser, see Upgrade and Migrations](#)
- [Knowledge Browser, see Query Tuning](#)
- [Known RMAN Performance Problems](#)

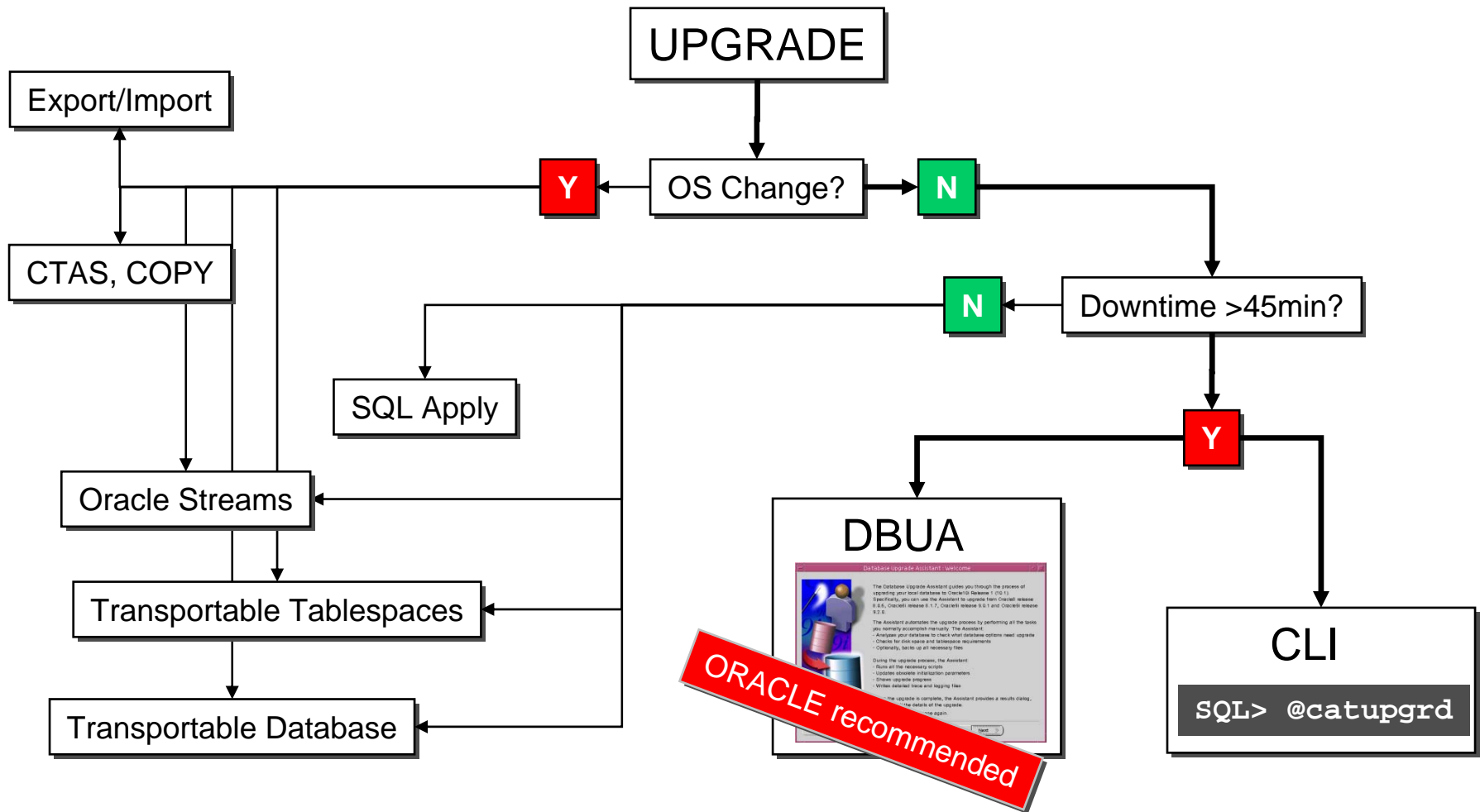
Scripts and Tools

- [OS Watcher](#)
- [OSWg](#)
- [LTOM](#)

White Papers

- [Best Practices for Load Testing System Upgrades](#)
- [Determining CPU Resource Usage for Linux and Unix](#)
- [Measuring Memory Resource Usage for Linux and Unix](#)

Upgrade Paths



Challenges

- >90% of highly visible problems attributed to an upgrade do not occur while upgrading **but** appear as unanticipated performance degradations days or weeks after the upgrade operation completed
 - Usually too late to schedule another extended outage to downgrade
 - Other changes have been introduced elsewhere to make the downgrade even more complex
- Typical root causes:
 - Optimizer regression - execution plan chosen is worse
 - Queries are slow
 - Reports or batches take longer to complete
 - Increased overall resource requirements
 - Changed behavior / new bottlenecks under high load

Best Practices – Preserve

- Preserve as much information as possible BEFORE you upgrade the production environment to the new release - **that's of vital importance!!!**
 - Capture accurate performance statistics to act as baseline
 - Allows comparison: before ↔ after
 - Measure query and batch timings
 - System level performance stats (OS Watcher / statspack / AWR)
 - Save execution plans
 - Save old configuration information (RDA / OCM)

Best Practices – Preserve


- Keep a backup copy of your current optimizer statistics. See [Note 465787.1](#)
- Incorrect / inaccurate optimizer statistics is one cause of suboptimal execution plans.
- Save execution plans

Best Practices – Pre Upgrade

- Upgrade and stress test a test database first
 - Do functional testing
 - Always use real production data
 - Create a copy of the production database with RMAN
 - Or leverage a standby DB if multiple exist
 - Run performance tests with real life loads!!!
- Rehearse both upgrade and back out procedures
 - Consider other dependent components that have to be shut down too
 - Should be able to do steps in your sleep
 - Most production systems upgrade during off-hours
 - Use a buddy system to make sure checklists are followed

Pre Upgrade

- Create **dictionary statistics** prior to the upgrade - otherwise it will take significantly longer



```
SQL> EXECUTE dbms_stats.gather_schema_stats
      ('SYS',
       options          => 'GATHER',
       estimate_percent => DBMS_STATS.AUTO_SAMPLE_SIZE,
       method_opt       => 'FOR ALL COLUMNS SIZE AUTO',
       cascade          => TRUE);
```

- Detailed scripts can be found here:
[Oracle® Database Upgrade Guide Appendix B](#)

- Or in  /  :

```
SQL> EXECUTE dbms_stats.gather_dictionary_stats;
```

Post Upgrade

- Create **system statistics** during a regular workload period - otherwise non-appropriate values for the CBO will be used:

```
SQL> EXECUTE dbms_stats.gather_system_stats('start');  
...  
SQL> EXECUTE dbms_stats.gather_system_stats('stop');
```

```
SQL> select pname NAME, pval1 WERT, pval2 INFO  
       from aux_stats$;
```

NAME	WERT	INFO
-----	-----	-----
STATUS		COMPLETED
DSTART		04-07-2008 12:30
DSTOP		05-07-2008 12:30
FLAGS	1	
CPUSPEEDNW	1392,39	
IOSEEKTIM	11,405	
IOTFRSPEED	25595,605	
...		

Post Upgrade

- Create **fixed table statistics** soon after the upgrade:

```
SQL> execute  
       dbms_stats.gather_fixed_objects_stats;
```

Validate statistics gathering strategy

Default for DBMS_STATS is

```
DBMS_STATS.GATHER_SCHEMA_STATS(OWNNAME=>'NAME',-  
  ESTIMATE_PERCENT=>DBMS_STATS.AUTO_SAMPLE_SIZE,-  
  METHOD_OPT=>'FOR ALL COLUMNS SIZE AUTO',-  
  GRANULARITY =>'AUTO',-  
  CASCADE=>DBMS_STATS.AUTO_CASCADE,-  
  NO_INVALIDATE=>DBMS_STATS.AUTO_INVALIDATE);
```

ESTIMATE_PERCENT is set to AUTO_SAMPLE_SIZE.

In 11g You are encouraged to use AUTO_SAMPLE_SIZE for
ESTIMATE_PERCENT .

In 11g AUTO_SAMPLE_SIZE is very fast compared to earlier versions.
and gives accuracy of close to 100 % sample size.

AUTO_SAMPLE_SIZE uses a new Hash-based Sampling for Column
Statistics.

Validate statistics gathering strategy

- New Features in dbms_stats in 11g
- Multicolumn Statistics
- Expression Statistics
- Statistic Preferences

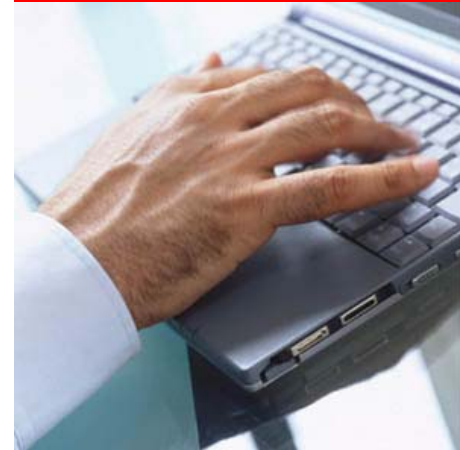
Best Practices

- Possibilities for performance analysis and prediction:
 - STATSPACK
 - AWR
 - SQL Plan Management
 - Real Application Testing
 - SQL Performance Analyzer
 - Database Replay



Agenda

- Recap
- Challenges & Best Practices
- AWR & STATSPACK
- SQL Plan Management
- Real Application Testing
- Q&A



Automatic Workload Repository

- Since Oracle 10g: **AWR** (Automatic Workload Repository)
 - Statistics repository in the SYSAUX tablespace
 - Contains AWR snapshots (current and past periods)
 - Requires a license for Diagnostic Pack
 - Command line report:
 - `@?/rdbms/admin/awrrpt.sql`
 - Export the AWR:

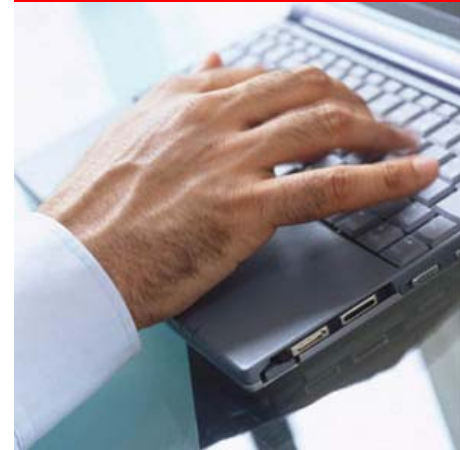
```
begin
  DBMS_SWRP_INTERNAL.AWR_EXTRACT(
    dmpfile => 'awr_data.dmp',
    dmpdir  => 'TMP_DIR',
    bid     => 302,
    eid     => 305);
end;
/
```

STATSPACK

- Database performance tool - pre-10g
 - [Note:394937.1](#) STATSPACK guide
 - Export the PERFSTAT user

Agenda

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Challenge



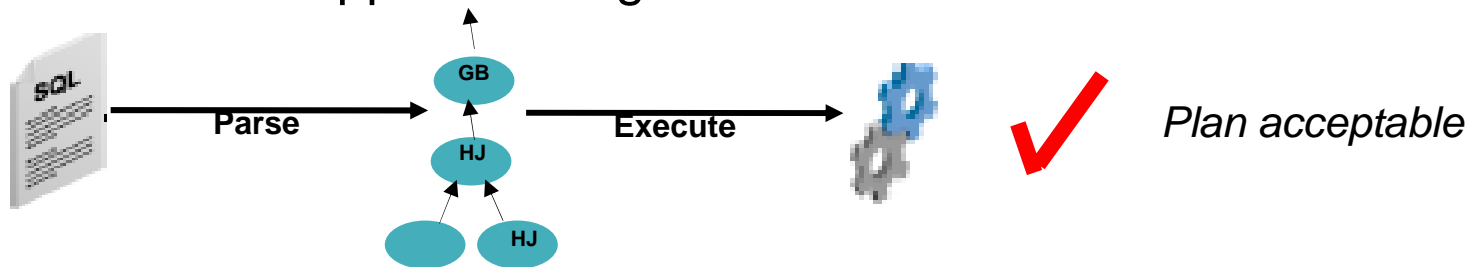
How do I ensure
plan stability???

Plan Stability Techniques

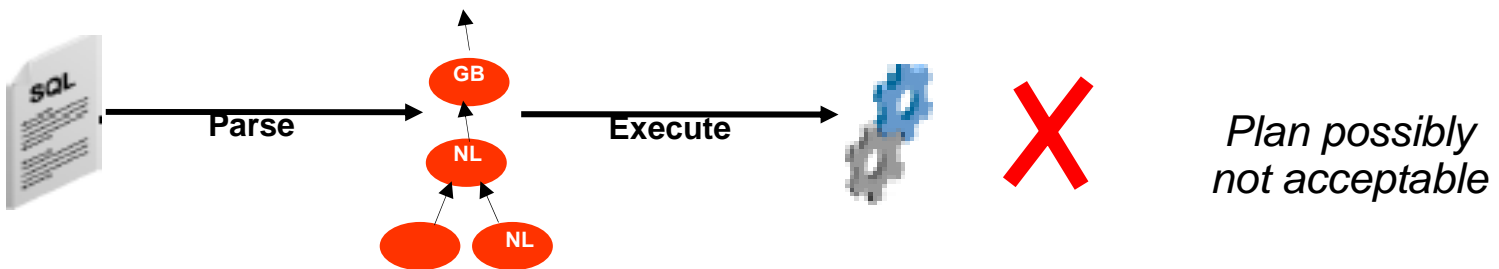
- Optimizer - prevent execution plan changes:
 - Classical approach:
 - Rule Based Optimizer (Please note: [RBO desupport since Oracle 10g](#))
 - Hints
 - Stored Outlines
 - Rewriting SQL statements
 - optimizer_features_enabled=n.n.n
 - Change specific optimizer parameters
 - Import and fix object and system statistics
 - Modern, efficient and better resource consumption:
 - SQL Plan Management
 - SQL Profiling

Without SQL Plan Management

- Challenging to "freeze" execution plans and statistics
- Difficulty:
 - Statement has been parsed and a plan got created. Verification happens during execution:



- Now some conditions get changed (e.g. upgrade)
 - A new plan will be created - is it better or worse???



SQL Plan Management

- First **preventive** and **fully transparent** database mechanism to ensure plan stability
- SQL execution plans will be recorded
- A SQL Baseline will be created
 - Consists of accepted execution plans
 - Contains only plans for statements being parsed/executed more than once
- Only known and verified and accepted plans will be used
- Package: **DBMS_SPM**

SQL Plan Management

- 3 phases for plan stability:
 - Capture
 - Create a SQL Baseline representing **trusted** execution plans
 - Baseline is stored in SQL Management Base in tablespace SYSAUX
 - There are two ways to capture execution plans in the SPM Management Base.
 - Automatic capture of execution plans by setting.
 - `OPTIMIZER_CAPTURE_SQL_PLAN.`
 - Manual Plan Loading or Bulk load of execution plans using
 - `DBMS_SPM.LOAD_PLANS_FROM_SQLSET`
 - `DBMS_SPM.LOAD_PLANS_FROM_CURSOR_CACHE`
 - Selection
 - Only accepted plans will be used
 - New execution plans will be recorded in the plan history
 - Evolution
 - Evaluate all unverified plans for a given statement in the plan history to become either accepted or rejected

SQL Plan Management

- White Paper:
 - http://www.oracle.com/technology/products/manageability/database/pdf/ow07/spm_white_paper_ow07.pdf

