ORACLE® 12*c*
ENTERPRISE MANAGER

Application Quality Management

ORACLE®

Executive Overview

Oracle Enterprise Manager is Oracle's integrated enterprise IT management product line and provides the industry's first complete cloud lifecycle management solution. Oracle Enterprise Manager's Business-Driven IT Management capabilities allow you to quickly set up, manage and support enterprise clouds and traditional Oracle IT environments from applications to disk. Enterprise Manager allows customers to achieve:

- *Best service levels for traditional and cloud applications* through management from a business perspective including Oracle Fusion Applications

- *Maximum return on IT management* investment through the best solutions for intelligent management of the Oracle stack and engineered systems

- *Unmatched customer support experience* through real-time integration of Oracle's knowledgebase with each customer environment

Introduction

Realistic and efficient testing has become more and more difficult in today's fast-paced IT environments, where agile development methodologies, SOA, cloud and other disruptive technologies compress deployment timeframes from months to days. In addition, the emerging consensus around the importance of DevOps underscores the desirability of testing methodologies that are tightly linked to IT operations best practices. Oracle understands this and has engineered market-leading Quality Management solutions in Oracle Enterprise Manager that provide realistic, production-level synthetic workloads, transportable real user workloads, deep instrumentation and the most efficient automation available for testing Oracle packaged and custom applications.

Application Quality Management

Businesses have invested huge amounts in new applications to deliver better and more cost-effective services to their customers. But poor software quality can put these investments at risk. Studies have shown that more than 40% of software applications are released with critical defects. And the cost to fix those defects in production is up to 100 times more expensive than in the development phase. In a customer satisfaction survey performed for Siebel customers, a correlation was shown between the amount of testing performed and customer satisfaction with the application. In every measure including overall product effectiveness, reliability, speed and scalability, customers that did more testing and more formalized testing had better results than those that did not test. This is why Application Quality Management is so important for maintaining business agility and ensuring service levels while also reducing costs and risk.

Oracle Enterprise Manager's Application Quality Management (AQM) solutions provide high quality testing for all tiers of the application stack. Thorough testing can help users identify application quality and performance issues prior to deployment. Testing is one of the most challenging and time consuming parts of successfully deploying an application, but it is also one of the most critical to the project's success. Oracle Enterprise Manager's AQM solutions provide a unique combination of test capabilities which enable users to:

- Test infrastructure changes: Real Application Testing is designed and optimized for testing database tier infrastructure changes using real application production workloads to validate database performance in your test environment. Application Replay is a new AQM product released with Enterprise Manager 12c and offers similar infrastructure testing capabilities as Real Application Testing does, but for the full application. If your applications have infrastructure changes, then these solutions will be instrumental in ensuring the success of your deployment.

- Test application changes: Application Testing Suite helps you ensure application quality and performance with complete end-to-end application testing solutions that allow you to automate functional & regression testing, execute load tests and manage the test process. Application Testing Suite is a synthetic test solution and can be used for testing new applications not yet deployed into production, application upgrades and may be used in combination with Real Application Testing as well as Application Replay.

- Manage your test data and enable secure production-scale testing: Data Masking Pack helps you achieve security & compliance objectives by obfuscating sensitive data in your production databases so you can leverage them in your test environments.

- Shrink storage costs: Oracle Test Data Management creates reduced size copies of production data for application development, training and testing while maintaining the referential integrity of the data set.

Together these products provide a comprehensive solution for Application Quality Management.

Application Testing with Oracle Application Testing Suite

Rigorous application testing can help ensure a successful application deployment and a positive experience for your end users. This involves end-to-end testing of the entire application and supporting infrastructure to ensure that it meets requirements and performs as expected. Too often however, testing is left to the very end of the application development process with little or no planning done in advance to guarantee success. Application functionality is usually tested manually, on an ad-hoc basis and performance testing is often an afterthought. Testers and quality assurance teams are faced with both limited time and not enough resources to ensure critical applications will function properly. As application development inevitably slips, testing time is further reduced in an effort to meet oftentimes rigid release schedules.

Oracle Application Testing Suite is an integrated test solution that provides synthetic end-to-end testing capabilities for ensuring application quality, performance and reliability. Application Testing Suite (ATS) includes a suite of products for automated functional testing, load testing and test management of Web, packaged and Service Oriented Architecture-based applications. By helping you automate your test cases, test and tune application performance and better manage your test processes – ATS can help you deliver higher quality applications while also increasing the efficiency of your testing team.

There are three separately licensed products in the Oracle Application Testing Suite:

- Oracle Test Manager for documenting and managing the overall testing lifecycle including test planning, test requirements, test cases and issues.

- Oracle Functional Testing for automating functional and regression testing of Web applications, Oracle packaged applications, Oracle databases and Web Services.

- Oracle Load Testing for automated load testing of Web applications, Oracle packaged applications, oracle databases and Web Services.

ATS provides heterogeneous test capabilities for any Web application or Web Service, regardless of the server technology or platform it is built on. ATS also provides custom test "accelerators" for testing Oracle packaged applications like Oracle e-Business Suite, Siebel and Oracle Fusion Applications providing more efficient and optimized testing. ATS also offers so called "Test Starter Kits (TSKs) with pre-build test automation scripts that help testers to get started with their test automations for Oracle EBS and Siebel quicker. Using ATS, customers can help ensure the success of their mission-critical application deployments and upgrades.

Oracle Test Manager

Ensuring application quality in the face of tight release schedules and limited resources can be a major challenge. The only way to address this challenge is by having an effective framework, in place for planning, executing, and managing the testing process. Implementing an effective testing process up front will allow you to:

- Reduce Test Cycle Times

- Improve Testing Efficiency

- Promote Reusability of Test Cases

- Increase Visibility of the Testing Process

Oracle Test Manager provides a complete test process management solution – helping you manage all of your test cases, test requirements and issues from a central repository to improve the effectiveness of your test process. Users access Oracle Test Manager through a fully Web-based console that provides four integrated modules:

- The Test planning module allows testers or test managers to define and manage test approach, methodologies that shall be used for testing, to define the scope, exit criteria as well as check lists of various kinds if needed. The Test planning module includes a template for Cap Gemini/Sogeti's riskbased testing methodology TMAP.

