

Real Application Testing Certified for SAP

Making a change to the SAP database can represent a significant risk to an organisation. The effects of an unexpected problem could be widely felt and have serious consequences. For this reason, testing of changes prior to production deployment is considered critical. The cost involved in testing using traditional methods can be very high both in time and money. Even after testing, many problems will only be discovered in production, and as a result end-users will suffer from poor performance or possibly even outages.

Oracle now has a new and unique testing tool for the Oracle Database called Real Application Testing. This **Database option** comprises of two complementary features, SQL Performance Analyzer (SPA) and Database Replay. Together, these features can help ensure that database changes do not negatively impact SAP availability and performance. They significantly improve the quality and lower the cost of testing changes to the SAP database system.

SQL Performance Analyzer (SPA)

One of the key tasks for a DBA is to tune SQL statements for optimal performance. Changes to database systems (such as optimizer statistics refresh, database upgrades, and patches) can cause the performance of previously well tuned SQL statements to regress, which can dramatically impact system performance for end-users. Until now, it was difficult if not impossible to predict how day to day operational changes to the database will impact application SQL performance. With SQL Performance Analyzer, or SPA, you can now know exactly how SQL will behave after routine system changes.

SPA automatically captures production SQL statements from your SAP database and re-executes them following a change to measure the impact. The statements are executed serially, in isolation from each other and regressed statements are automatically highlighted. Integration with SQL Plan Management and SQL Tuning Advisor enables automatic tuning of these statements to address any regressions prior to a change being implemented in production.

Orchestration of the entire SPA process can be done using Enterprise Manager, which provides a number of workflows for testing common operations such as Database Upgrades. There is also a Guided Workflow which enables custom experiments to be conducted.

ORACLE Enterprise Manager 10g
Grid Control

Home | **Targets** | Deployments | Alerts | Compliance | Jobs | Reports

All Targets | Hosts | Databases | Middleware | Web Applications | Services | Systems | Groups | Oracle Applications | Virtual Servers

Database Instance: emrep > Advisor Central > SQL Performance Analyzer > Logged in As SYSMAN

Guided Workflow

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The following guided workflow contains the sequence of steps necessary to execute a successful two-trial SQL Performance Analyzer test.
Note: Be sure that the Trial environment matches the tests you want to conduct.

Step	Description	Executed	Status	Execute
1	Create SQL Performance Analyzer Task based on SQL Tuning Set		■	
2	Create SQL Trial in Initial Environment		■	
3	Create SQL Trial in Changed Environment		■	
4	Compare Step 2 and Step 3		■	
5	View Trial Comparison Report		■	

TIP For an explanation of the icons and symbols used in the following table, see the [Icon Key](#)

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Real Application Testing was introduced in the 11g release of the Oracle Database, however, SQL Performance Analyzer is also available for previous releases of the Oracle Database. Consequently, SQL Performance Analyzer can be used to test changes in SAP environments even if there are no immediate plans to move to Oracle Database 11g Release 2.

Some examples of changes that could be assessed using SQL Performance Analyzer in SAP environments are:-

- Upgrade SAP Database from Oracle Database 10g Release 2 to 11g Release 2
- Install Database Patchset
- Migration from single instance to RAC
- Implement Partitioning
- Implement Advanced Compression
- Changes to `_FIX_CONTROLS` parameter settings
- Creation of Histograms on SAP tables

Some of these changes can actually be tested safely on the production system, therefore removing the need for establishing a separate test environment.

There are no SAP specific patches required to use SQL Performance Analyzer. Further general information on using SQL Performance Analyzer can be found in the following documents:

[Technical White Paper: SQL Performance Analyzer](#)

[Viewlet: SQL Performance Analyzer in Oracle Database 11g](#)

[Oracle Database Real Application Testing User's Guide](#)

Database Replay

Load testing today is generally done using tools that allow testing teams to generate synthetic workloads based on what they expect users to do on a system. These workloads can then be replayed by application virtual users, which simulate the end users by submitting requests to the application. Although widely used, this approach has a number of shortcomings when it comes to testing database level changes:

- Creating the synthetic workload can take a considerable time and requires programming expertise
- User behaviour is not well understood, so many possible workflows are often missed in the synthetic tests
- Production scale database concurrency is near impossible to simulate with these tools
- A full application stack is required for testing as these tools simulate end users

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.

Database Replay is suitable for testing changes to the database tier and anything below it, such as storage or OS platform. This also means that tiers such as the Web and Application Server tier are not required in the test environment. The Database Replay capture process has been backported and certified for SAP databases running on Oracle Database 10g Release 2 (10.2.0.4).

Changes that Database Replay could be used to validate include:

- SAP Database upgrade from 10gR2 (10.2.0.4) to 11gR2
- Platform migration such as from Windows to Oracle Solaris
- Database Patchset install
- Changes to `_FIX_CONTROLS` parameter settings
- Schema changes
- Migration from single instance to RAC
- Implement Partitioning

- Implement Advanced Compression
- Database storage changes (e.g. Direct NFS)
- Tablespace encryption
- Object Reorganization

Database Replay is included with Oracle Database 11g. In addition, Database Replay capture can be run against Oracle Database 10.2.0.4 and higher versions.