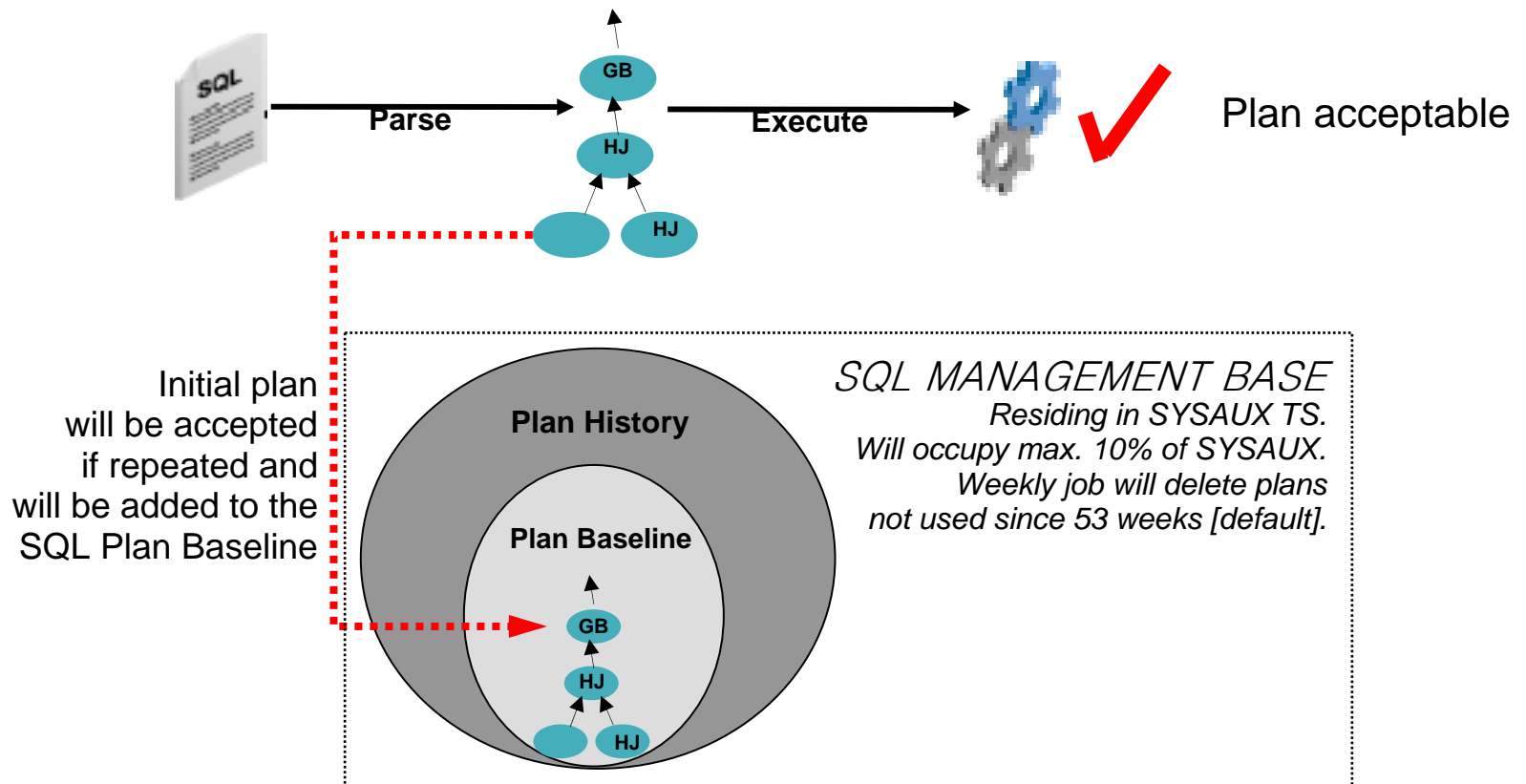
SQL Plan Management in Oracle Database 11g

An Oracle White Paper
June 2007

SQL Plan Management

- Phase 1 - Capture

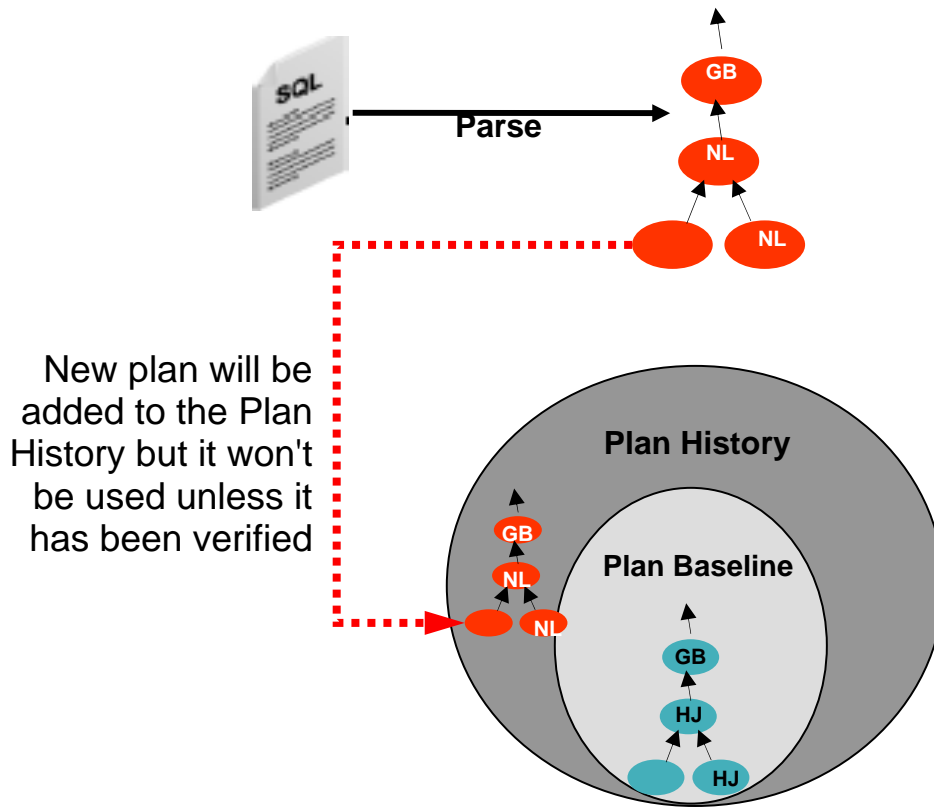
- `OPTIMIZER_CAPTURE_SQL_PLAN_BASELINE=TRUE` (Default: `FALSE`)



SQL Plan Management

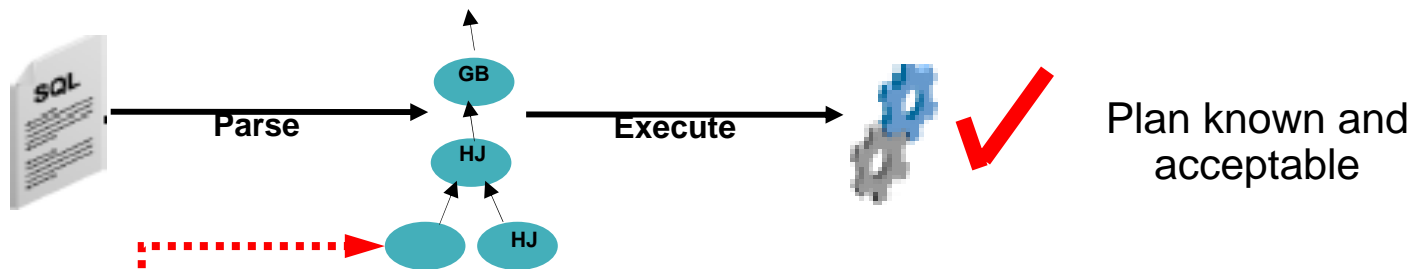
- Phase 2 - Selection

- `OPTIMIZER_USE_SQL_PLAN_BASELINE=TRUE` (Default: `TRUE`)
- Same statement parsed again but a different plan will be created

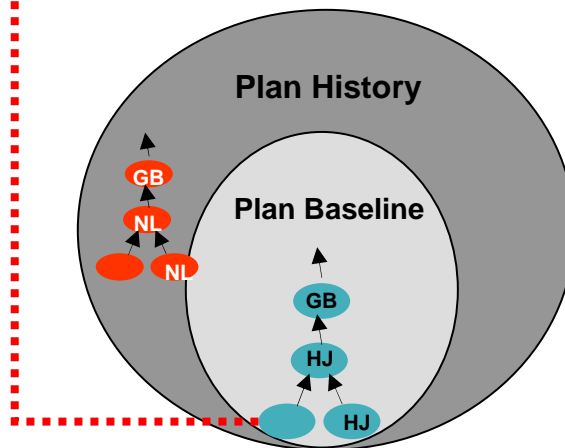


SQL Plan Management

- Phase 2 - Selection
 - `OPTIMIZER_USE_SQL_PLAN_BASELINE=TRUE`

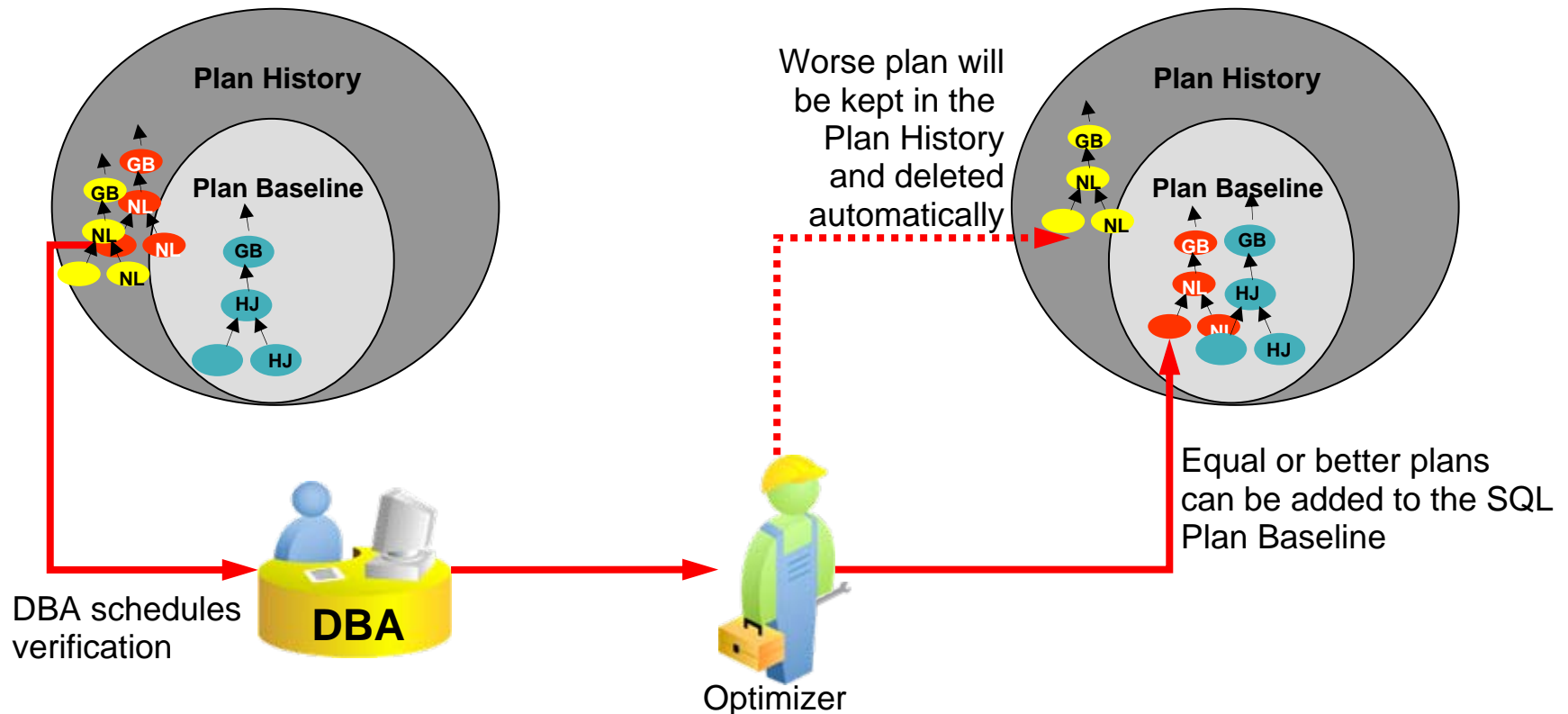


The optimizer will use only one of the VERIFIED plans stored in the SQL Baseline because only these will guarantee PLAN STABILITY



SQL Plan Management

- Phase 3 - Evolution



SQL Plan Management

- DatabaseControl:

Database Instance: ORCL

The screenshot displays the Oracle Database Control interface for instance ORCL. The 'Server' tab is selected, indicated by a red arrow labeled '1'. The interface is organized into several sections:

- Storage**
 - [Control Files](#)
 - [Tablespaces](#)
 - [Temporary Tablespace Groups](#)
 - [Datafiles](#)
 - [Rollback Segments](#)
 - [Redo Log Groups](#)
 - [Archive Logs](#)
 - [Migrate to ASM](#)
 - [Make Tablespace Locally Managed](#)
- Statistics Management**
 - [Automatic Workload Repository](#)
 - [AWR Baselines](#)
- Database Configuration**
 - [Memory Advisors](#)
 - [Automatic Undo Management](#)
 - [Initialization Parameters](#)
 - [View Database Feature Usage](#)
- Resource Manager**
 - [Getting Started](#)
 - [Consumer Groups](#)
 - [Consumer Group Mappings](#)
 - [Plans](#)
 - [Settings](#)
 - [Statistics](#)
- Change Database**
 - [Add Instance](#)
 - [Delete Instance](#)
- Oracle Scheduler**
 - [Jobs](#)
 - [Chains](#)
 - [Schedules](#)
 - [Programs](#)
 - [Job Classes](#)
 - [Windows](#)
 - [Window Groups](#)
 - [Global Attributes](#)
 - [Automated Maintenance Tasks](#)
- Security**
 - [Users](#)
 - [Roles](#)
 - [Profiles](#)
 - [Audit Settings](#)
 - [Transparent Data Encryption](#)
 - [Virtual Private Database Policies](#)
 - [Application Contexts](#)
- Query Optimizer**
 - [Manage Optimizer Statistics](#)
 - [SQL Plan Control](#)

A red arrow labeled '2' points to the 'SQL Plan Control' link in the 'Query Optimizer' section.

SQL Plan Management

- DatabaseControl - Configuration:

ORACLE Enterprise Manager 11g
Database Control

[Setup](#) [Preferences](#) [Help](#) [Logout](#)

Database

Database Instance: orcl.de.oracle.com >

Logged in As SYS

SQL Plan Control

[SQL Profile](#)

1

SQL Plan Baseline

[Refresh](#)

A SQL Plan Baseline is an execution plan deemed to have acceptable

Start with 5-14 weeks:

```
exec DBMS_SPM.CONFIGURE('plan_retention_weeks',5);
```

2

Settings

Capture SQL Plan Baselines [TRUE](#)

Use SQL Plan Baselines [TRUE](#)

Plan Retention(Weeks) [Configure](#)

[Load Jobs](#)

Search

SQL Text [Go](#)

By default, the search returns all uppercase matches beginning with the string you entered. To run an exact or case-sensitive match, double quote the search string. You can use the wildcard symbol (%) in a double quoted string.

[Load](#) [Unpack](#)

[Enable](#) [Disable](#) [Drop](#) [Evolve](#) [Pack](#) Fixed - Yes [Go](#)

[Previous](#) 1-25 of 338 [Next 25](#)

[Select All](#) | [Select None](#)

Select	Name	SQL Text	Enabled	Accepted	Fixed	Auto Purge	Created	Last Modified
<input type="checkbox"/>	SYS SQL PLAN ffd2e0664c0ef6a	select end_time, wait_class#, (time waited)...	YES	YES	NO	YES	Aug 20, 2007 7:45:26 PM	Aug 20, 2007 7:45:26 PM
<input type="checkbox"/>	SYS SQL PLAN ff7b3f95f59a06ad	SELECT timezone region FROM mgmt targets WHERE tar...	YES	YES	NO	YES	Aug 21, 2007 8:42:53 AM	Aug 21, 2007 8:42:53 AM

3

SQL Plan Management

- DatabaseControl - details:

ORACLE Enterprise Manager 11g
Database Control

[Setup](#) [Preferences](#) [Help](#) [Logout](#)

Database

Database Instance: ord.de.oracle.com >

Logged in As SYS

SQL Plan Control

Return

SQL Plan Baseline Details

SQL handle: SYS_SQL_f1df8ad0ff7b3f95
SQL text: SELECT timezone_region FROM mgmt_targets WHERE target_name=:1 AND
 target_type=:2

Plan name: SYS_SQL_PLAN_ff7b3f95f59a06ad
Enabled: YES Fixed: NO Accepted: YES Origin: AUTO-CAPTURE

Plan hash value: 2383372605

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	54	1 (0)	00:00:01
1	TABLE ACCESS BY INDEX ROWID	MGMT_TARGETS	1	54	1 (0)	00:00:01
* 2	INDEX UNIQUE SCAN	MGMT_TARGETS_PK	1		0 (0)	00:00:01

Predicate Information (identified by operation id):


2 - access("TARGET_TYPE"=:2 AND "TARGET_NAME"=:1)

SQL Plan Management

- DatabaseControl - evolve:

Enable Disable Drop Evolve Pack Fixed - Yes Go

Select All Select None

Select	Name	SQL Text	Enabled	Accepted	Fixed	Auto Purge	Created	Last Modified
	SYS_SQL_PLAN_6221c9c4380f747a	SELECT name, sql_text, SUBSTR(sql_text,1,50),categ...	YES	NO	NO	YES	Aug 20, 2007 10:10:09 PM	Aug 20, 2007 10:10:09 PM
<input type="checkbox"/>	SYS_SQL_PLAN_6221c9c4c6d535c1	SELECT name, sql_text, SUBSTR(sql_text,1,50),categ...	YES	YES	NO	YES	Aug 20, 2007 7:46:01 PM	Aug 20, 2007 7:46:01 PM



Database Instance: orcl.de.oracle.com >

Logged in As SYS

SQL Plan Control

Cancel OK

Evolve SQL Plan Baselines

Plans that have not yet been accepted can be evolved (verified) to confirm they are suitable plan baselines.

Name	SQL Text
SYS_SQL_PLAN_6221c9c4380f747a	SELECT name, sql_text, SUBSTR(sql_text,1,50),categ...