- The Requirements module allows testers to document and manage their test requirements before the testing process begins

- The Tests module enables testers to create and document automated and manual test cases, execute these test cases and store results.

- The Issues module allows testers and developers to capture and share issues found during the testing process and then track their resolution.

Oracle Test Manager's integrated reporting interface helps you provide end-to-end visibility into your test process. It's also fully customizable to fit your test methodology. And because it is built on a scalable enterprise architecture based on Oracle Database and Weblogic Server, it provides unlimited scalability to meet your expanding needs.
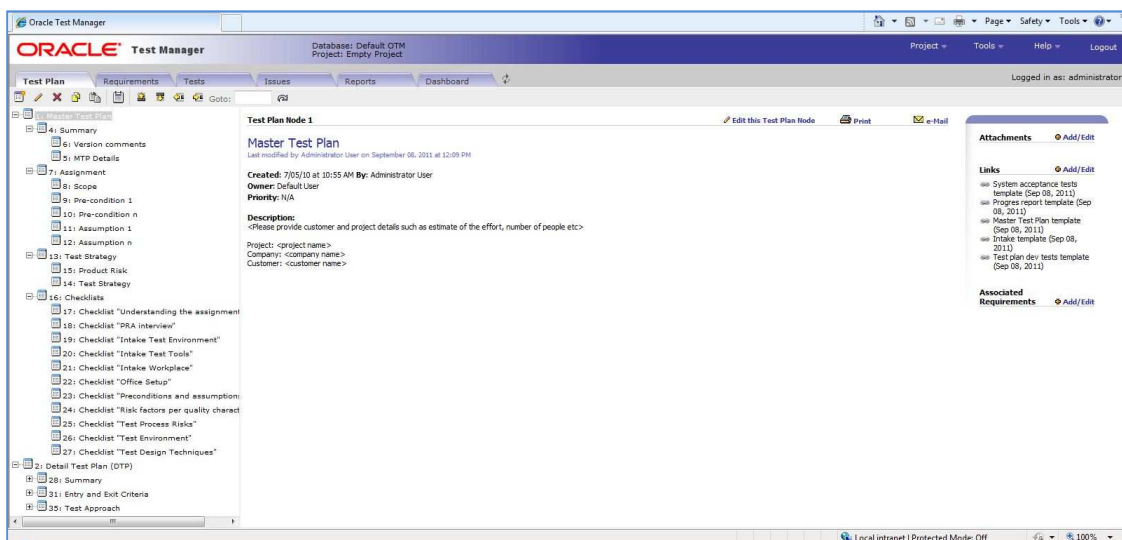

Figure 1. Oracle Test Manager.

Oracle Functional Testing

Functional testing helps you validate that your application's functionality meets end user business requirements. Whether you are deploying a brand new application or upgrading an existing application, functional testing is critical to ensure the application works as expected and to identify and address any issues prior to deployment. Functional testing requires both validating new functionality as well as testing existing functionality as part of an upgrade to make sure the application didn't "regress" in the latest release. This combination of functional and regression testing is key to ensuring overall application quality.

Manual testing accounts for the majority of functional & regression testing performed for all applications today. Manual testing typically involves a team of testers, developers, business analysts and possibly even end-users stepping through the application manually in a test or staging environment, to check that it works prior to being deployed to production. This type of testing leverages the hands-on knowledge and experiences of these testers. However, it can be very time consuming, expensive and inefficient - especially in the face of a major application rollout or a series of repeated application upgrade cycles that require continuous ongoing testing. Automated test tools can help you automate many of your test cases, extend test coverage to a greater percentage of your application and reduce the need for manual testing which saves you both time and money. Automated functional and regression testing can help you complement your manual testing activities and make your testers more efficient and effective.

Oracle Functional Testing is an automated functional & regression testing solution for Web, SOA and Oracle packaged applications. Oracle Functional Testing's OpenScript integrated scripting platform enables users to create automated test scripts that simulate complex business transactions. The same solution is used to create both automated functional test scripts and load/performance test scripts, so users aren't forced to learn different tools and scripting languages for each task. OpenScript provides an intuitive visual scripting interface that simplifies the scripting process combined with a powerful Java IDE that provides superior scripting extensibility for advanced users. With OpenScript, users can record test automation scripts by simply stepping through their transactions in a web browser. OpenScript automatically captures all user actions and data inputs and accurately identifies the objects that the user interacts with. Users can then run their automated scripts to execute these transactions and leverage the graphical scripting interface to analyze playback results, parameterize script inputs and add custom test cases to validate application content. Load test scripts can also be created in OpenScript and then run in Oracle Load Testing across thousands of concurrent Virtual Users to validate application performance. Custom testing accelerators for Oracle E-Business Suite, Siebel, Oracle Fusion applications, ADF based applications, Oracle databases and SOA Web Services provide customized automation capabilities for more efficient, optimized testing.
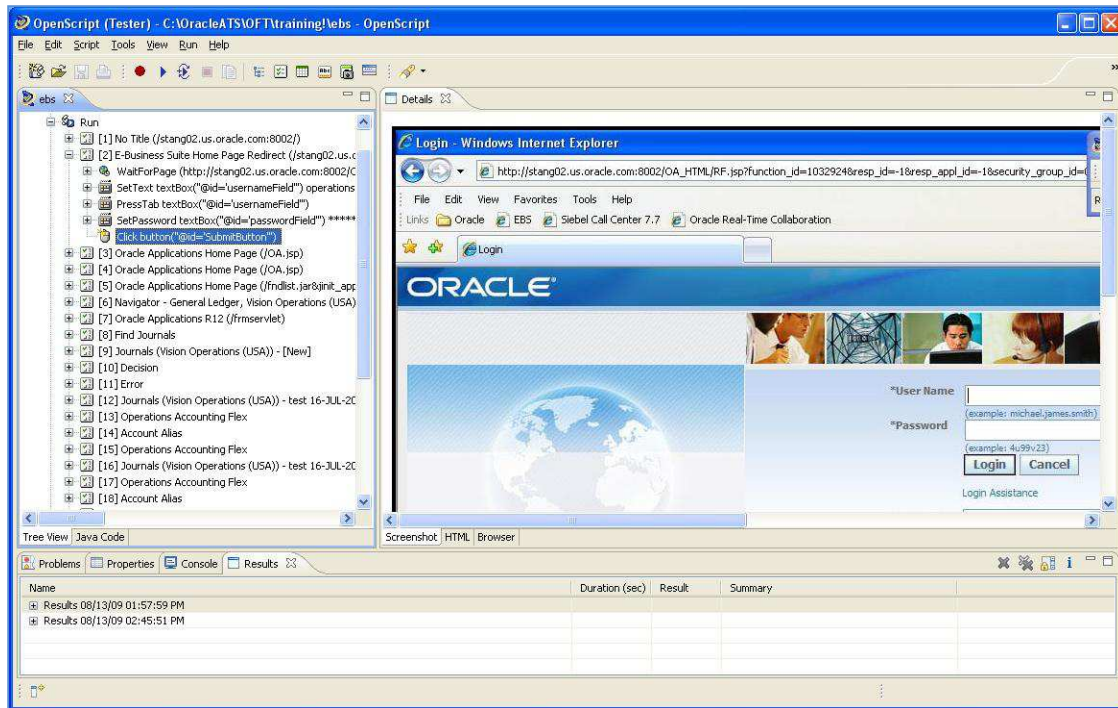
Figure 2. Oracle Functional Testing