Patch 9233285 is required on the Replay database to use Database Replay in SAP environments.

For more technical information on using Database Replay please refer to the following whitepaper

[Technical White Paper: Database Replay](#)

[Viewlet: Database Replay in Oracle Database 11g](#)

[Oracle Database Real Application Testing User's Guide](#)

Results of Testing

The Oracle/SAP Development Team recently concluded comprehensive testing of SAP applications using both SQL Performance Analyzer and Database Replay. The testing consisted of SAP R/3 and BW workloads running in-house on the ABAP stack. Further testing was undertaken at a large utilities customer running the SAP IS-U (Industry Specific Utilities) module.

The objective was to use Real Application Testing to measure the effects of Advanced Compression for OLTP and SecureFiles on DML operations for SAP R/3. The testing activity consisted of using Database Replay to capture a production workload from a 10.2.0.4 SAP database. This workload was then replayed multiple times against both compressed and non-compressed Oracle Database 11g Release 2 databases. Key AWR metrics from the replays are shown below.

DB size after normal reorg:	3562,00 GB
DB size after reorg and OLTP+SecureFiles(med)+Index compression:	1589,00 GB
Space saved (~ 55%)	1973,00 GB

KEY AWR Metrics	Replay without Compression	Replay with Compression	%Diff
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Load Profile	1)		
Redo size/s	153456,80	203407,00	32,55
Logical reads/s	18748,80	18210,00	-2,87
Block changes/s	459,70	595,20	29,48
Physical reads/s	3820,60	1635,80	-57,18
Physical writes/s	74,60	72,00	-3,49
User calls/s	1806,50	2042,10	13,04
Parses/s	247,20	254,10	2,79
Hard parses/s	32,70	33,60	2,75
W/A MB processed/s	12,50	12,70	1,60
Executes/s	2572,10	2834,60	10,21
Transactions/s	4,50	4,80	6,67
Instance Efficiency Percentages (Target 100%)			
Buffer Hit %	81,91	91,79	12,06
Library Hit %	95,08	95,52	0,46
Host CPU (CPUs: 8 Cores: 8 Sockets: 4)			
%User	12,30	12,80	4,07
%System	4,40	4,20	-4,55
%WIO	12,30	11,20	-8,94
%Idle	81,80	81,80	0,00

1) normalized redo (+6,67%) is 163692/s for the uncompressed run

In order to further analyze the effects of Advanced Compression on DML operations, SQL Performance Analyzer (SPA) was used concurrently with Database Replay. As the workload was being replayed, SPA's automatic cursor cache capture feature was used to capture the SQL statements into a SQL Tuning Set. SQL Tuning Set contains the text of the SQL statements along with their bind values, execution plans and statistics. This was done for both replays, with compression enabled and without compression. In all over 5000 SQL statements were analyzed. The table below shows the SQL Tuning Set comparison of some the most frequently executed DML operations in the SAP workload.

Sample SQL Tuning Set Comparison

Compression	SQL ID	SQL Text	Executions	Elapsed Time	CPU Time	Buffer Gets	Disk Reads	Module
N	g9makkh1cnq94	INSERT INTO "ALCLASTOOL" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	37648	180,29	152,97	1136194	32901	SAPLSALU
Y	g9makkh1cnq94	INSERT INTO "ALCLASTOOL" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	40434	215,54	164,10	1118975	33911	SAPLSALU
N	6kxdz6nknay0m	INSERT INTO "ALGRPCUSGE" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	18257	80,88	71,32	518407	9978	SAPLSALU
Y	6kxdz6nknay0m	INSERT INTO "ALGRPCUSGE" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	18889	92,12	74,99	532217	9615	SAPLSALU
N	c42810chs804v	INSERT INTO "ALGRPCUSPF" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	4100	20,51	16,67	134523	3652	SAPLSALU
Y	c42810chs804v	INSERT INTO "ALGRPCUSPF" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	4202	24,07	17,32	137029	3493	SAPLSALU
N	8wz2ywwcrh7c7	INSERT INTO "ALGRPCUSMC" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	2144	12,48	9,08	77571	2758	SAPLSALU
Y	8wz2ywwcrh7c7	INSERT INTO "ALGRPCUSMC" VALUES (:A0 , :A1 , :A2 , :A3 , :A4...	1820	13,18	7,94	65849	2289	SAPLSALU

Overall the test results were very instructive. Key findings are described as follows (note: results will vary according to your workload):

- No significant overhead observed during capture process

- Advanced Compression reduced database size by 50%
- Redo generated increased by ~25%
- Physical reads reduced by 60%
- CPU usage stayed flat

Problems encountered:

During the testing bug # 9233285 was encountered. Patch for this bug must be applied before using Real Application Testing with SAP systems.

Conclusion

Real Application Testing proved a vital tool for validating upgrade from Oracle Database 10g Release 2 to 11g Release 2. The ability to test with production workloads and SQL statements is essential for testing business critical applications like SAP and this feature will significantly mitigate upgrade and change risk when used by experienced DBAs.