Verify Performance ☒ Yes ☐ No

Time Limit ☒ Auto ☐ Unlimited ☐ Specify (minutes)

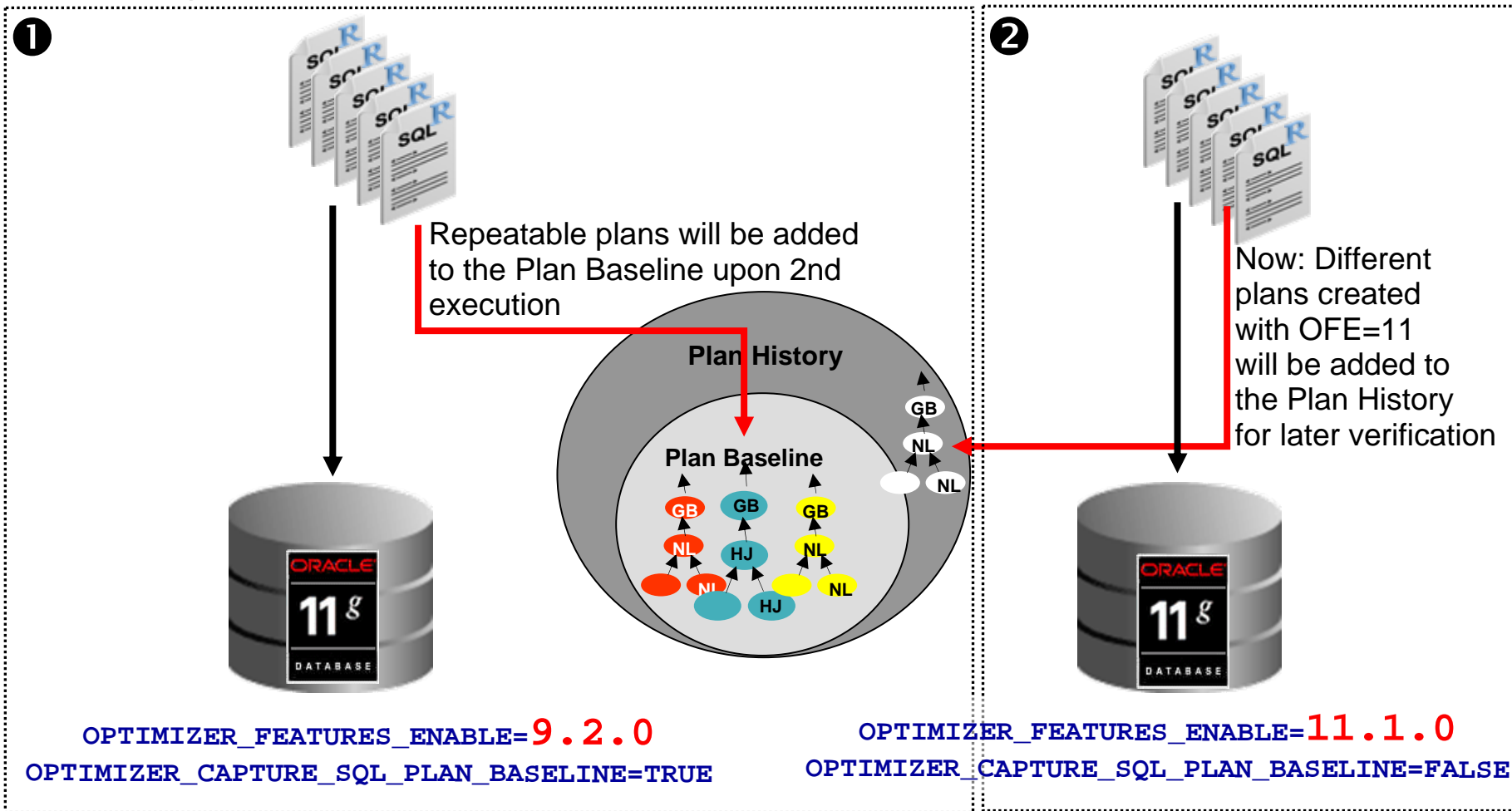
Action ☒ Report and Accept ☐ Report only

SQL Plan Management - Scenarios

- Upgrade scenario 1:
 - Parameterize the optimizer back to the "old" behaviour
 - Works for all database releases since 8.0.3
- Upgrade scenario 2:
 - Transport all well known plans to the new release
 - Works since 10gR2
- Ship a new application (module) along with appropriate SQL plan baselines:
 - Ship the best execution plans for the new statements within a staging table and ensure that they'll be used
 - Works since 10gR2

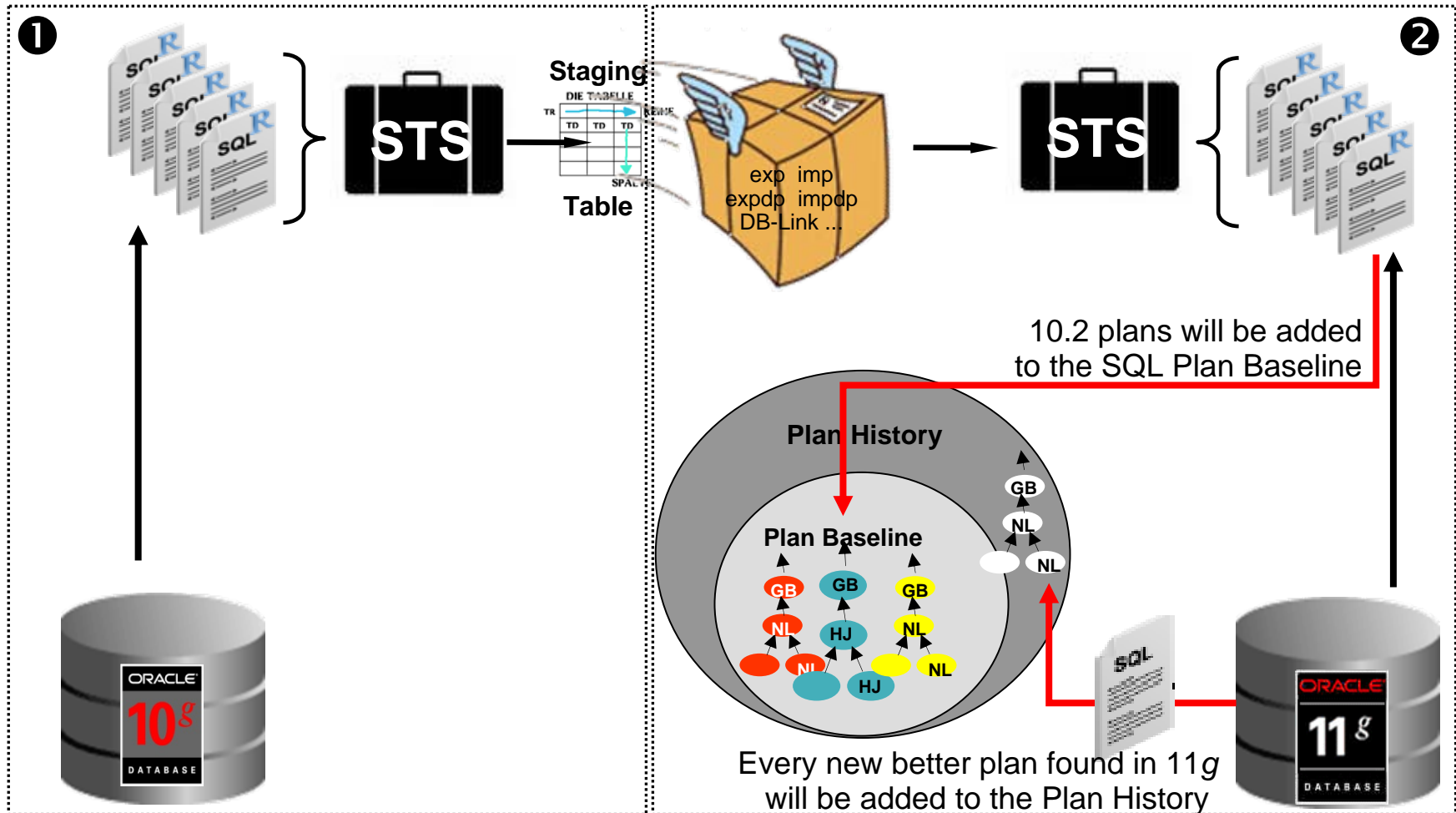
SQL Plan Management - Upgrade 1

- Upgrade scenario 1



SQL Plan Management - Upgrade 2

- Upgrade scenario 2

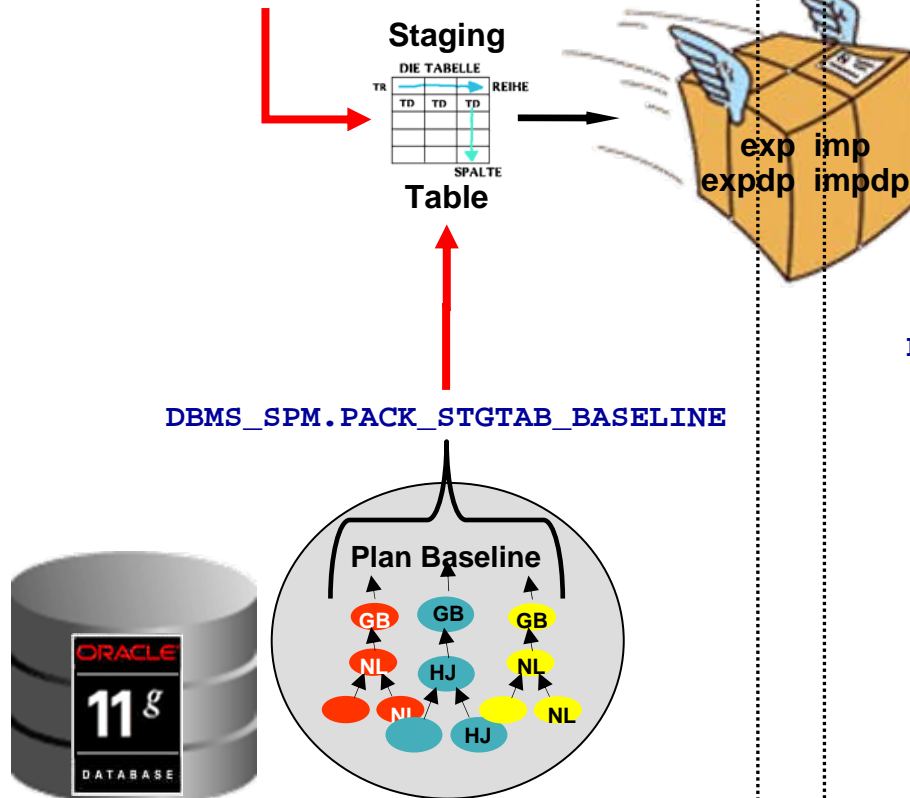


SQL Plan Management - New Application

- New application (module) gets delivered

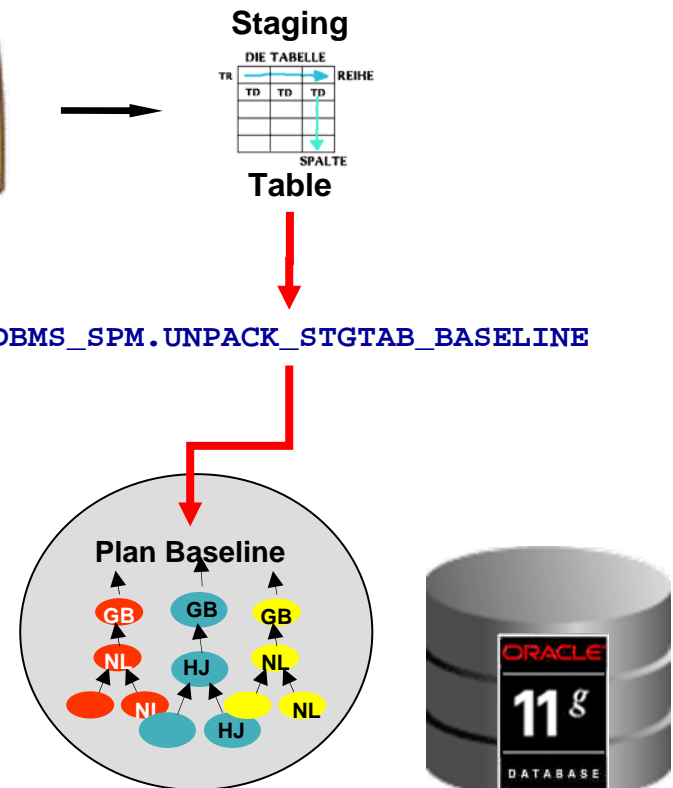
1 @Vendor

DBMS_SPM.CREATE_STGTAB_BASELINE



② @Customer

DBMS_SPM.UNPACK_STGTAB_BASELINE

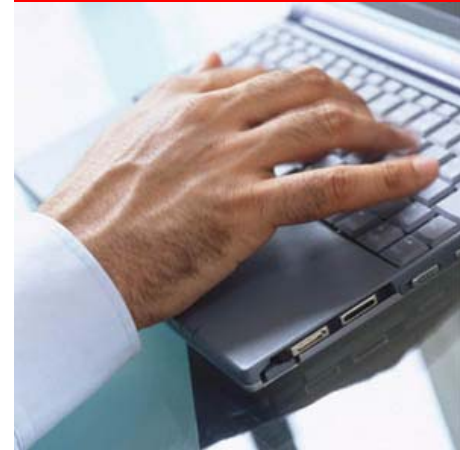


SPM NOTES

- **Note.789888.1**
HOW TO LOAD SQL PLANS INTO SPM FROM AWR.
- **Note 801033.1**
HOW TO MOVE 10gR2 EXECUTION PLANS AND LOAD INTO 11g SPM.
- **Note.790039.1**
HOW TO DROP PLANS FROM SPM REPOSITORY.
- **Note.456518.1 SQL PLAN MANAGEMENT.**

Agenda

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- Challenges & Best Practices
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Real Application Testing

- Goal:
 - Enable successful adoption of new technology and features - specifically new releases of the database - at **low-cost** and **low-risk** by:
 - Record and replay a real workload to see how the new system performs
 - Finding regressions and changing plans before the upgrade
- Licensable database pack "Real Application Testing"
 - ⇒ Available with Oracle Database 11.1.0.6
 - ⇒ Available with patch set 10.2.0.4
 - ⇒ Available as single patch for 9.2.0.8 and 10.2.0.3
 - ⇒ For patch numbers please see [Note:560977.1](#)
 - ⇒ Can be used for upgrades from
 - ⇒ 9.2.0.8 to 10.2.0.3/4
 - ⇒ 9.2.0.8 to 11.1.0.x
 - ⇒ 10.2.0.3/4 to 11.1.0.x

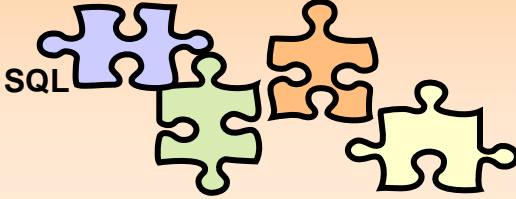
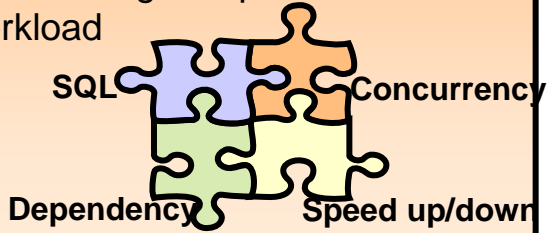
Real Application Testing

- Real Application Testing consists of:
 - Database Replay
 - Package `DBMS_WORKLOAD_CAPTURE`
 - Package `DBMS_WORKLOAD_REPLAY`
 - SQL Performance Analyzer (SPA)
 - Package `DBMS_SQLPA`
 - SQL Tuning Sets (STS)
 - Package `DBMS_SQLTUNE`

Real Application Testing

- White Paper:
 - SQL Performance Analyzer:
 - [Technical White Paper: SQL Performance Analyzer](http://www.oracle.com/technology/products/manageability/database/pdf/ow07/spa_white_paper_ow07.pdf)
`http://www.oracle.com/technology/products/manageability/database/pdf/ow07/spa_white_paper_ow07.pdf`
 - Database Replay:
 - [Technical White Paper: Database Replay](http://www.oracle.com/technology/products/manageability/database/pdf/ow07/db_replay_white_paper_ow07_1.pdf)
`http://www.oracle.com/technology/products/manageability/database/pdf/ow07/db_replay_white_paper_ow07_1.pdf`

Real Application Testing: Tools of the Trade

	<i>SQL Performance Analyzer</i>	<i>Database Replay</i>
What is it?	<ul style="list-style-type: none">Predicts SQL performance deviations before end-users can be impacted, helps assess impact of change on SQL response time	<ul style="list-style-type: none">Replays real database workload on test system, helps assess impact of change on workload throughput
How it works?	<ul style="list-style-type: none">Executes each SQL, stored in SQL Tuning Set, in isolation using production context and then compares before and after execution plans and run-time statistics	<ul style="list-style-type: none">Captures workloads and replays it with production characteristics including concurrency, synchronization & dependencies
When to use?	<ul style="list-style-type: none">Unit testing of SQL with the goal to identify the set of SQL statements with improved/regressed performance  <p>SQL</p>	<ul style="list-style-type: none">Comprehensive testing of all sub-systems of the database server using real production workload  <p>SQL Concurrency Dependency Speed up/down</p>

Real Application Testing

- Database Control:

The screenshot displays the Oracle Enterprise Manager 11g Database Control interface. At the top, the header includes the Oracle logo, 'Enterprise Manager 11g', and 'Database Control'. Navigation links for 'Setup', 'Preferences', 'Help', and 'Logout' are present. A 'Database' tab is selected. The main content area is titled 'Database Instance: SOURCE'. A navigation bar contains links for 'Home', 'Performance', 'Availability', 'Server', 'Schema', and 'Data Management'. A red arrow with the number '1' points to the 'Software and Support' link in this bar. Below the navigation bar, the 'Software' section is active, showing links for 'Configuration' (Collection Status, Clone Oracle Home, Host Configuration, Oracle Home Inventory), 'Database Software Patching' (Patch Advisor, View Patch Cache, Patch Prerequisites, Stage Patch, Apply Patch), 'Deployment Procedure Manager' (Getting Started with Deployment Procedure Manager, Deployment Procedures, Procedure Completion Status, Deployment and Provisioning Software Library), and 'Support' (Support Workbench). A red arrow with the number '2' points to the 'Real Application Testing' link in the left sidebar, which also includes 'Database Replay' and 'SQL Performance Analyzer'.