Oracle Load Testing

Load testing can help you ensure that your application will perform and scale under real user workloads once it's deployed to production. This will help you assess that your application will be able to handle the number of concurrent users and resulting traffic during peak usage periods while maintaining acceptable performance and response times. It can also help you identify and address critical bottlenecks prior to deployment. Stress testing then allows you to test beyond the limits of normal operation and helps you assess the capacity and scalability of your application infrastructure.

In order to effectively analyze application performance and identify bottlenecks you need to be able to simulate production-level loads and accurately measure resulting application performance. Performance tuning is also typically an iterative process that requires constant retesting as you address bottlenecks and make changes to your application and infrastructure. As a result, there really is no realistic manual alternative to run these tests without using an automated load testing tool.

Oracle Load Testing lets you run realistic load tests for Web, Oracle databases, SOA and Oracle packaged applications – helping you simulate thousands of concurrent users and analyze the impact of production load levels on application performance. Users create load test scripts that automate key application workflows using Oracle's OpenScript integrated scripting platform. With OpenScript users can create load test scripts for any Web-based application regardless of the technology or platform it's built on. Integrated load testing accelerator options then provide customized load testing capabilities for applications like Oracle e-Business Suite, Oracle Fusion applications and Siebel as well as SOA-based Web Service interfaces and Oracle databases

Oracle Load Testing then provides an intuitive, fully-Web based console to configure these scripts to run across any number of concurrent users. Oracle Load Testing is deployed on the Oracle WebLogic Server and allows you to configure your load test scenarios, run your tests and view graphs and reports to analyze application performance. Oracle Load Testing also includes integrated server monitors as well as integrations with Oracle Enterprise Manager for JAVA and database diagnostics to help identify & resolve performance bottlenecks.   This comprehensive set of infrastructure performance monitors can record in-depth performance metrics of Web servers, application servers, databases, and other infrastructure components during the load test. When this information is combined with the performance results gathered by the virtual users, developers have the real-time information needed to analyze and ensure optimal application performance during and after test execution.
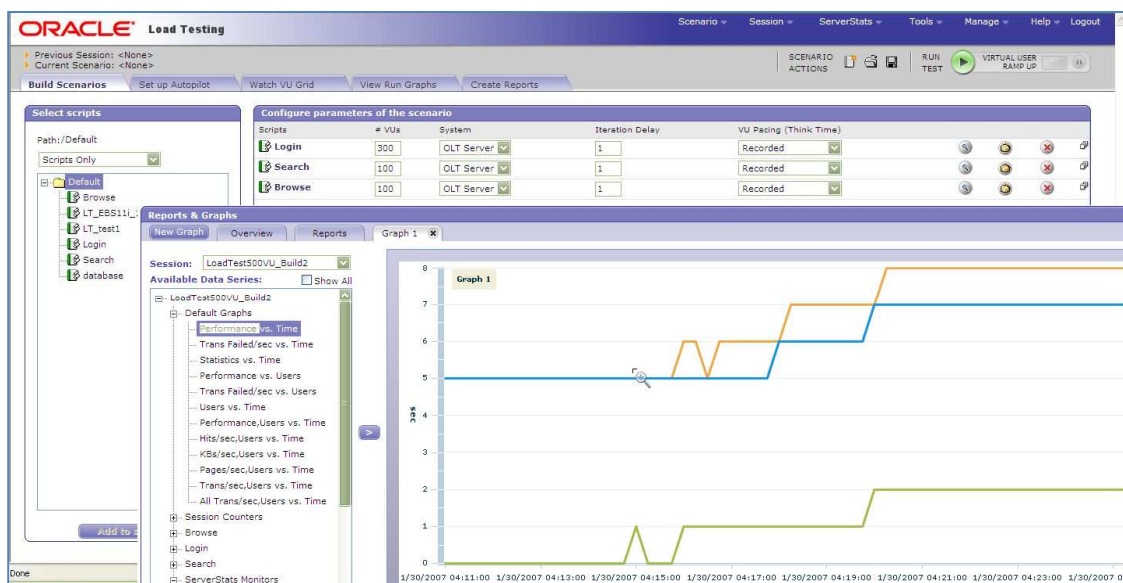

Figure 3. Oracle Load Testing

Benefits of Application Testing Suite

Organizations that have used Oracle Application Testing Suite to automate functional & regression testing, execute load tests and manage their test process have realized significant benefits in the following areas:

- Reduced Testing Time & Cost: By automating their test cases and leveraging easy-to-use test solutions, organizations have been able to reduce the need for manual testing while making their test cycles more efficient and effective.

