

# ORACLE REAL APPLICATION TESTING

## KEY FEATURES AND BENEFITS

THE INDUSTRY'S ONLY SOLUTION FOR CAPTURING REAL PRODUCTION WORKLOAD AND REPLAYING IT ON A TEST SYSTEM WITH IDENTICAL CHARACTERISTICS

### FEATURES

- Database Replay
- SQL Performance Analyzer (SPA)
- Compare SQL Tuning Sets (STS)

### BENEFITS

- Reduces the task of assessing the impact of system changes for production environment from months to days
- Database Replay makes it possible to capture actual production workload including timing, concurrency and dependency information
- Database Replay allows captured workload to be replayed on a test system to assess the impact of change
- SPA allows fine-grain impact analysis of database environment change on SQL execution plan and performance changes
- Backported to pre-11g database releases to help customers smoothly transition to higher releases
- Oracle Enterprise Manager Testing further simplifies testing through automation of end-to-end Database Replay and simplified workflow for transporting SQL workloads between databases

*Oracle Real Application Testing offers an extremely cost-effective and easy-to-use change assurance solution that enables businesses to fully assess the outcome of a system change in a test environment, take any corrective action if necessary, and then to introduce the change safely to production systems, minimizing the undesirable impact on them. Real Application Testing offers two key unique features, Database Replay and SQL Performance Analyzer (SPA), that together provide a comprehensive and flexible solution for assessing impact of changes on test systems using “real” production workload, thereby enabling businesses to adopt new technology changes with minimal risk, and at a significantly reduced cost while at the same time improving their SLAs.*

### Real Application Testing

System changes such as hardware/software upgrades, patch application, etc. are routine operations for which businesses conduct extensive testing and change impact analysis before going live. Despite such testing using various simulation tools, many issues often go undetected until production deployment and negatively impact system performance and availability. The main reason for the low success rate of their testing is the inability of existing tools to test using real production workloads. Similarly, changes in query execution environment can often impact system performance and availability, therefore, the ability to do fine-grain SQL response time assessment and fix any regressions due to the change are important to the smooth functioning of any business.

Oracle Real Application Testing option includes two solutions to test the effect of system changes on real-world applications, Database Replay and SQL Performance Analyzer (SPA). Database Replay enables you to effectively test system changes in test environments by replaying a full production workload on the test system to help determine the overall impact of the change. The SPA enables you to assess the impact of system changes on SQL performance by identifying any variation in SQL executions plans and performance statistics resulting from the change.

### Database Replay

Database Replay makes it possible to capture a workload on a production system with negligible performance overhead and replay it on a test system with the exact timing, concurrency, and transaction characteristics of the original workload. This makes possible complete assessment of the impact of the change including identifying undesired results - new contentions points or performance regressions –

all without spending huge effort developing simulation scripts. Extensive analysis and reporting is provided to help identify any potential problems, such as new errors encountered and performance divergences. As a result, realistic testing of even complex applications using load simulation tools/scripts that previously took several months now can be accomplished at most in a few days with Database Replay.

Database Replay workload capture is performed at the database server level and therefore can be used to assess the impact of any system change below the database tier level such as: a) Database upgrades, patches, parameter, schema changes, etc. b) Configuration changes such as conversion from a single instance to RAC, ASM, etc. c) Storage, network, interconnect changes, and d) Operating system, hardware migrations, patches, upgrades, parameter changes

The Database Replay process can be broken down to 4 main steps described below:

#### **i. Workload Capture**

When workload capture is enabled, all external client requests directed to the Oracle server are stored into compact “capture” files on the database host file system while incurring negligible overhead. These files contain all relevant information about the call needed for replay such as SQL text, bind values, wall clock time, SCN, etc.

The workload capture start and end time as well as criteria for targeted capture (e.g. by user, service, action, etc.) can be specified by the user. The workload that has been captured on Oracle Database release 9.2.0.8 and higher can be replayed on Oracle Database 11g release. Workloads capture and replay in shared-server environment is also supported.

#### **ii. Workload Processing**

Once the workload has been captured, the information in the capture files has to be processed, preferably on the test system. This processing transforms the captured data and creates all necessary metadata needed for replaying the workload.