ORACLE® Enterprise Manager 11g
Database Control

Setup Preferences Help Logout

Database

Logged in As SYS

Database Instance: SOURCE

Home Performance Availability Server Schema Data Management **1** Software and Support

Software

Configuration
[Collection Status](#)
[Clone Oracle Home](#)
[Host Configuration](#)
[Oracle Home Inventory](#)

Database Software Patching
[Patch Advisor](#)
[View Patch Cache](#)
[Patch Prerequisites](#)
[Stage Patch](#)
[Apply Patch](#)

Deployment Procedure Manager
[Getting Started with Deployment Procedure Manager](#)
[Deployment Procedures](#)
[Procedure Completion Status](#)
[Deployment and Provisioning Software Library](#)

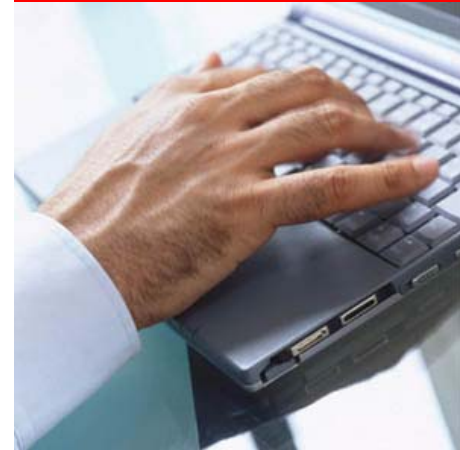
Support
[Support Workbench](#)

2 **Real Application Testing**
[Database Replay](#)
[SQL Performance Analyzer](#)

Agenda

- Recap
- Challenges & Best Practices
- AWR & STATSPACK
- SQL Plan Management
- Real Application Testing
- Q&A

SQL Performance Analyzer
Database Replay



Challenge



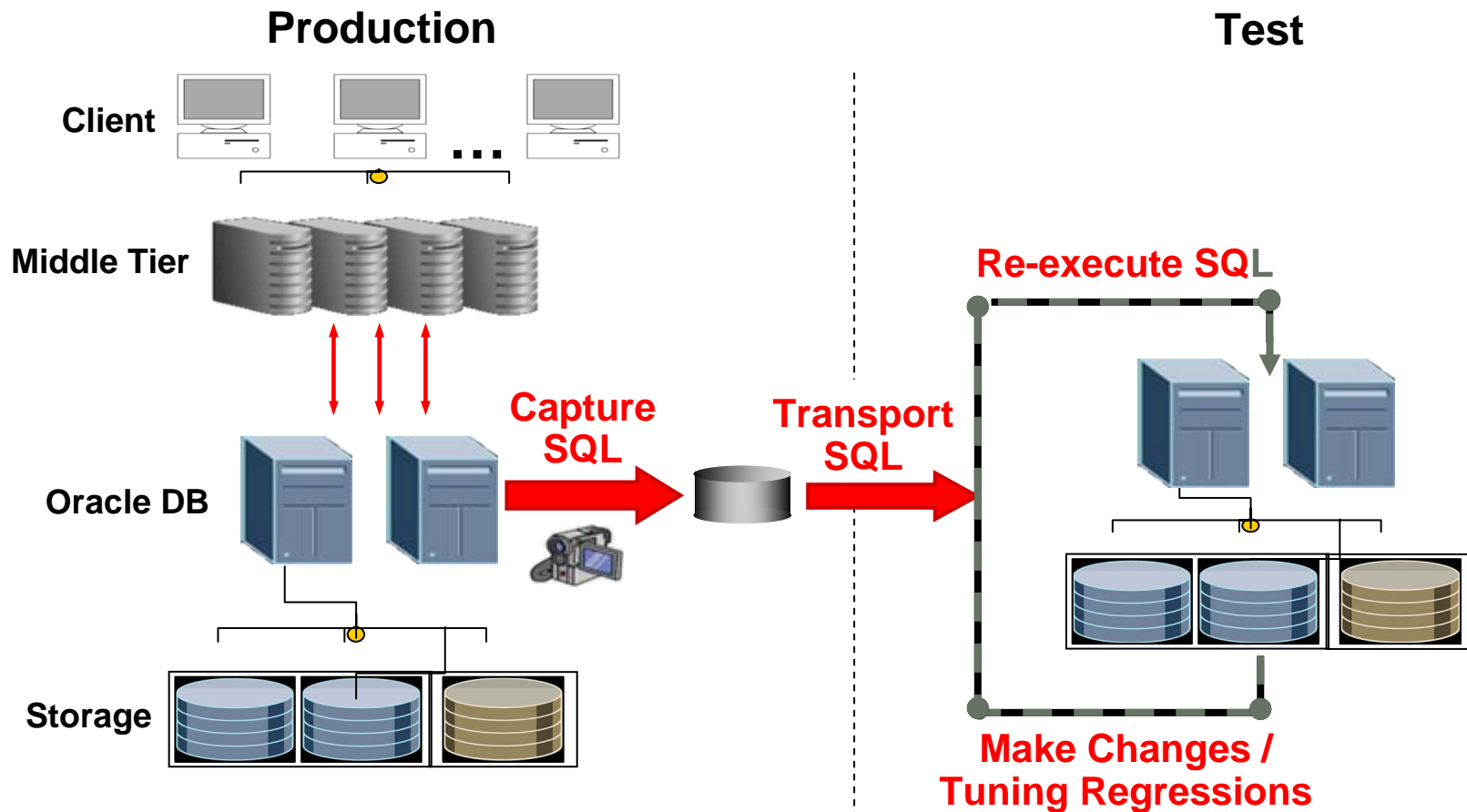
How do I find out
which plans will
be changed?

How do I verify
parameter
changes?

Common SPA Usage Scenarios

- Common SPA usage scenario examples
 - Database upgrades, patch set changes
 - Parameter changes
 - Schema changes
 - Optimizer statistics refresh, etc.
- SPA interface
 - Rich GUI through Enterprise Manager
 - Command line interface through **DBMS_SQLPA** PL/SQL package

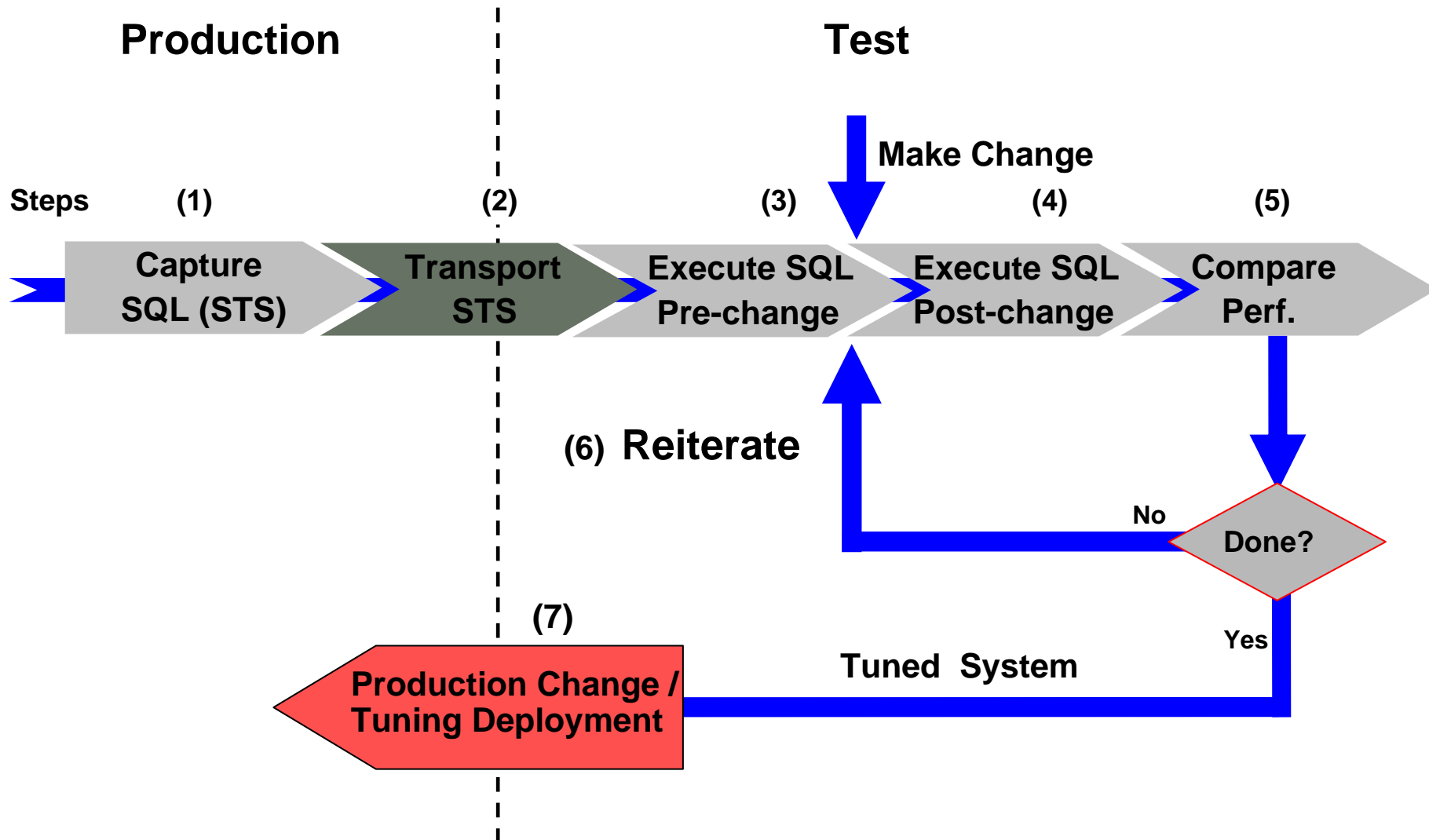
SQL Performance Analyzer: Overview



- If adequate spare cycles available, optionally execute SQL here

* No middle & application tier setup required

SQL Performance Analyzer: Workflow



SPA Workflows

- Possible workflows:
 - Optimizer upgrade simulation (Start: 8.0.0)
 - Init parameter change
 - Guided workflow for manual changes
- All are based on SQL Tuning Sets

Database Instance: v3f.us.oracle.com

SQL Performance Analyzer

Home Performance Availability Serv Page Refreshed Nov 6, 2007 7:10:22 PM PST Refresh

Software

- Configuration
- Collection Status
- Clone Oracle Home
- Host Configuration
- Oracle Home Inventory
- Real Application Testing
- Database Replay
- SQL Performance Analyzer

SQL Performance Analyzer allows you to analyze the effects of environmental changes on the execution performance of SQL contained in a SQL Tuning Set.

SQL Performance Analyzer Workflows


Create and execute SQL Performance Analyzer Task experiments of different types using the following links.

- [Optimizer Upgrade Simulation](#) Test the effects of optimizer version changes on SQL Tuning Set performance.
- [Parameter Change](#) Test and compare an initialization parameter change on SQL Tuning Set performance.
- [Guided Workflow](#) Create a SQL Performance Analyzer Task and execute custom experiments using manually created replay trials.

SQL Performance Analyzer Tasks

Delete Previous 1-25 of 35 Next 10

Select	Name	Owner	Description	Last Run Status	Created	Last Modified
•	TEST1111	SYS		■	Oct 30, 2007 3:40:33 PM	Oct 30, 2007 3:40:33 PM
•	GGG	SYS		✓	Oct 26, 2007 4:25:27 PM	Oct 26, 2007 4:27:52 PM



Database Upgrade: 10g to 11g

Scenario 1:

I want to upgrade from 10.x to 11.x database release to benefit from 11g functionality. How can I best accomplish the upgrade?

Goal:

Assess impact of upgrade on SQL workload performance so that there are no surprises after upgrade. Once upgraded to 11g new features can be enabled one at a time.

Database Upgrade: 10g to 11g

- Step 1:

- Capture workload into STS:
Preferred method (> 10.2.0.1)

```
EXEC DBMS_SQLTUNE.CAPTURE_CURSOR_CACHE_SQLSET( .. )
```

- Create STS from Top SQL in AWR / AWR Baseline

- For 9i database enable SQL tracing:

```
alter system set events  
    '10046 trace name context forever, level 4';
```

Database Upgrade: 10g to 11g

- Step 1 in EM:

SQL Tuning Sets

Page Refreshed Oct 18, 2007 3:36:45 PM PDT

A SQL Tuning Set is a collection of SQL Statements that can be used for tuning purposes.

Search
Filter on a name or partial name

Select	Name	Schema	Description	SQL Count	Created	Last Modified
<input checked="" type="radio"/>	DEMO_TOP_SQL	SYS	TOP SQL used for Database Replay Demo	0	7/17/07 4:14 PM	7/17/07 4:14 PM
<input type="radio"/>	HR_WORKLOAD	APPS	HR SQL Workload	50	7/17/07 12:12 PM	7/17/07 12:12 PM
<input type="radio"/>	REPLAY_WKLD	SYS	Automatically generated by Top SQL	2	7/17/07 4:30 PM	7/17/07 4:30 PM
<input type="radio"/>	TOP_SQL_1184650853048	SYS	Automatically generated by Top SQL	2	7/16/07 10:41 PM	7/16/07 10:41 PM

Create SQL Tuning Set: Load Methods

Database v3f.us.oracle.com

Step 2 of 5

Pick one of the load methods to collect and load SQL statements into the SQL tuning set.

- ☒ Incrementally capture active SQL statements over a period of time from the cursor cache
Specify the duration within which the SQL statements will be collected, and specify frequency over which the active SQL statements from the cursor cache will be collected repeatedly.

Duration Hours

Frequency Minutes

- ☐ Load SQL statements one time only

Data Source

Step 2 of 5

[Home](#) | [Setup](#) | [Preferences](#) | [Help](#) | [Logout](#)

Database Upgrade: 10g to 11g

- Step 2:
Upgrade a copy of 10g production to 11g test database
- Step 3:
Run SPA in 11g test database
 - Select “Optimizer Upgrade” workflow link

Database Upgrade: 10g to 11g

- Step 3 in EM: Run SPA task

SQL Performance Analyzer Workflows

Create and execute SQL Performance Analyzer Task experiments of different types using the following links.

[Optimizer Upgrade](#)

Test the effects of optimizer version changes on SQL Tuning Set performance.

[Parameter Change](#)

Test and compare an initialization parameter change on SQL Tuning Set performance.

[Guided Workflow](#)

Create a SQL P
created replay

Optimizer Upgrade Simulation

Test the effects of optimizer version changes on SQL Tuning Set performance.

Task Information

* Task Name

* SQL Tuning Set

Description

Per-SQL Time Limit

☒ **TIP** Time limit is on elapsed time of test execution of SQL.
EXPLAIN ONLY generates plans without test execution.

Optimizer Versions

Version 1

Version 2

Evaluation

Comparison Metric

Schedule

Time Zone

☒ Immediately

Database Upgrade: 10g to 11g

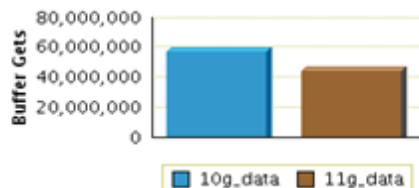
- SPA results

SQL Performance Analyzer Task Result: SYS.UPGRADE_10G11G

Task Name	UPGRADE_10G11G	SQL Tuning Set Name	OOW_54G	Replay Trial 1	10g_data
Task Owner	SYS	STS Owner	SYS	Replay Trial 2	11g_data
Task Description	test upgrade to 11g	Total SQL Statements	54	Comparison Metric	Buffer Gets
		SQL Statements With Errors	0		

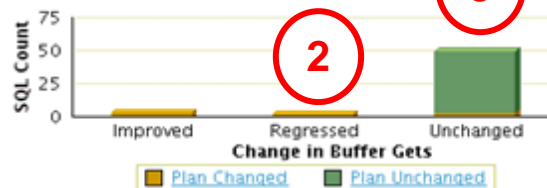
Global Statistics

Projected Workload Buffer Gets



Improvement Impact **24%** ↑
Regression Impact **-2%** ↓
Overall Impact **22%** ↑

SQL Statement Count



Recommendations

Oracle offers two options to fix regressed SQL resulting from plan changes:

Use the better execution plan from SQL Trial 1 by creating SQL Plan Baselines.