- Increased Application Quality & Performance: By leveraging test automation for both functional testing and load testing, organizations have been able to extend their test coverage, test their applications under production-level workloads and identify and address more functionality issues and performance bottlenecks prior to deployment, when they are less costly to fix.

- Improved Control & Visibility over the Test Process: By managing their testing from a centralized console, organizations have enabled their test teams to collaborate and share information while gaining more control and visibility over their test processes.

These benefits were realized by a major financial services company that was rolling out a new version of Siebel CRM. In addition to performing a major upgrade and adding new application functionality, the customer was also consolidating their server platform to fewer more powerful machines. A previous Siebel upgrade had been a challenge due to unexpected issues that had caused poor performance for end users, once the application was deployed to production. With Application Testing Suite, this customer was able to quickly automate key Siebel transactions to create their load test scripts. They were then able to run these test scenarios across hundreds of concurrent users to simulate application usage in production. The tests identified application performance issues caused by excessive CPU usage in the database tier due to some costly, ad-hoc queries being executed. After addressing this performance bottleneck, they were able to re-run their load test to validate that the database was no longer an issue and application performance was acceptable. As a result of their thorough testing and tuning, the customer's production upgrade was a success and end-users reported positive feedback on the performance of the application.

Infrastructure Testing with Oracle Application Replay

Oracle Application Replay complements the synthetic testing done with ATS by providing the ability to capture and replay the application workload as deployed in production.

Oracle Application Replay enables realistic testing of planned changes to any part of the application infrastructure stack from application server down to disk, by re-creating the production workload on a test system. Using Oracle Application Replay, you can capture a workload on the production system and replay it on a test system with the exact timing, concurrency, and transaction characteristics of the original workload. This enables you to fully assess the impact of any change, including new contention points, SQL execution plan regressions or undesired results. Extensive analysis and reporting is provided to help identify any potential problems, such as new errors encountered and performance divergence. Types of changes that can be tested with Oracle Application Replay include application server upgrades, hardware updates, operating system changes, configuration changes, and so on.

Testing with Real-World Application Workloads

The Oracle Application Replay feature provides a testing structure that works by first capturing the entire workload relevant to an application, as generated by the application's Web interface, at the production site.

The captured application workload is then moved to the test environment, where the replay infrastructure reproduces the captured workload, preserving its original properties, such as concurrency, dependency and request timings. Extensive performance and correctness data from all layers of the stack is collected and reported. This enables you to compare the replay with the original captured workload at all levels. Any issues resulting from infrastructure changes that occurred during

the replay can be easily identified, and appropriate troubleshooting action undertaken to prevent them from occurring in production.
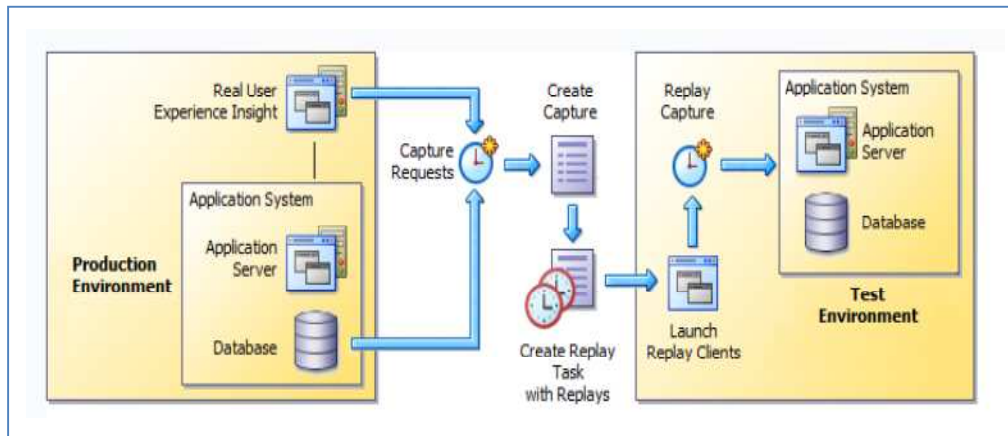

Figure 4. Oracle Application Replay Workflow

The use of real workloads offers a number of unique capabilities.   In particular:

- It provides a system-wide perspective starting from the user's activity.   Only testing individual components, as traditionally done, can provide little information on the components combined behavior and performance under a realistic workload.

- The use of real workloads provides comprehensive testing, subjecting the system to real user's operations. For Web applications, this not only means exploring all possible ways a user interacts with the system, but also all possible load conditions. This is necessary because systems behave quite differently under different workload characteristics (for example, the number of concurrent users).

- Far greater insight is obtained into possible errors. Test results include data for every layer of the stack, and these can be correlated across different layers. It provides a means to verify correct execution, by checking for errors or unexpected server responses.

Capturing Application Workload Using RUEI

In order to capture the application workloads, Oracle Application Replay uses Oracle Real User Experience Insight (RUEI). RUEI is a Web-based utility for monitoring and reporting on real-user's experience with your Weband packaged applications. It measures the response times of pages, issues users are experiencing, if issues are application or network related,user flows and much more.. It provides you with powerful analysis of your network and business infrastructure, while an insightful diagnostics facility allows application managers as well as IT technical staff to perform root-cause analysis.

You can implement checks on page content, site errors, and the functional requirements of your user flows. Based on this information, you can verify your business and technical operations. You can set custom alerts on the availability, throughput, and traffic of everything identified in RUEI.

RUEI comes with a library of powerful reports that provide both business-orientated and technical-orientated users with the information they need to make effective decisions. In addition, authorized users can quickly create their own reports or modify existing reports. Using these reports, they can directly interact with the Web data to gain a deep understanding of online usage behavior, as well as the overall status of Web applications. They can view these reports interactively, or receive them by e-mail.

Using RUEI's dynamic drill-down capabilities, you can quickly focus on any desired level of Web results. You can sort, filter, and export information. In addition, you can correlate any data across a wide variety of criteria, including time, client location, user flow, and user name. In cases where synthetic testing is preferred, individual user session captured by RUEI may be exported as load/performance test scripts for Oracle Load Testing.