#### **iii. Workload Replay**

Before performing workload replay, the test system has the intended system change applied and database restored to the point in time before the capture started using various mechanisms such as RMAN backups, Oracle Database 11g Snapshot Standby, Datapump export/import, etc. The replay can be configured appropriately to re-map connection strings, database links, and directory objects to that of the test system. Once replay is initiated, a special client program called the “replay client” replays the workload from the processed files. It submits calls to the database with the exact same timing and concurrency as in the capture system and puts the exact same load on the system as seen in the production environment. The replay driver automatically re-maps physical locators and preserves sequence numbers or GUIDS during replay. The replay driver is client-agnostic and uses a scaleable multi-threaded architecture with support for client estimation and running on multiple hosts. There are various options that are available to control the behavior of the replay such as to scale up or down the think and login times, and maintain commit synchronization – these are useful for throttling the user call rate to the database.

#### **iv. Analysis and Reporting**

Extensive reports that encompass both high-level summary and detailed drill-down information in terms of errors, performance and data divergence are provided to help understand how the replay fared in comparison to capture or other replays.

Basic performance comparison reports between replay and capture or other replays

are provided and for advanced analysis, AWR, ASH, and Replay Compare Period reports are available.

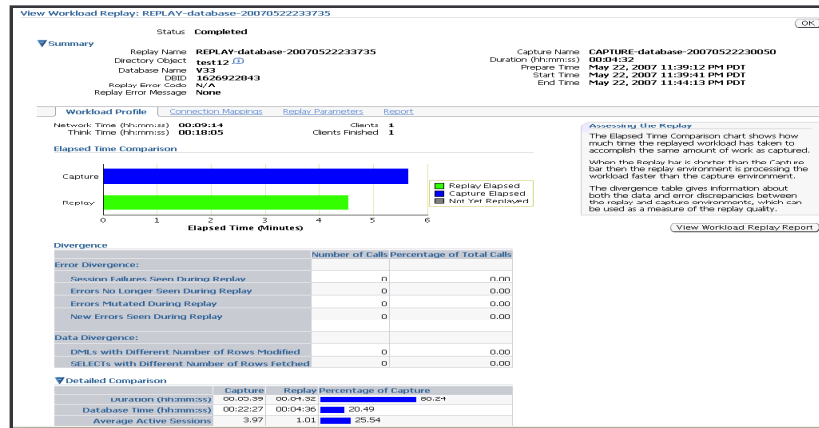


Figure 1: Workload Replay Summary

Additionally, Oracle Enterprise Manager 10g Release 5 significantly enhances the value of Real Application Testing by supporting end-to-end Database Replay automation. This simplifies the process of provisioning software and deploying replay clients correctly, setting up the test database system to the correct point-in-time for replay, saving the workloads, and orchestrating the entire replay through Grid Control interface.

### SQL Performance Analyzer

Changes that affect SQL execution plans can severely impact system performance and availability. As a result, DBAs spend an enormous time in identifying and fixing SQL statements that have regressed due to the system change. SPA provides fine-grain assessment of environment change on SQL execution plan and statistics by running the SQL statements in isolation and serial manner in before-change and after-change environments. SPA functionality is well integrated with existing SQL Tuning Set (STS), SQL Tuning Advisor, and SQL Plan Management functionality. As a result, SPA completely automates and simplifies the manual and time consuming process of assessing the impact of change on even extremely large SQL workloads (thousands of SQL statements) and automating the remediation of any SQL regressions as a result of the system change.

Examples of common system changes for which you can use the SPA include: database upgrade, patches, initialization parameter changes, configuration changes to the operating system, hardware, or database, schema changes such as adding new indexes, partitioning or materialized views, validating optimizer statistics refresh or SQL tuning actions (such as creating SQL profiles).

The SPA usage model is similar to Database Replay and consists of 5 main steps:

- Capture the SQL workload- You can capture a SQL workload into STS from several sources such as incrementally from cursor cache over a duration or Automatic Workload Repository (AWR). Typically, you would capture the SQL workload on a production database and then transport the STS to a test database where SPA testing will take place.