Create SQL Plan Baselines

Explore alternate execution plans using SQL Tuning Advisor.

Run SQL Tuning Advisor

Top 10 SQL Statements Based on Impact on Workload

SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	% of Workload		Plan Changed
		10g_data	11g_data		10g_data	11g_data	
↑ g4dzf4ak4rus2	12.000	20,318,458.000	13,502,097.000	33.550	35.780	30.670	Y
↑ gfacm5jr3rz9j	11.990	6,990,541.000	180,401.000	97.420	12.310	0.410	Y
↓ 2ny751aat2vd9	-0.820	12,973,052.000	13,440,825.000	-3.610	22.850	30.530	Y
↓ c2fb0ug5p7d4p	-0.750	12,740,524.000	13,165,998.000	-3.340	22.440	29.910	Y
↑ 2wtgxbjz6u2by	0.050	244,678.000	218,533.000	10.690	0.430	0.500	Y

Database Upgrade: 10g to 11g

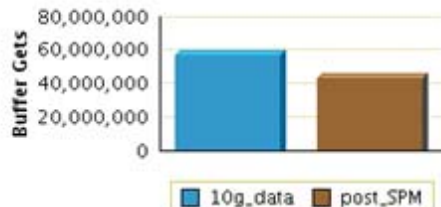
- After using SQL Plan Management with a baseline

SQL Performance Analyzer Task Result: SYS.UPGRADE_10G11G

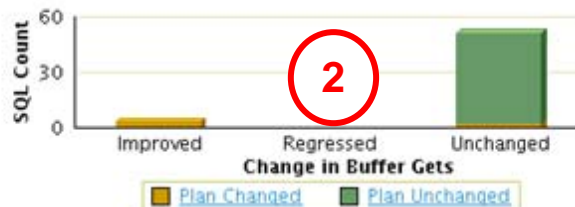
Task Name	UPGRADE_10G11G	SQL Tuning Set Name	OOW_54G	Replay Trial 1	10g_data
Task Owner	SYS	STS Owner	SYS	Replay Trial 2	post_SPM
Task Description	test upgrade to 11g	Total SQL Statements	54	Comparison Metric	Buffer Gets
		SQL Statements With Errors	0		

Global Statistics

Projected Workload Buffer Gets



SQL Statement Count



Improvement Impact 24% ↑

Regression Impact 0% →

Overall Impact 24% ↑

1

Top 10 SQL Statements Based on Impact on Workload

SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	% of Workload		Plan Changed
		10g_data	post_SPM		10g_data	post_SPM	
g4dzf4ak4rus2	12.010	20,318,458.000	13,501,307.000	33.550	35.780	31.300	Y
qfacm5jr3rz9j	11.990	6,990,541.000	180,401.000	97.420	12.310	0.420	Y
2wtqxbjz6u2by	0.050	244,678.000	218,533.000	10.690	0.430	0.510	Y

Parameter Changes

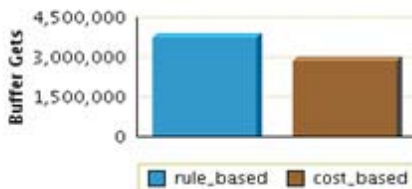
- SPA Recommendation: SQL Tuning Advisor

SQL Performance Analyzer Task Result: SYS.PARAM_CHANGE

Task Name	PARAM_CHANGE	SQL Tuning Set Name	HR_WORKLOAD	Replay Trial 1	rule_based
Task Owner	SYS	STS Owner	APPS	Replay Trial 2	cost_based
Task Description	test rule-based vs cost-based optimizer		Total SQL Statements	50	Comparison Metric
		SQL Statements With Errors	0		Buffer Gets

Global Statistics

Projected Workload Buffer Gets



Improvement Impact **28%** ↑
Regression Impact **-3%** ↓
Overall Impact **24%** ↑

SQL Statement Count



Recommendations

Oracle offers two options to fix regressed SQL resulting from plan changes:

Use the better execution plan from SQL Trial 1 by creating SQL Plan Baselines.

[Create SQL Plan Baselines](#)

Explore alternate execution plans using SQL Tuning Advisor.

[Run SQL Tuning Advisor](#)

Top 10 SQL Statements Based on Impact on Workload

SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	% of Workload		Plan Changed
		rule_based	cost_based		rule_based	cost_based	
↑ 73s2sgy2svfrw	13.790	1,753,552.000	1,238,620.000	29.370	46.950	43.860	Y
↑ qq2a407mv2hsy	13.790	1,753,552.000	1,238,620.000	29.370	46.950	43.860	Y
↓ 2wtqxbjz6u2by	-3.050	218,621.000	332,519.000	-52.100	5.850	11.780	Y
↓ fbp9za0hqk2km	-0.070	6.000	2,721.000	-45,250.000	0.000	0.100	Y

Parameter Changes

- SQL Tuning Advisor offers SQL Profiles

SQL Tuning Results:TUNEREG

Status COMPLETED
Started Jul 17, 2007 2:03:03 PM
Completed Jul 17, 2007 2:03:34 PM

Page Refreshed Oct 18, 2007 6:01:09 P
Tuning Set Owner APPS
Tuning Set Name HR_WORKLOAD
Time Limit (seconds) 1800
Running Time (seconds) 31

Recommendations

[View](#) [Implement All Profiles](#)

Select SQL Text	Parsing Schema	SQL ID	Statistics	SQL Profile	Index	Restructure SQL	Misce
<input checked="" type="radio"/> SELECT /* my_query_14_scott */ /*+ ORDERED INDEX(t1) USE_HASH(t1) */ 'B' t2.pg_featurevalue_0...	APPS	2wtgxbjz6u2by		✓		✓	
<input type="radio"/> SELECT /* my_query_4_scott */ DISTINCT 'B' t1.pg_featurevalue_47_id pg_featurevalue_47_id FRO...	APPS	fbp9za0hqk2km		✓			
<input type="radio"/> SELECT /* my_query_1_scott */ DISTINCT 'B' t1.pg_featurevalue_15_id pg_featurevalue_15_id FRO...	APPS	1h3c2y092ds9d		✓			
<input type="radio"/> SELECT /* my_query_2_scott */ DISTINCT 'B' t1.pg_featurevalue_15_id pg_featurevalue_15_id FR...	APPS	654xs8xs5wp42		✓			

Parameter Changes

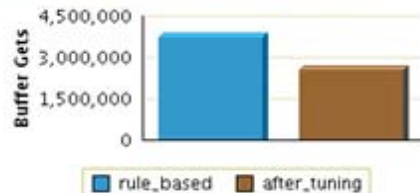
- SPA run after SQL Profiles had been applied

SQL Performance Analyzer Task Result: SYS.PARAM_CHANGE

Task Name	PARAM_CHANGE	SQL Tuning Set Name	HR_WORKLOAD	Replay Trial 1	rule_based
Task Owner	SYS	STS Owner	APPS	Replay Trial 2	after_tuning
Task Description	test rule-based vs cost-based optimizer	Total SQL Statements	50	Comparison Metric	Buffer Gets
		SQL Statements With Errors	0		

Global Statistics

Projected Workload Buffer Gets



Improvement Impact **33%** ↑
 Regression Impact **0%** →
 Overall Impact **33%** ↑

SQL Statement Count



1

Top 10 SQL Statements Based on Impact on Workload

SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	% of Workload		Plan Changed
		rule_based	after_tuning		rule_based	after_tuning	
73s2sqy2svfrw	13.790	1,753,552.000	1,238,620.000	29.370	46.950	49.300	Y
gq2a407mv2hsy	13.790	1,753,552.000	1,238,620.000	29.370	46.950	49.300	Y
2wtqxbjz6u2by	5.090	218,621.000	28,343.000	87.040	5.850	1.130	Y

SQL Performance Analyzer

- SPA: SQL statement details example

SQL Performance Analyzer Task Result: SYS.SPA_JFV1

Task NameSPA_JFV1Task OwnerSYSTask Description

SQL Tuning Set NameSTS_JFVSTS OwnerSYSTotal SQL Statements41SQL Statements With Errors0

Replay Trial 1initial_sql_trialReplay Trial 2second_sql_trialComparison MetricElapsed Time

SQL Details: 4nvxdshmlusna

Parsing SchemaAPPS

Execution Frequency1

Schedule SQL Tuning Advisor

SQL Text

Single Execution Statistics

	Execution Statistic Name	Net Impact on Workload (%)	Execution Statistic Collected		Net Impact on SQL (%)	% of Workload	
			initial_sql_trial	second_sql_trial		initial_sql_trial	second_sql_trial
↓	Elapsed Time	-6.090	44.303	66.475	-50.050	12.180	28.890
↓	Parse Time	-5.920	0.060	0.120	-100.000	5.920	9.840
↓	CPU Time	-19.330	4.095	66.341	-1,520.050	1.270	30.590
↓	Buffer Gets	-32.050	522,950.000	15,295,217.000	-2,824.800	1.130	30.720
↑	Optimizer Cost	1.770	2,900.000	2,163.000	25.410	6.980	5.010
↑	Disk Reads	84.460	65,496.000	0.000	100.000	84.460	0.000
→	Direct Writes	0.000	0.000	0.000	0.000	0.000	0.000
→	Rows Processed	0.000	8.000	8.000	0.000	0.000	0.000

Problem Findings

The performance of this SQL has regressed.

Symptom Findings

The structure of the SQL execution plan has changed.

Information Findings

Plan Comparison

initial_sql_trial

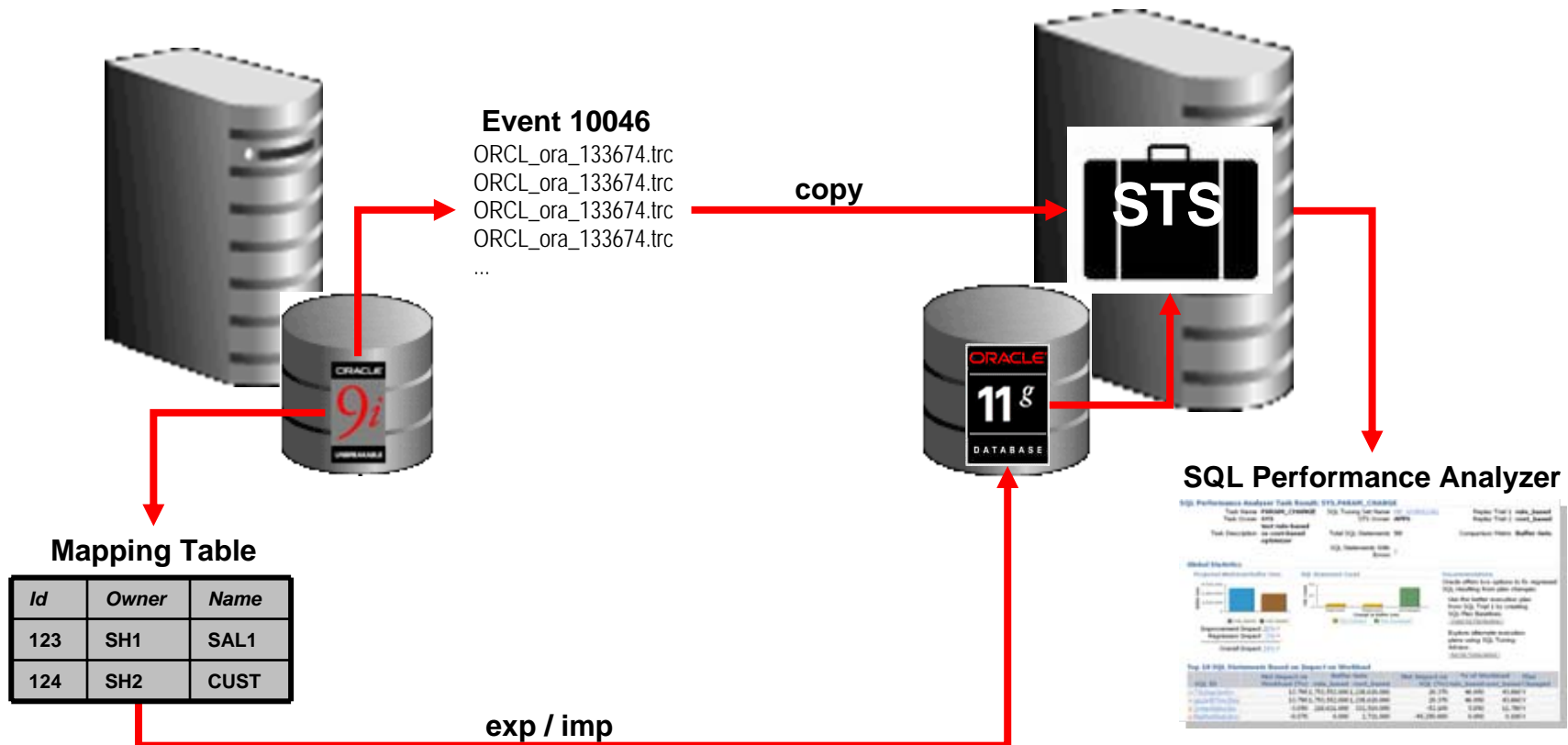
Plan Hash Value 3480296

Expand AllCollapse All

Operation	Line ID	Object	Rows	Cost	Predicate
SELECT STATEMENT	0		1	2,900	
HASH	1		1	2,900	
VIEW	2		1	2,899	
HASH	3		1	2,899	
FILTER	4				
HASH JOIN	5		1	2,754	"T2"."CH_FEATUREVALUE_02_ID"=...
HASH JOIN	6		1	2,610	"T2"."COUNTRY_CHANNEL_ID"="T4"...
HASH JOIN	7		1	2,466	"T1"."OUTLET_ID"="T2"."OUTLET_...
HASH JOIN	8		1	2,343	"T1"."PERIOD_ID"="T8"."VALUE_I...

SPA for a 9i workload against 11g

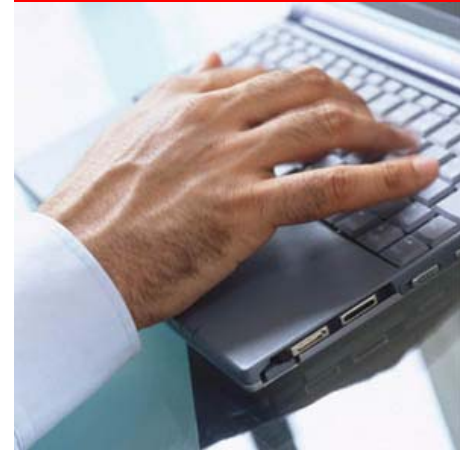
- Upgrade scenario from 9i directly to 11g
 - See Note: 562899.1 for the [White Paper](#) and Note:455889.1 for a SPA example



Agenda

- Recap
- Challenges & Best Practices
- AWR & STATSPACK
- SQL Plan Management
- Real Application Testing
- Q&A

SQL Performance Analyzer
Database Replay



Challenge



How will my system
perform after an
upgrade?

Will all
application calls
work in 11g?