Replaying the Application Workload

After capturing the application workload in production, it can easily be replayed in a test environment by using Application Replay. The test hardware and software environment should be configured to mirror the production environment, with the desired infrastructure changes applied.   In addition to the hardware and software environments, the application data state on the test system should be restored so it is logically equivalent to that of the capture system at the start time of workload capture.

Once initiated, the workload replay issues identical HTTP/NCA (Oracle Forms) requests as captured in production, and maintains the characteristics of the capture in terms of concurrency and timing. This creates the identical load and stress in the test environment as seen in production. You can replay a workload as many times as you wish, allowing investigation of multiple performance and tuning solutions.
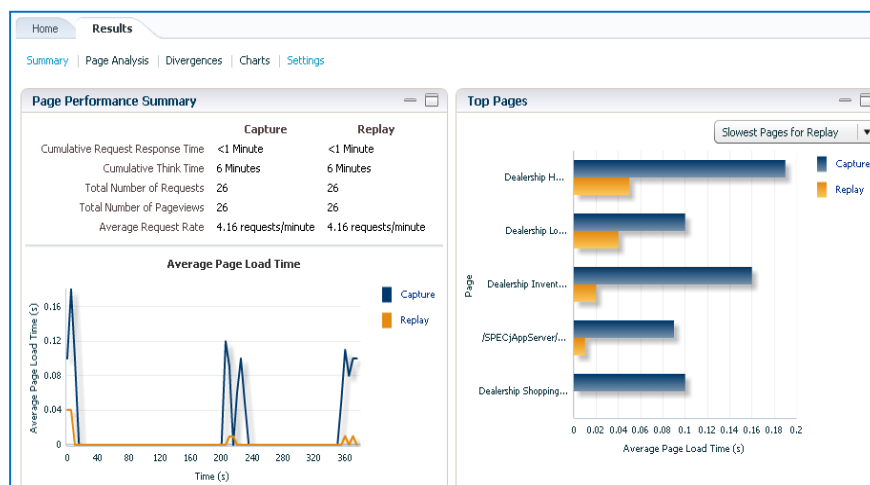
Analysis and Reporting

Figure 5. Oracle Application Replay Results

Oracle Application Replay provides extensive analysis and reporting which encompass both a high-level summary and detailed drill-down analysis in terms of errors, performance and data divergence to help understand how the replay fared in comparison to capture or to other replays. The extensive reporting enables you to quickly identify problem areas and helps you determine an action plan to resolve those issues.

Infrastructure Testing with Oracle Real Application Testing

Real Application Testing provides the highest quality load testing solution for the database stack complementing ATS's and Application Replay's testing capabilities. Real Application Testing can be used for testing existing applications for system changes related to database stack or below. Some typical examples of supported system changes that routinely happen in a database operational environment are: Operating system and hardware upgrades, storage subsystem changes, database upgrade and/or patches, RAC instance addition, conversion to RAC, migration to Exadata V2, database parameter or optimizer related changes.

Real Application Testing includes two solutions to test the impact of system changes on real-world applications:

- SQL Performance Analyzer (SPA) to assess the impact of system changes on SQL response time by identifying any variation in SQL executions plans and performance statistics resulting from the change.

- Database Replay 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 change on the workload

Database Replay and SPA together provide a comprehensive, flexible, and end-to-end solution for assessing impact of database stack related changes. They enable 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 functionality is accessible both from Oracle Enterprise Manager and command-line APIs.

SQL Performance Analyzer

Changes in SQL execution plans due to routine system changes such as optimizer statistics refresh, schema changes, upgrades or patch set application, often severely impact production system performance and stability. Therefore, the ability to perform fine-grain SQL response time assessment with SPA and to fix any regressions is important to the smooth functioning of any application.

SPA runs the SQL statements in isolation and serial manner in before-change and after-change environments and provides a detailed change impact report showing SQL that have remained the same, improved and regressed. SPA functionality is integrated with database tuning solutions like SQL Tuning Advisor, and SQL Plan Management. As a result, SPA completely automates and simplifies the manual and time consuming process of identifying application SQL problems on even extremely large

SQL workloads (hundreds of thousands of SQL statements). Any SQL regressions resulting from the system change can be automatically and transparently remediated without changing the application.

The SPA report summarizes the change impact on entire workload as well as the net impact on individual SQL statements. Figure 6 below shows Oracle Enterprise Manager's SPA Task Result page for a completed SPA test run.
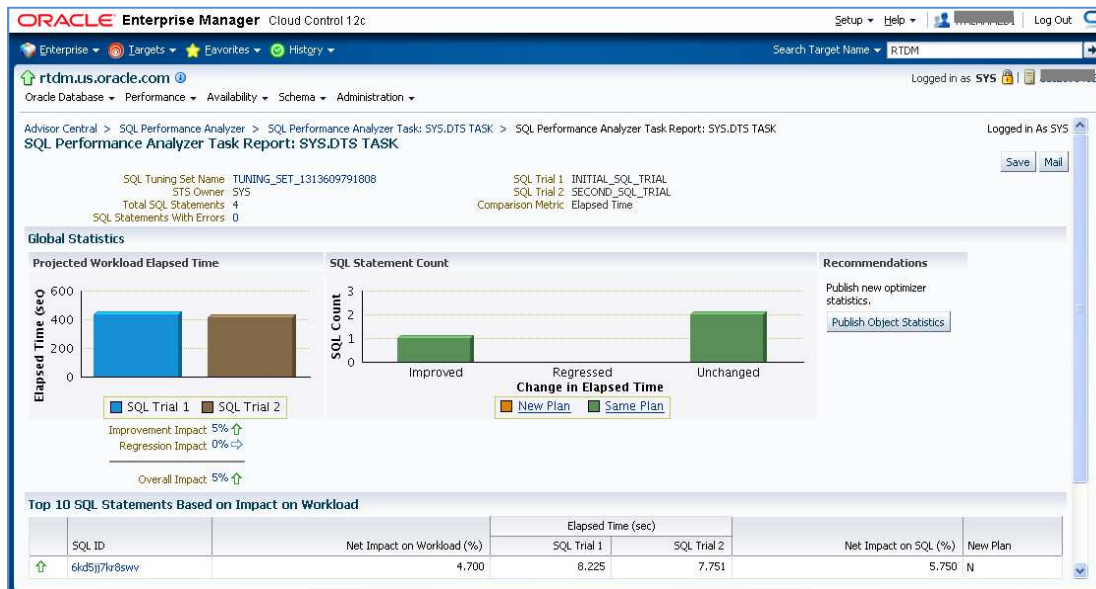

Figure 6. SQL Performance Analyzer Report

SPA testing covers all SELECT statements and query component of DML in the workload. As queries do not change the state of the data, SPA can even be used on production systems with appropriate resource and time limits during non-peak hours or maintenance windows. SPA testing can be scoped to private session attributes in a controlled manner to avoid impacting production users. For large terabyte-sized databases, some customers may be not able to provision a full-blown test system due to resource constraints. In such cases, SPA provides flexibility to test in production environment itself or also on a subset of the production database on test.