- Measure the performance of the workload before a change by executing the SQL tuning set (aka trial) either locally or remotely over a database link.
- Make a change such as a database upgrade or optimizer statistics refresh
- Measure the performance of the workload after the change by executing the SQL tuning set again (post change trial) either locally or remotely over a database link.
- Compare performance of the two executions of the SQL tuning set to identify, which SQL statements regressed, improved, or were unchanged.

A STS stores all the information about the workload (such as SQL text, schema, execution plans, statistics, etc.) that is necessary to re-execute the statements in a standalone environment. STS also supports rich filtering and ranking criteria to target specific SQL for tuning. For Oracle Database Releases 9i/10.2, existing SQL Trace mechanism can be used to capture the SQL workload and converted to STS using supported API.

The SPA report summarizes the change impact on entire workload as well as the net impact on individual SQL statements. The execution frequency of SQL is used in weighting the workload in assessing the net impact. Additionally, improvements, regressions, and SQL with unchanged performance are listed in the report. If there are any regressed SQL statements after the system change, recommendations on how to correct the regressions is also provided with the SQL Tuning Advisor and SQL Plan Baselines features of Oracle Database 11g. Further, the execution plans generated on the test system with system change implemented can be used to seed the SQL Plan Baseline repository on a production system to make sure only the previously validated execution plans are picked by the optimizer. Any new plans generated by the optimizer after seeding through the SQL Plan Baseline feature can be validated automatically by the database by test-executing them or manually by the DBAs.

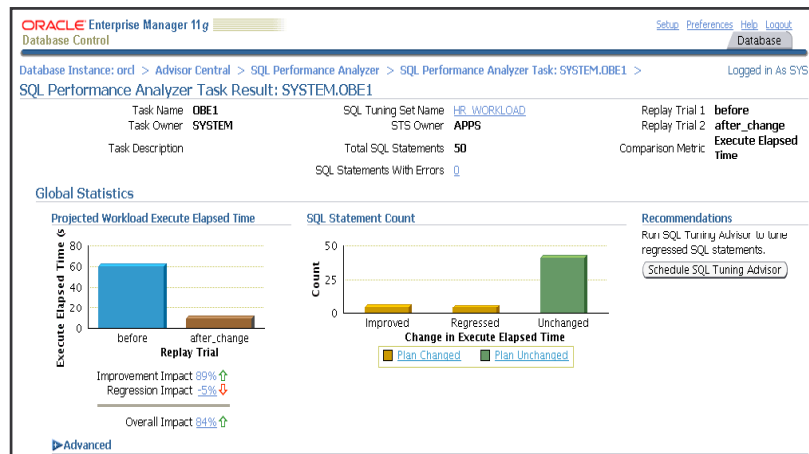


Figure 2: SQL Performance Analyzer Report

SPA can be used to validate optimizer statistics refresh or SQL Advisors’ tuning actions on a regular basis (weekly, daily etc.). SPA also supports following interesting features for assessing system changes:

## ORACLE REAL APPLICATION TESTING

Oracle Real Application Testing delivers maximum benefits when used with the following Oracle products.

### RELATED PRODUCTS

- Oracle Diagnostics Pack
- Oracle Tuning Pack
- Oracle Configuration Pack
- Oracle Change Management Pack
- Oracle Provisioning Pack

1. Exadata Simulation - SPA helps estimate the IO reduction that can be accomplished by migrating to Exadata server but without actually provisioning the hardware. This can be used to identify potential workloads that are good candidates for Exadata migration.
2. Compare STSs - By capturing SQL workload in two different STSs (for before and after change runs), one can also use SPA to assess the impact of the system change. This functionality is useful when you have load-testing scripts to test system changes or to perform detailed SQL-centric analysis and regression remediation following Database Replay workload capture/replays.

### Licensing

Real Application Testing features may be accessible through Oracle Enterprise Manager, and API provided with Oracle Database software. The use of these and other features described in the product licensing documentation requires licensing of the Oracle Real Application Testing option regardless of the access mechanism.

### Contact Us

For more information about Oracle Real Application Testing, please visit [oracle.com](http://oracle.com) or call +1.800.ORACLE1 to speak to an Oracle representative.



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