Database Replay

- **Capture and replay** an actual production database workload
- Identify, analyze and fix potential instabilities before making changes to production



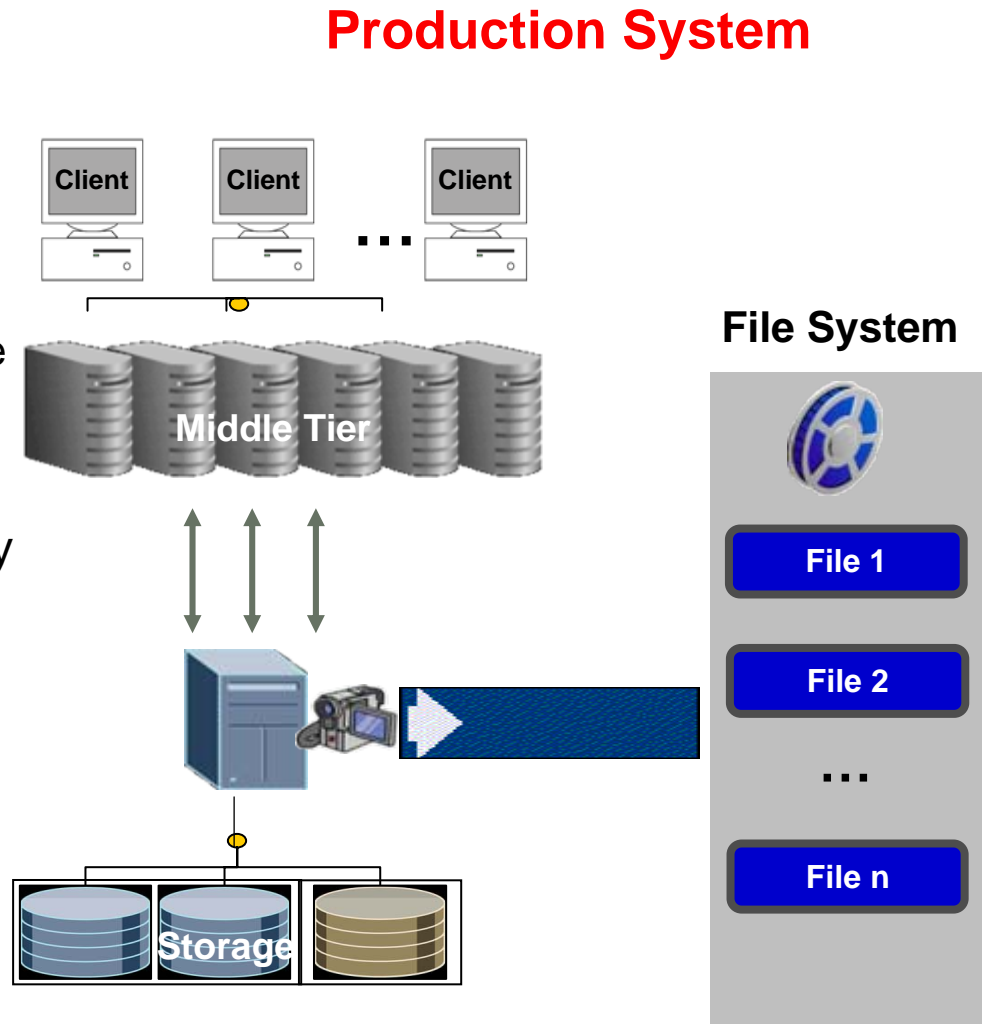
- **Capture Workload in Production**
 - Capture full production workload with real load, timing & concurrency characteristics
 - Move the captured workload to test system
- **Replay Workload in Test**
 - Make the desired changes in test system
 - Replay workload with full production characteristics
 - Honor commit ordering

- **Analyze & Report**
 - Errors
 - Data divergence
 - Performance divergence



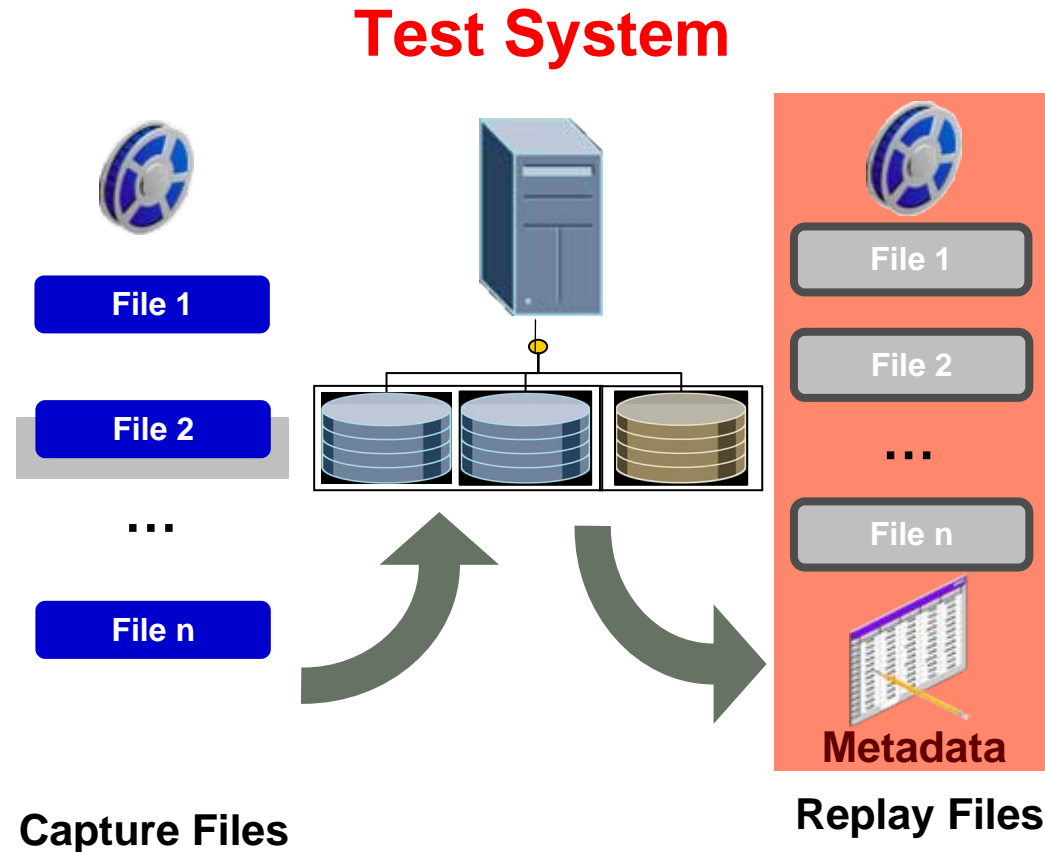
Step 1: Workload Capture

- All external client requests captured in **binary files**
- System background and internal activity excluded
- Minimal overhead
 - Avoids function call when possible
 - Buffered I/O
- Independent of client protocol
- Can capture on 9.2.0.8 and replay on 11g
- Capture load for interesting time period, e.g., peak workload, month-end processing, etc.



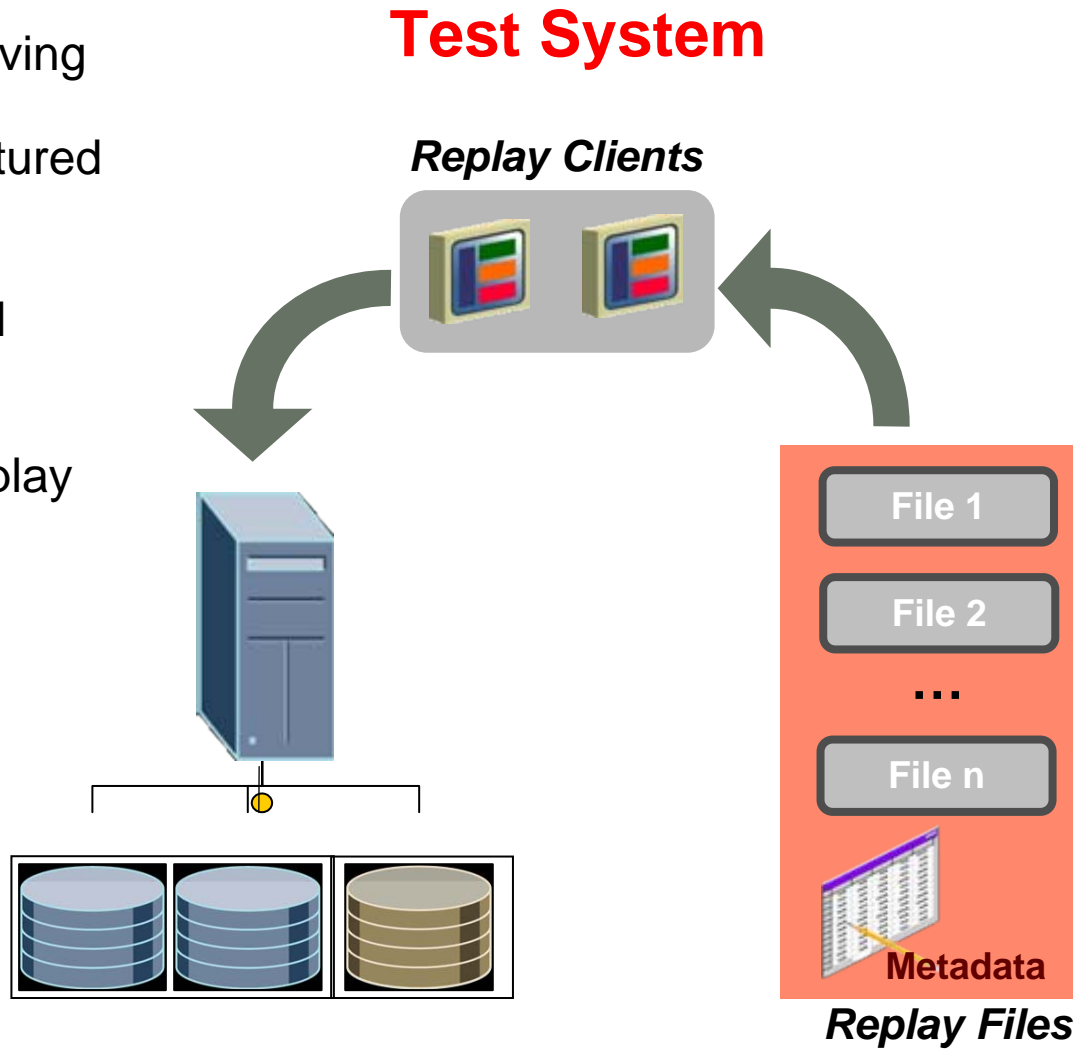
Step 2: Process Workload Files

- Setup test system
 - Application data should be same as production system as of capture start time
 - Use RMAN, Snapshot Standby, imp/exp, Data Pump, etc. to create test system
 - Make change: upgrade db and/or OS, change storage, migrate platforms, etc.
- Pre-processing transforms captured data into replayable format
- Once pre-processed, workload can be replayed many times



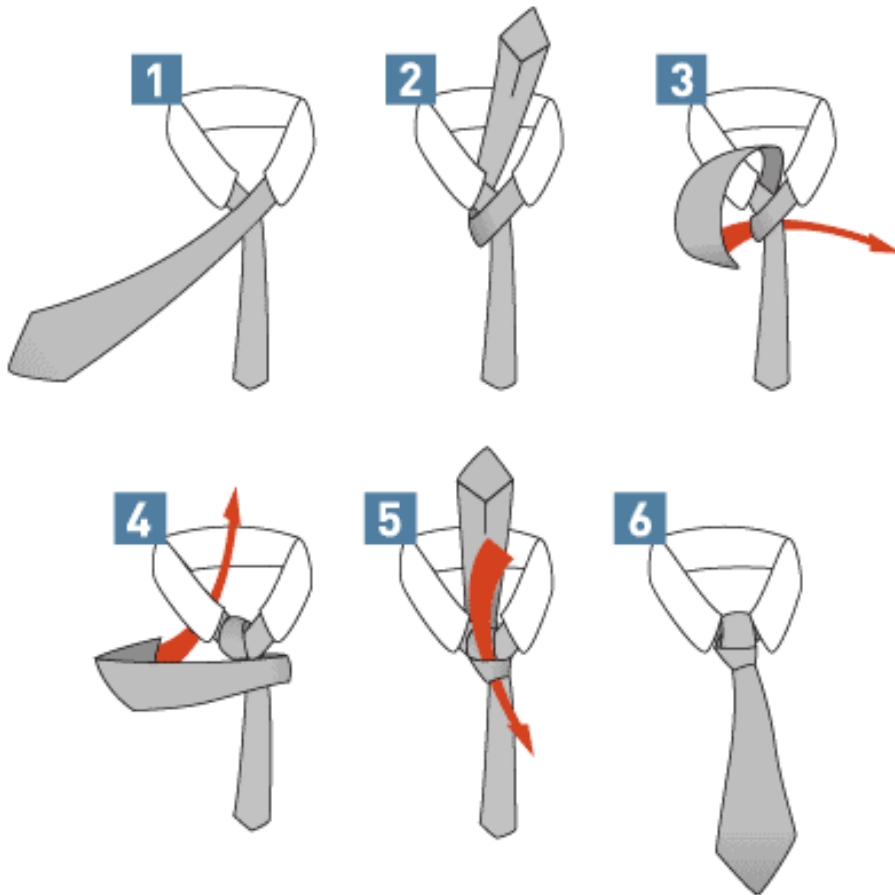
Step 3: Replay Workload

- Replays workload preserving timing, concurrency and dependencies of the captured system
- Replay Client is a special program that consumes processed workload and sends requests to the replay system
- For high concurrency workloads, it may be necessary to start multiple clients



Database Replay

- Step-By-Step



Database Replay

1. Create a copy of the database to replay the workload
 - RMAN Duplicate
 - Snapshot Standby

Database Replay




2. Workflow in EM: Workload Capture

ORACLE Enterprise Manager 11g
Database Control

Setup Preferences Help Logout
Database

Database Instance: SOURCE > Logged in As SYS

Database Replay
The Database Replay feature allows database workload to be captured on one system and replayed later on a different system. Replaying a captured workload can be useful to compare two different systems.
Page Refreshed Aug 27, 2007 7:37:11 PM CEST Refresh

Task	Task Name	Description	Go to Task
1	Capture Workload	Choose this option to capture workload on this database.	
2	Preprocess Captured Workload	Preprocessing will prepare a captured workload for replay. This must be done once for every captured workload.	
3	Replay Workload	Choose this option to replay a preprocessed workload on this database.	

Overview
The following are the typical steps to perform Database Replay:

1. Capture the workload on a database. (Task 1)
2. Optionally export the AWR data. (Task 1)
3. Restore the replay database on a test system to match the capture database at the start of the workload capture.
4. Make changes (such as perform an upgrade) to the test system as needed.
5. Copy the workload to the test system.
6. Preprocess the captured workload. (Task 2)
7. Configure the test system for the replay.
8. Replay the workload on the restored database. (Task 3)

[View Workload Capture History](#)

Active Capture and Replay

Select	Name	Type	Directory Object	Start Time
	No items found			

Database Replay

2. Preparation steps in EM: Workload Capture

ORACLE® Enterprise Manager 11g Database Control [Setup](#) [Preferences](#) [Help](#) [Logout](#)

Database

Plan Environment Options Parameters Schedule Review

Capture Workload: Plan Environment

Database **SOURCE** [Cancel](#) Step 1 of 5 [Next](#)
Logged In As **SYS**

The following prerequisites should be met before proceeding to capturing the workload to avoid potential problems.

i It is highly recommended to meet and acknowledge each of the following prerequisites.

Prerequisite	Acknowledge
<u>Restarting the database</u> prior to workload capture is recommended for the best workload replay result. Consider scheduling the workload capture at a time when the database can be restarted.	<input type="checkbox"/>
Make sure there is <u>enough disk space</u> to hold the captured workload. Consider doing a short duration workload capture and use it for estimating disk space requirement of a full workload capture.	<input type="checkbox"/>
Make sure <u>you can restore the replay database</u> to match the capture database at the start of the workload capture. A successful workload replay depends on application transactions accessing application data identical to that on a capture system. Common ways to restore application data state include point-in-time recovery, flashback, and import/export.	<input type="checkbox"/>

[Cancel](#) Step 1 of 5 [Next](#)

Database Replay

3. Workload Filter:

Plan Environment

Options

Parameters

Schedule

Review

Capture Workload: Options

Database **SOURCE**
Logged In As **SYS**

Cancel Back Step 2 of 5 Next

Database Restart Options

A database restart prior to a workload capture is normally required to ensure a complete and accurate capture.

☒ **TIP** Not restarting could result in in-flight transactions being captured, which may adversely affect the replay of subsequent captured transactions.

☒ Restart the database prior to the capture. (Recommended)

☐ Do not restart the database prior to the capture.

Workload Filters

Workload filters are used to customize what workload will be captured. By default, most external client requests made to the database are captured. Refer to system documentation for more information.

Filter Mode Exclusion

Excluded Sessions

All sessions will be captured except for those listed below.

Filter Name	Type	Session Attribute	Value	Remove
Oracle Management Service (DEFAULT)	Excluded	Program	OMS	
Oracle Management Agent (DEFAULT)	Excluded	Program	emagent%	

Add Another Row

☒ **TIP** You may use % for wildcard in a filter value.

Database Replay

4. Prepare an empty directory for capture files

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Plan Environment Options **Parameters** Schedule Review

Confirmation
Directory object created successfully.

Capture Workload: Parameters

Database **SOURCE**
Logged In As **SYS**

Cancel Back Step 3 of 5 Next

Workload Capture Parameters

* Capture Name CAPTURE-SOURCE-Testlauf01

* Directory Object TEMPORARY

Create Directory Object

The selected directory object cannot already contain a captured workload.

AUDIT_DIR
DATA_PUMP_DIR
DPDIR
ORACLE_OCM_CONFIG_DIR
TEMPORARY

Cancel Back Step 3 of 5 Next

Setup Preferences Help Logout

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[About Oracle Enterprise Manager](#)

Database Replay

- Job scheduling - specify time frame for capture:

ORACLE® Enterprise Manager 11g Database Control [Setup](#) [Preferences](#) [Help](#) [Logout](#) **Database**

Plan Environment Options Parameters **Schedule** Review

Capture Workload: Schedule

Database **SOURCE** [Cancel](#) [Back](#) Step 4 of 5 [Next](#)
Logged In As **SYS**

Job Parameters


* Job Name
Description

Job Schedule

Choose a start time and a capture duration so that the workload you are interested in replaying at a later time can be captured.