Besides providing testing capability in production environment, SPA testing also covers a broad range of database releases and use cases. For example, SPA can be used for testing routine optimizer statistics refresh, Oracle Database 10.2.0.x to 10.2.0.y patch set application and Oracle Database 9i/10g to 10.2 and higher release upgrades. SPA testing can also be extended to home grown scripts, ATS or Database Replay. By capturing workloads into different STSs in two given environments (before and after change), and using the "Build from STS" trial method of SPA, one can understand the impact of system change on SQL workload. SPA testing can also be conducted on an Oracle Active Data Guard database (read-only physical standby). This lets businesses leverage the idle resources on a standby database using a full blown copy of the dataset that is also current. Thus, businesses can leverage the existing investment in standby database infrastructure for testing as well as for reporting purposes.

Database Replay

Database Replay provides full workflow coverage and uses real production-scale workload that results in highest quality testing. Database Replay allows you to capture a production workload with negligible performance overhead and replay it on a test system with the exact timing, concurrency, and transaction characteristics of the original workload. By replaying real-production workload Database Replay provides complete assessment of the impact of the change including identifying undesired results - new contention points or performance regressions. It also provides extensive analysis and reporting to help identify potential problems, such as new errors encountered and performance divergence. Thus the task of assessing a system change using Database Replay is reduced from months to days.

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 such as:

- Database upgrades, patches, parameter, schema changes, etc.

- Configuration changes such as conversion from a single instance to RAC, ASM

- Storage, network, interconnect changes

- Migration to Exadata

- Operating system, hardware migrations, patches, upgrades and parameter changes.

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

- Workload Capture to record all requests made by external clients to Oracle Database, these include all relevant information about the client request, such as SQL text, bind values, and transaction information. Background activities and database scheduler jobs are not captured.

- Workload Processing to transform the captured data and create necessary metadata needed for replaying the workload.

- Workload Replay to submit 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. It is assumed that the test system is set up appropriately for replay purposes.

- Analysis and Reporting provides extensive information that helps understand impact of system change. Both high-level summary and detailed drill-down information in terms of errors, performance and data divergence are reported.

Figure 7 shows Oracle Enterprise Manager's Database Replay Summary page of a completed workload replay.
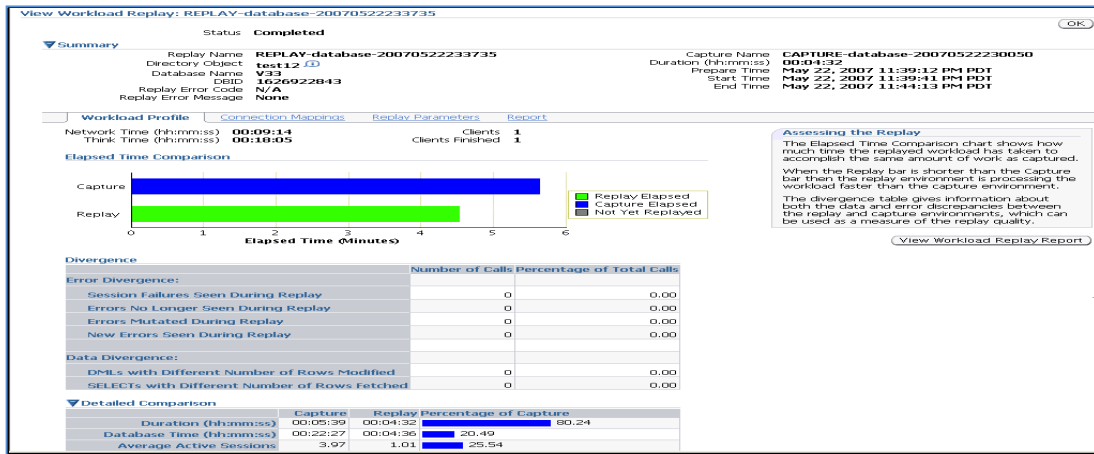
Figure 7. Database Replay Summary Page

Real Application Testing and Application Testing Suite Integration

Oracle Application Testing Suite Load Testing Accelerator for Oracle Database enables automated load and performance testing of Oracle databases using synthetic test scripts. Users create their database load test scripts using Oracle Functional Testing's OpenScript integrated scripting platform.

OpenScript is integrated with Oracle Real Application Testing. This takes database testing even further by enabling you to construct a highly customized testing workload based on real production SQL and PL/SQL and use that for scale up testing and smart capacity planning.