Start

☒ Immediately
☐ Later

Date 
(example: Aug 27, 2007)

Time ☐ AM ☒ PM

Capture Duration

☐ Not Specified
Capture must be stopped manually if an end is not specified
☒ Duration

Hours Minutes

Database Replay

- Database Control - capture review and submit:

ORACLE® Enterprise Manager 11g Database Control [Setup](#) [Preferences](#) [Help](#) [Logout](#) **Database**

Plan Environment Options Parameters Schedule **Review**

Capture Workload: Review

Database **SOURCE** [Cancel](#) [Back](#) **Step 5 of 5** [Submit](#)

Logged In As **SYS**

Review the following settings for capturing the workload.

Job Name	CAPTURE-SOURCE-TESLAUF01-JOB
Capture Name	CAPTURE-SOURCE-Testlauf01
Directory Object	TEMPORARY
Start Time	Immediately
Capture Duration	0 Hours 15 Minutes

Database Restart

Restart Database **No**

Workload Filters: Excluded Sessions

Filter Name	Type	Session Attribute	Value
Oracle Management Service (DEFAULT)	Excluded	Program	OMS
Oracle Management Agent (DEFAULT)	Excluded	Program	emagent%

[Cancel](#) [Back](#) **Step 5 of 5** [Submit](#)

Database Replay

- Database Control - capture summary:

Database Control

Database

Database Instance: ORCL >

Logged in As SYS

Confirmation

Job 'CAPTURE-ORCL-TESTLAUF_01-JOB' to capture the workload has been created successfully.

[View Job](#)

Once the capture is complete you will need to do the following prior to replaying the workload on a different system:

1. Optionally export the AWR data.
2. Restore the replay database on a test system to match the capture database at the start of the workload capture.
3. Make changes (such as perform an upgrade) to the test system as needed.
4. Copy the workload to the test system.
5. Preprocess the captured workload.

Database Replay

The Database Replay feature allows database workload to be captured on one system and replayed later on a different system. Playing a captured workload can be useful to compare two different systems.

Page Refreshed Aug 29, 2007 2:42:58 PM CEST Refresh

Task	Task Name	Description	Go to Task
1	Capture Workload	Choose this option to capture workload on this database.	
2	Preprocess Captured Workload	Preprocessing will prepare a captured workload for replay. This must be done once for every captured workload.	
3	Replay Workload	Choose this option to replay a preprocessed workload on this database.	

Overview

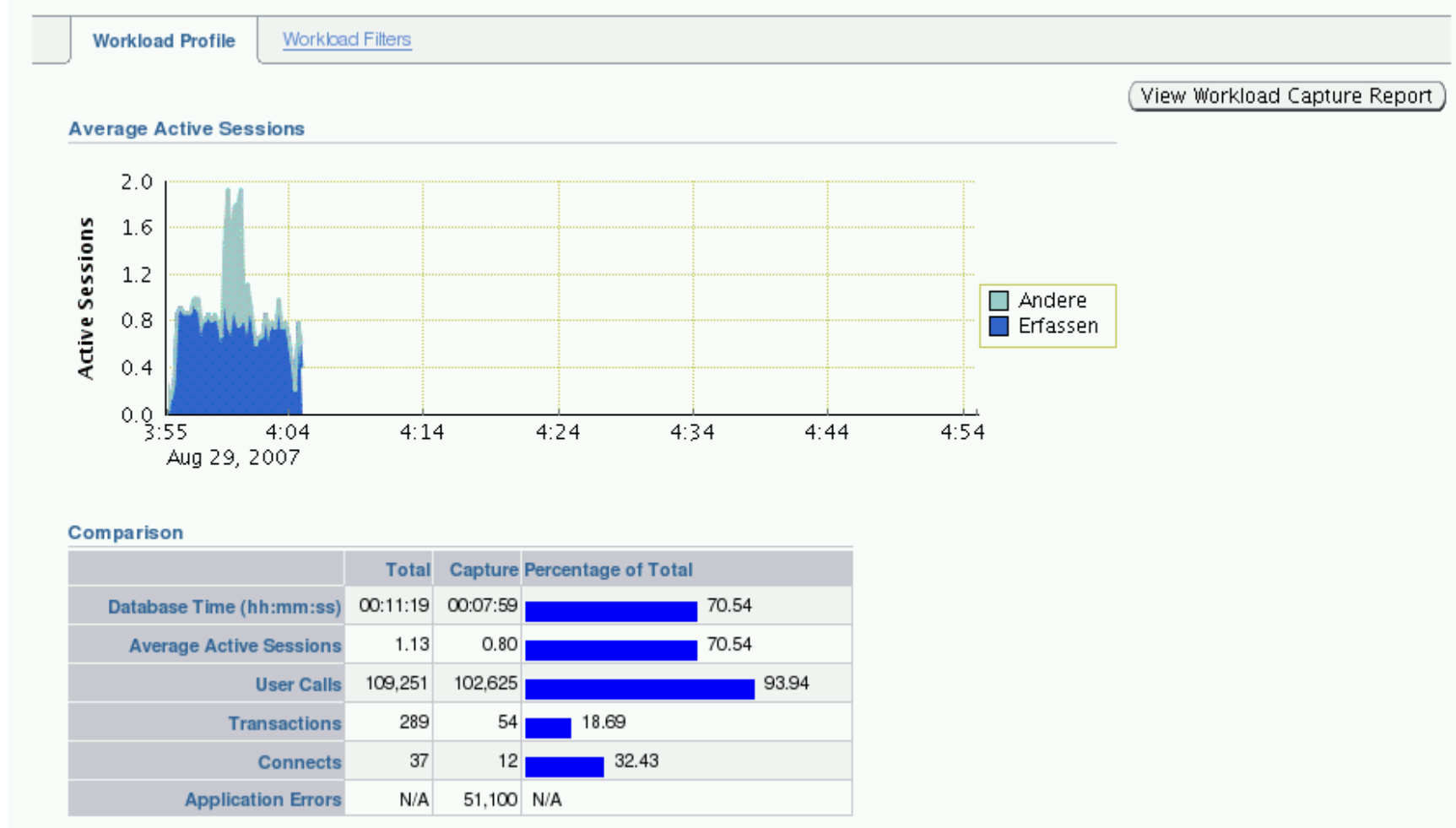
The following are the typical steps to perform Database Replay:

1. Capture the workload on a database. (Task 1)
2. Optionally export the AWR data. (Task 1)
3. Restore the replay database on a test system to match the capture database at the start of the workload capture.
4. Make changes (such as perform an upgrade) to the test system as needed.
5. Copy the workload to the test system.
6. Preprocess the captured workload. (Task 2)
7. Configure the test system for the replay.
8. Replay the workload on the restored database. (Task 3)

ORACLE®

Database Replay

- Database Control - capture statistics:



Database Replay

- Preprocessing captured workload:

ORACLE Enterprise Manager 11g
Database Control

Setup Preferences Help Logout

Database

Database Instance: SOURCE >

Logged in As SYS

Database Replay

The Database Replay feature allows database workload to be captured on one system and replayed later on a different system. Replaying a captured workload can be useful to compare two different systems.

Page Refreshed Aug 27, 2007 7:37:11 PM CEST Refresh

Task	Task Name	Description	Go to Task
1	Capture Workload	Choose this option to capture workload on this database.	
2	Preprocess Captured Workload	Preprocessing will prepare a captured workload for replay. This must be done once for every captured workload.	
3	Replay Workload	Choose this option to replay a preprocessed workload on this database.	

Overview

The following are the typical steps to perform Database Replay:

1. Capture the workload on a database. (Task 1)
2. Optionally export the AWR data. (Task 1)
3. Restore the replay database on a test system to match the capture database at the start of the workload capture.
4. Make changes (such as perform an upgrade) to the test system as needed.
5. Copy the workload to the test system.
6. Preprocess the captured workload. (Task 2)
7. Configure the test system for the replay.
8. Replay the workload on the restored database. (Task 3)

[View Workload Capture History](#)

Active Capture and Replay

Select	Name	Type	Directory Object	Start Time
	No items found			

Database Replay

- Replaying the captured workload:

ORACLE Enterprise Manager 11g
Database Control

Setup Preferences Help Logout

Database

Database Instance: SOURCE >

Logged in As SYS

Database Replay

The Database Replay feature allows database workload to be captured on one system and replayed later on a different system. Replaying a captured workload can be useful to compare two different systems.

Page Refreshed Aug 27, 2007 7:37:11 PM CEST Refresh

Task	Task Name	Description	Go to Task
1	Capture Workload	Choose this option to capture workload on this database.	
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3	Replay Workload	Choose this option to replay a preprocessed workload on this database.	

Overview

The following are the typical steps to perform Database Replay:

1. Capture the workload on a database. (Task 1)
2. Optionally export the AWR data. (Task 1)
3. Restore the replay database on a test system to match the capture database at the start of the workload capture.
4. Make changes (such as perform an upgrade) to the test system as needed.
5. Copy the workload to the test system.
6. Preprocess the captured workload. (Task 2)
7. Configure the test system for the replay.
8. Replay the workload on the restored database. (Task 3)

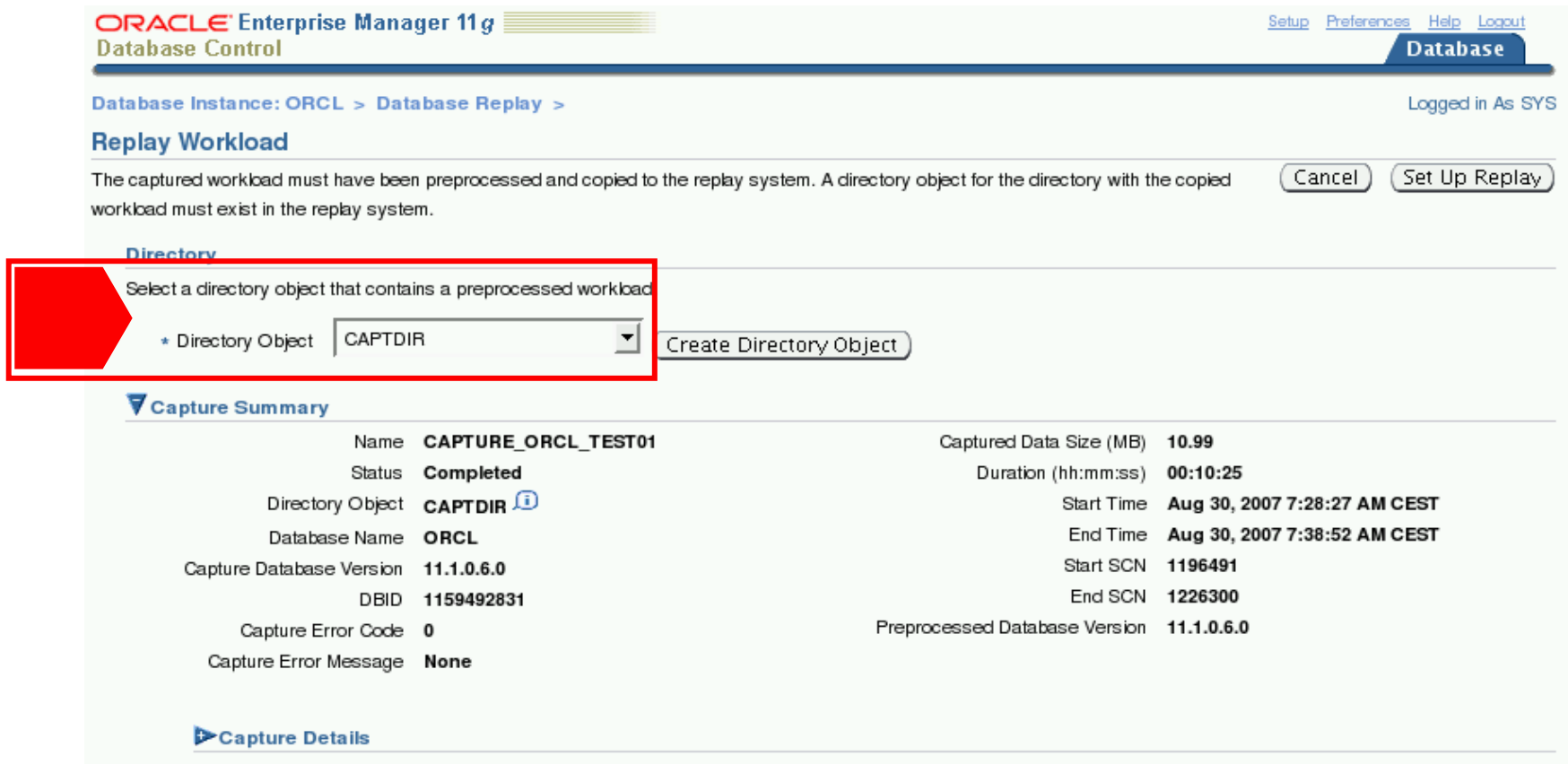
[View Workload Capture History](#)

Active Capture and Replay

Select	Name	Type	Directory Object	Start Time
No items found				

Database Replay

- Choose directory containing preprocessed capture files



ORACLE® Enterprise Manager 11g Database Control

Setup Preferences Help Logout **Database**

Database Instance: ORCL > Database Replay > Logged in As SYS

Replay Workload

The captured workload must have been preprocessed and copied to the replay system. A directory object for the directory with the copied workload must exist in the replay system. Cancel Set Up Replay

Directory

Select a directory object that contains a preprocessed workload

* Directory Object Create Directory Object

▼ Capture Summary

Name	CAPTURE_ORCL_TEST01	Captured Data Size (MB)	10.99
Status	Completed	Duration (hh:mm:ss)	00:10:25
Directory Object	CAPTDIR ⓘ	Start Time	Aug 30, 2007 7:28:27 AM CEST
Database Name	ORCL	End Time	Aug 30, 2007 7:38:52 AM CEST
Capture Database Version	11.1.0.6.0	Start SCN	1196491
DBID	1159492831	End SCN	1226300
Capture Error Code	0	Preprocessed Database Version	11.1.0.6.0
Capture Error Message	None		

[▶ Capture Details](#)

Database Replay

- Workload Replay - choose replay name:

The screenshot shows the Oracle Enterprise Manager 11g Database Control interface. At the top, there's a navigation bar with links for Setup, Preferences, Help, and Logout. Below this is a progress bar with five steps: Choose Initial Options (selected), Customize Options, Prepare Replay Clients, Wait for Client Connections, and Review. The main section is titled "Replay Workload: Choose Initial Options". It displays the following information: Database ORCL, Capture Name CAPTURE_ORCL_TEST01, and Logged In As SYS. There are "Cancel", "Step 1 of 5", and "Next" buttons. A red arrow points to the "Replay Name" input field, which contains the text "REPLAY_TEST02". Below this, there's a section for "Initial Options" with the instruction "Choose the initial replay options." and two radio buttons: "Use the default replay options" (selected) and "Use replay options from a previous replay". A "Replay Name" dropdown menu is also visible.

ORACLE® Enterprise Manager 11g
Database Control

Setup Preferences Help Logout

Database

Choose Initial Options Customize Options Prepare Replay Clients Wait for Client Connections Review

Replay Workload: Choose Initial Options

Database **ORCL** Cancel Step 1 of 5 Next

Capture Name **CAPTURE_ORCL_TEST01**

Logged In As **SYS**

Replay Name **REPLAY_TEST02**

Initial Options

Choose the initial replay options.

☒ Use the default replay options

☐ Use replay options from a previous replay

Replay Name

Database Replay

- Workload Replay: Wait for replay clients to connect

The screenshot displays the Oracle Enterprise Manager 11g Database Control interface. At the top, the title bar reads 'ORACLE® Enterprise Manager 11g Database Control'. On the right, there are links for 'Setup', 'Preferences', 'Help', and 'Logout', and a 'Database' tab. Below the title bar is a progress bar with five steps: 'Choose Initial Options', 'Customize Options', 'Prepare Replay Clients', 'Wait for Client Connections' (which is the current step, indicated by a blue circle), and 'Review'. The main content area is titled 'Replay Workload: Wait for Client Connections'. It shows the following details: Database: ORCL, Capture Name: CAPTURE_ORCL_TEST01, and Logged In As: SYS. To the right of these details are buttons for 'Cancel', 'Back', 'Step 4 of 5', and 'Next'. A red rectangular box highlights a message that says: 'The database is waiting for connections from the Replay Clients. Start the Replay Clients now. When all the Replay Clients have connected, proceed to the next step to continue the replay setup.' Below this message is a clock icon and the text 'The database is waiting for connections from Replay Clients.' At the bottom of the interface, a warning message states: '⚠ This operation may take some time to complete. If you close this browser window or navigate to a different page, your place in the replay process will not be saved.'

ORACLE® Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Choose Initial Options Customize Options Prepare Replay Clients **Wait for Client Connections** Review


Replay Workload: Wait for Client Connections

Database **ORCL** Capture Name **CAPTURE_ORCL_TEST01** Logged In As **SYS**

Cancel Back Step 4 of 5 Next

The database is waiting for connections from the Replay Clients. Start the Replay Clients now.

When all the Replay Clients have connected, proceed to the next step to continue the replay setup.



The database is waiting for connections from Replay Clients.

⚠ This operation may take some time to complete. If you close this browser window or navigate to a different page, your place in the replay process will not be saved.

Database Replay

- Workload Replay Clients: Calibrate
 - `$> wrc mode=calibrate replaydir=/tmp/testing`
- Workload Replay Clients: Start
 - `$> wrc system/oracle mode=replay`

```
$ wrc system/oracle@orcl mode=replay
```

```
Workload Replay Client: Release 11.1.0.6.0 - Production on Thu Aug 30 09:02:10 2007
```

```
Copyright (c) 1982, 2007, Oracle. All rights reserved.
```

```
Wait for the replay to start (09:02:10)
```

Database Replay

- Workload Replay: WRC client(s) connected

ORACLE® Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Choose Initial Options Customize Options Prepare Replay Clients **Wait for Client Connections** Review

Replay Workload: Wait for Client Connections

Database **ORCL** Step 4 of 5

Capture Name **CAPTURE_ORCL_TEST01**

Logged In As **SYS**

The database is waiting for connections from the Replay Clients. Start the Replay Clients now.

When all the Replay Clients have connected, proceed to the next step to continue the replay setup.



 ✓ At least one Replay Client is connected. You may start more connections or continue to the next step.

⚠ This operation may take some time to complete. If you close this browser window or navigate to a different page, your place in the replay process will not be saved.

Client Connections

SID	Host	OS Process ID	OS User Name	Program
135	vmware.de.oracle.com	15203	oracle	wrc@vmware.de.oracle.com (TNS V1-V3)

Database Replay

- Monitor Workload Replay during replay

View Workload Replay: **REPLAY_TEST02**

Page Refreshed **Aug 30, 2007 9:11:02 AM CEST** [Refresh](#)

[OK](#)

Status **In Progress** [Stop Replay](#)

Summary

Replay Name **REPLAY_TEST02**
Directory Object **CAPTDIR** ⓘ
Database Name **ORCL**
DBID **1159492831**
Replay Error Code **N/A**
Replay Error Message **None**

Capture Name **CAPTURE_ORCL_TEST01**
Duration (hh:mm:ss) **00:07:32** ⓘ
Prepare Time **Aug 30, 2007 8:59:45 AM CEST**
Start Time **Aug 30, 2007 9:03:28 AM CEST**
End Time **N/A**

Workload Profile

[Connection Mappings](#)

[Replay Parameters](#)

[Report](#)

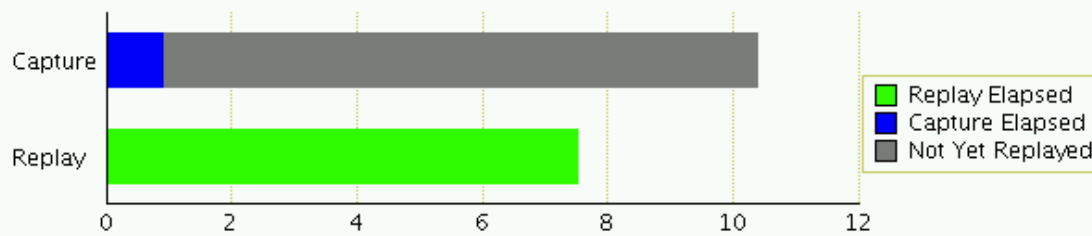
Network Time (hh:mm:ss) **00:00:00**

Clients **1**

Think Time (hh:mm:ss) **00:00:00**

Clients Finished **0**

Elapsed Time Comparison



Assessing the Replay

The Elapsed Time Comparison chart shows how much time the replayed workload has taken to accomplish the same amount of work as captured.

When the Replay bar is shorter than the Capture bar, the replay environment is processing the workload faster than the capture environment.

The divergence table gives information about both the data and error discrepancies between the replay and capture environments, which can be used as a measure of the replay quality.





Database Replay

- Monitor divergence stats:

Divergence

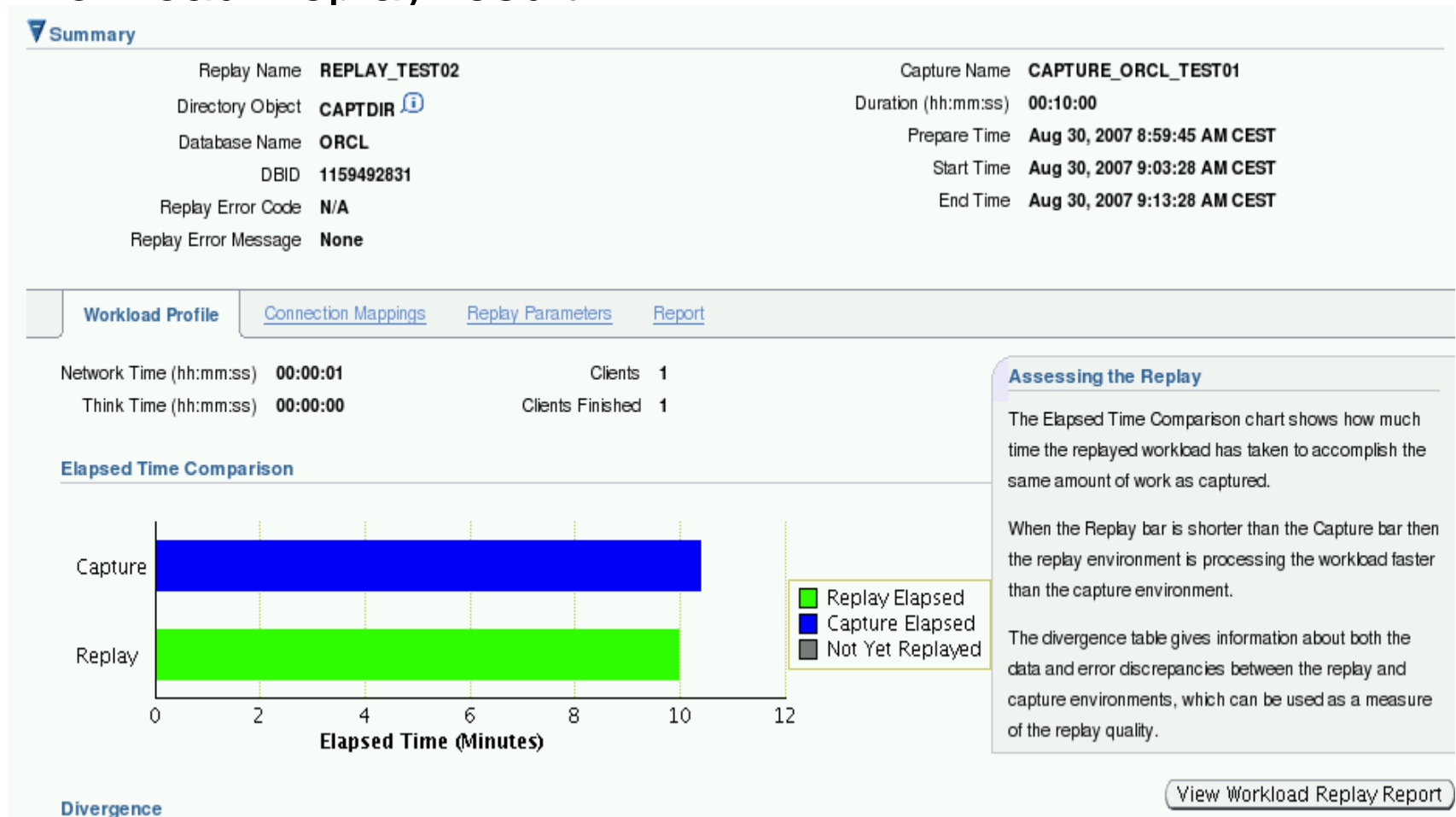
	Number of Calls	Percentage of Total Calls
Error Divergence:		
Session Failures Seen During Replay	0	0.00
Errors No Longer Seen During Replay	0	0.00
Errors Mutated During Replay	0	0.00
New Errors Seen During Replay	0	0.00
Data Divergence:		
DMLs with Different Number of Rows Modified	0	0.00
SELECTs with Different Number of Rows Fetched	0	0.00

Detailed Comparison

	Capture	Replay	Percentage of Capture
Duration (hh:mm:ss)	00:10:25	00:10:00	 96.00
Database Time (hh:mm:ss)	00:17:06	00:15:22	 89.86
Average Active Sessions	1.64	1.54	 93.61
User Calls	18,141	18,133	 99.96

Database Replay

- Workload Replay result:



Database Replay

- Workload replay reporting:

[Workload Profile](#) [Connection Mappings](#) [Replay Parameters](#) **Report**

Workload Replay Report

Run Report

AWR Compare Period Report

First Workload Capture or Replay

CAPTURE_ORCL_TEST01 (Aug 30, 2007 7:28:27 AM) ▼

Second Workload Capture or Replay

REPLAY_TEST02 (Aug 30, 2007 9:03:28 AM) ▼

Run Report

AWR Report

Workload Capture or Replay

REPLAY_TEST02 (Aug 30, 2007 9:03:28 AM) ▼

Run Report



Additional Pieces of Info

Important Upgrade Notes at a glance



Upgrade to Oracle 10gR2

[Note: 466181.1](#) Upgrade Companion 10gR2

[Note: 316889.1](#) Complete Checklist for Manual Upgrade to 10gR2

[Note: 555579.1](#) Known Issues 10.2.0.4

Upgrade to Oracle 11g

[Note: 601807.1](#) Upgrade Companion 11g

[Note: 429825.1](#) Complete Checklist for Manual Upgrades to 11g

[Note: 454506.1](#) Known Issues and Alerts 11.1.0.6

Performance Testing

[Note: 560977.1](#) Real Application Testing available for earlier releases

[Note: 562899.1](#) Using SQL Performance Analyzer for upgd. 9.2 to 10.2

[Note: 394937.1](#) Statspack Guide

[Note: 295819.1](#) Potential Query Tuning Related Issues

[Note: 345048.1](#) GROUP BY does not sort if you don't use ORDER BY

[Upgrading to Oracle Database 10g: What to expect from the Optimizer](#)

Upgrade Webpage on OTN

- <http://www.oracle.com/technology/products/database/oracle11g/upgrade/index.html>

shortcuts

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ORACLE[®] DATABASE 11^g Oracle Database Upgrade

Upgrading to Oracle Database 11g provides the latest in efficient, reliable, secure data management for mission-critical on-line transaction processing applications, query-intensive data warehouses, and content management and Web2.0 applications. The right planning, preparation, and upgrade steps will make the upgrade process simpler, faster, and more predictable from start to finish.

Latest (July 2008)

- ☑ [Database Rolling Upgrade Using Transient Logical Standby: Oracle Data Guard 11g](#) (PDF) (June 2008)
- ☑ [Database Rolling Upgrade Using Data Guard SQL Apply - Oracle Database 11g and 10gR2](#) (PDF) (April 2008)
- ☑ [Database Replay \(RAT\) DBUA for Upgrade](#) (PDF) (May 2008)
- ☑ [Best Practices for Upgrading to Oracle Database 11g](#) (PDF) (November 2007)
- ☑ [Innovate Faster with Oracle Database 11g](#) (PDF) (August 2007)
- ☑ [Updating to Oracle RAC 11g on Oracle Enterprise Linux](#) (OTN) (October 2007)

Technical Information

- ☑ [Different Upgrade Methods for Upgrading your Database](#) (Metalink)
- ☑ [Complete Checklist for Manual Upgrades - 11gR1](#) (Metalink)
- ☑ [Complete Checklist for Upgrades - 11gR1 Using DBUA](#) (Metalink)
- ☑ [Database Server Upgrade/Downgrade Compatibility Matrix](#) (Metalink)

Documentation

- [11g Upgrade Companion](#) (Metalink)
- [Oracle 11g Release 1 Documentation](#)

Support

- [11g Upgrade Companion](#) (Metalink)
- [Recommended Patches Tool](#) (Metalink)
- [Oracle Lifetime Support Policy](#)

Previous Releases

- [10g Upgrade Companion](#) (Metalink)
- [Database Rolling Upgrade Using Transient Logical Standby - Oracle Database 10g Release 2](#) (PDF) (April 2008)
- [Real Application Testing on earlier releases](#) (Metalink)
- [Complete Checklist for Manual Upgrades - 10gR2](#) (Metalink)

Questions

- [Oracle MetaLink Information](#)

OTN Upgrade Forum

- <http://forums.oracle.com/forums/forum.jspa?forumID=583&start=0>

[Forum Home](#) » [Database](#) » [Database - Upgrade](#)

Forum: Database - Upgrade

Discuss all aspects of database upgrade from planning and testing through execution and troubleshooting. Also, information about helpful tools and utilities, documentation, and other information to make your database upgrade easier, faster, and less risky.

You are watching this forum. To remove this watch, click "Stop Watching Forum" below. [Watch Options](#)

[Post New Thread](#) [Post Announcement](#) [Create Poll](#) [Stop Watching Forum](#) [Back to Category](#)

Messages: 669 - Threads: 141 - Filter: Pages: 3 [[1](#) [2](#) [3](#) | [Next](#)]

	Thread	Author	Views	Replies	Last Post
	OTN Database Upgrade Page Posted By: Brian.McCarthy -- Aug 4, 2008 11:44 PM				Edit - Expire - Delete
	11 client installed, 10 client still exist - which client is in use?	mssqladminfromh...	19	1	Dec 8, 2008 1:55 PM Last Post By: Pierre Forstma... »
	Upgrade from 10.2.0.1.0 x64 to 10.2.0.4.0 x64	user611309	56	2	Dec 7, 2008 9:01 AM Last Post By: Mike Dietrich »
	How to Upgrade the DB through exp/imp utility	user10687886	54	2	Dec 7, 2008 8:56 AM Last Post By: Mike Dietrich »
	Using DBUA to migrate Oracle 9i to Oracle 11g	JuanDiego Prudot	236	4	Dec 6, 2008 8:22 AM Last Post By: user10687886 »
	Migrating Report from 10.7 to 11i Apps (data bases 7.6 to latest)	user10646273	65	1	Dec 5, 2008 6:51 PM Last Post By: rov.swonger »
	9.2.0.7 to 10.2.0.3 upgrade with DBUA do I need 2 change the Spfile manually	qaqanahuja	100	3	Dec 3, 2008 4:36 PM Last Post By: Satish Kandi »
	trigger problem	user10646487	55	1	Dec 3, 2008 3:52 PM Last Post By: user10646487 »
	upgrade oracle 10.2.3.0 patchset2 to 10.2.3.0 patchset	user10646487	55	1	Dec 3, 2008 1:20 PM

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 [user21123](#) (5)



Latest Patchset 11.1.0.7.0

Patch Number 6890831

Available for all major platforms

Upgrade Information / Alerts

- [Note 738538.1](#) Known Issues specific to the 11.1.0.7 Patch Set

11.1.0.7 Alerts / Issues

This section lists alerts and important issues relevant to 11.1.0.7 .

General Alerts / Issues

Note:756435.1*	Block change tracking on physical standby can cause incorrect backups
Note:731599.1P*	Linux: Random node reboots in RAC induced by OCSSD

Upgrade Issues

Note:742647.1*	ASM rolling upgrade to 11.1.0.7 fails in RAC environments
--------------------------------	---

Issues introduced in 11.1.0.7

This section lists bugs **introduced** in 11.1.0.7 (if any). Such issues may be either serious or trivial but the aim is to list them all to help customers assess the risk of applying the Patch Set on top of 11.1.0.6

7272646P	Linux-x86_64: ORA-27103 on startup when MEMORY_TARGET > 3g
7213937	Various OERI using Resource Manager
7211965	Different default cost for BETWEEN
7113299	Dump [kkslmtl] with fix for bug 6163785

Real World Experience

- White Paper available on OTN
 - http://www.oracle.com/technology/products/database/oracle11g/upgrade/presentations/9i_to_11g_real_world_customer_experience.pdf

Upgrading from Oracle 9i to
Oracle Database 11g:
A Real World Customer Experience

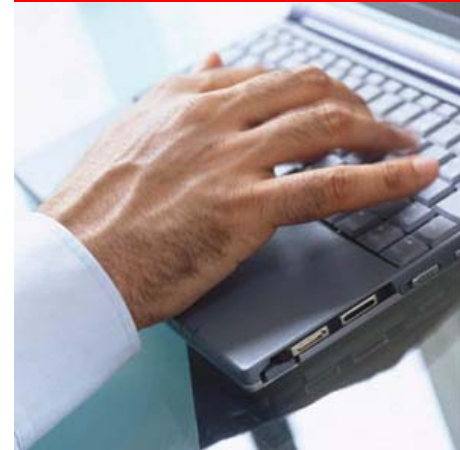
An Oracle White Paper
October 2008

Guidelines

- **Never ever** change too many system components at once!
- Document **all** changes detailed and clearly into a change log!
- **Always (!!!)** use real world data for testing!
- Don't underestimate the test efforts. Reserve enough time and resources for testing.
- **ALWAYS** collect as much performance data BEFORE the upgrade will be started!!
- Create a fallback strategy!
- **PLEASE** test your fallback strategy - does it really work??
- Please remember:
Upgrade has never been easier - but you still have to test!!!

Agenda

- Recap
- Challenges & Best Practices
- AWR & STATSPACK
- SQL Plan Management
- Real Application Testing
- Q&A



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