You can import a Database Replay capture file from your production database into OpenScript to automatically generate your synthetic test scripts. This will import all of the SQL statements and parameters that are used to drive your script. The script can then be parameterized, desired workload scenarios created, and configured to run in Oracle Load Testing using concurrent virtual users to perform scalability testing.
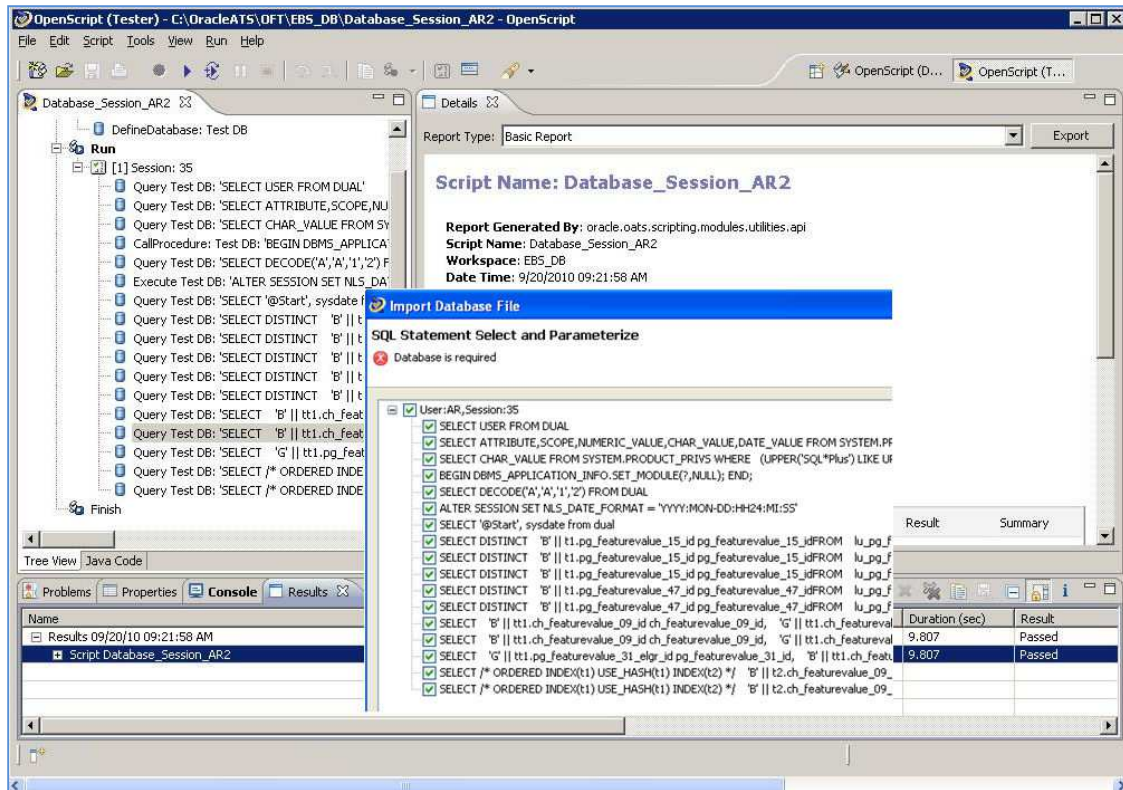
Figure 8. Importing Database Replay files through OpenScript

Figure 8 above illustrates the OpenScript workflow in Application Testing Suite to import a Database Replay capture file.

Real Application Testing and Data Masking Integration

Real Application Testing and Data Masking functionality integration provides users with the ability to perform secure testing in situations where data in production needs to be shared by non-production users due to organization or business requirements. Typically testing is done in a non-production environment or by a different group or organization. This integration addresses a common requirement that the data used for testing be shared in a manner that adheres to data privacy and compliance regulations.

Data masking functionality has been enhanced to work consistently across all workload artifacts - sensitive data in the database, SQL Tuning Sets, and Database Replay workload capture files while at the same time preserving the performance characteristics of the workload before and after masking. Thus secure testing can be accomplished in a manner compliant to data privacy regulations.

Figure 9. Real Application Testing Integration with Data Masking

Figure 9 above illustrates Data Masking workflow to mask the specified STSs and capture files along with sensitive data in the database.

Benefits of Real Application Testing

Businesses that have used Oracle Real Application Testing to test system changes have realized significant benefits in the following areas:

- Highest quality testing: By using real-production workload for testing, organizations have identified and corrected issues in test before production deployment. This had led to improved performance, SLAs, and stability of production systems.

- Reduced IT costs: By using Real Application Testing on an on-going basis, organizations have been able to reduce the burden on DBAs who previously had to be involved in fire fighting operational issues in production environment. Now these resources are directed towards more proactive and strategic part of the business.

A major retailer that used Real Application Testing to upgrade to Oracle Database 11g realized the above benefits. The customer's challenge in this case was to upgrade their mission critical database hosting the retail stores. The customer had previously used homegrown testing tools for upgrading from Oracle Database 8.1.7. They observed unpredictable performance following the 8.1.7 upgrade and numerous application changes were required to maintain system stability. With Real Application Testing use for Oracle Database 11g upgrade, the time to test was reduced by 50% from before and no application changes were necessary. And importantly, the production go-live was smooth and no surprises were noted in the last two years of operations. The customer used SPA for testing SQL response time and finding the optimal database configuration setting for their workload. Database Replay was used for testing workload performance. The customer used SQL Profiles to improve application performance transparently. The retailer is now in a better position to accommodate future growth and plans to extend use of Real Application Testing for adopting new technologies like OLTP compression, TDE, etc. Thus, the retailer accomplished a smooth Oracle Database 11g upgrade with significantly reduced effort while eliminating the risk associated with such a change.

Secure Test Data Management with Oracle Data Masking Pack

Enterprises have always shared data within and outside the organization for various business purposes. Database administrators (DBAs) in these enterprises copy production data into staging or test environments to allow in-house developers or offshore testers to perform application development and application testing. The problem with data sharing is that copies of production data often contain company confidential, sensitive or personally identifiable information, access to which is restricted by government regulations. Therefore, these enterprises run the risk of breaching sensitive information when sharing production data with application developers or software quality testers.

Oracle Data Masking Pack

Oracle Data Masking Pack helps reduce this risk by irreversibly replacing the original sensitive data with fictitious data so that production data can be shared safely with IT developers or offshore business partners. Oracle Data Masking Pack helps maintain the integrity of the application while masking data. Accessible via Oracle Enterprise Manager, this Management Pack provides end to end secure automation for provisioning test databases from production in compliance with regulations.

Sensitive Data Discovery and Application Integrity

Data may be sensitive for a variety of reasons, such as confidentiality (employee salary), regulatory (Sarbanes-Oxley or HIPAA compliance) or established business practices (PCI-DSS). Using Oracle Data Masking Pack's search capabilities, information security administrators can quickly search the database to identify sensitive data. In some applications, the same sensitive data is maintained in multiple tables related by referential (primary key-foreign key) relationships, e.g. employee numbers in a

Human Resources application. Oracle Data Masking Pack discovers these relationships and masks all related data elements automatically while preserving referential relationships.

Comprehensive and Extensible Mask Library

Oracle Data Masking Pack provides a centralized library of out-of-the-box mask formats for common types of sensitive data, such as credit card numbers, phone numbers, national identifiers (social security number for US, national insurance number for UK). By leveraging the Format Library in Oracle Data Masking Pack, enterprises can apply data privacy rules to sensitive data across enterprise-wide databases from a single source and thus, ensure consistent compliance with regulations. Enterprises can also extend this library with their own mask formats to meet their specific data privacy and application requirements.

Sophisticated Masking Techniques

Oracle Data Masking Pack provides a variety of sophisticated masking techniques to meet application requirements while ensuring data privacy. These techniques ensure that applications continue to operate without errors after masking. For example,

- Condition-based masking: this technique makes it possible to apply different mask formats to the same data set depending on the rows that match the conditions. For example, applying different national identifier masks based on country of origin.

- Compound masking: this technique ensures that a set of related columns is masked as a group to ensure that the masked data across the related columns retain the same relationship, e.g. city, state, zip values need to be consistent after masking.

- Deterministic masking: this technique ensures repeatable masked values after a mask run. Enterprise may use this technique to ensure that certain values, e.g. a customer number gets masked to the same value across all databases.

Prior to mask execution, Oracle Data Masking Pack performs several pre-mask validation checks, such as validating that the mask formats matches the table data types, checking for space, to ensure that the masking process is error-free.
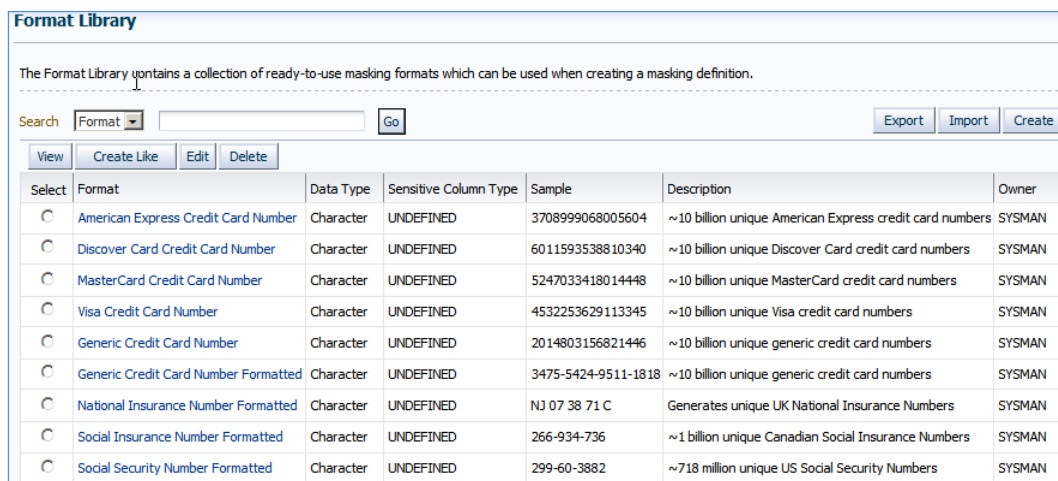
Unlike traditional masking processes that are typically slow, Oracle Data Masking Pack uses highly efficient parallelized bulk operations to replace the original sensitive data with masked data. Because the entire data masking process is done in place, enterprises can be assured of a greater sense of security knowing that the sensitive data would never leave the database during the masking process.

Oracle Data Masking Pack is also integrated with Oracle Provisioning and Patch Automation Pack in Oracle Enterprise Manager to clone-and-mask via a single workflow. The secure high performance nature of Oracle Data Masking combined with the end-to-end workflow ensures that enterprise can provision test systems from production rapidly instead of days or weeks that it would with separate manual processes.

Optimized for Oracle Databases

Oracle Data Masking Pack leverages key capabilities in Oracle databases to enhance the overall manageability of the masking solution. Some of these include:

- Flashback: Administrators can optionally configure Oracle databases to enable flashback to a pre-masked state if they encounter problems with the masked data.

- PL/SQL: Unlike other solutions, Oracle Data Masking Pack generates DBA-friendly PL/SQL that allows DBAs to tailor the masking process to their needs. This PL/SQL script can also be easily integrated into any cloning process.

Format Library

The Format Library contains a collection of ready-to-use masking formats which can be used when creating a masking definition.

Search [Format ▼] [_____] [Go]   [Export] [Import] [Create]

[View] [Create Like] [Edit] [Delete]

Select	Format	Data Type	Sensitive Column Type	Sample	Description	Owner
○	American Express Credit Card Number	Character	UNDEFINED	3708999068005604	~10 billion unique American Express credit card numbers	SYSMAN
○	Discover Card Credit Card Number	Character	UNDEFINED	6011593538810340	~10 billion unique Discover Card credit card numbers	SYSMAN
○	MasterCard Credit Card Number	Character	UNDEFINED	5247033418014448	~10 billion unique MasterCard credit card numbers	SYSMAN
○	Visa Credit Card Number	Character	UNDEFINED	4532253629113345	~10 billion unique Visa credit card numbers	SYSMAN
○	Generic Credit Card Number	Character	UNDEFINED	2014803156821446	~10 billion unique generic credit card numbers	SYSMAN
○	Generic Credit Card Number Formatted	Character	UNDEFINED	3475-5424-9511-1818	~10 billion unique generic credit card numbers	SYSMAN
○	National Insurance Number Formatted	Character	UNDEFINED	NJ 07 38 71 C	Generates unique UK National Insurance Numbers	SYSMAN
○	Social Insurance Number Formatted	Character	UNDEFINED	266-934-736	~1 billion unique Canadian Social Insurance Numbers	SYSMAN
○	Social Security Number Formatted	Character	UNDEFINED	299-60-3882	~718 million unique US Social Security Numbers	SYSMAN

Figure 10. Data Masking Pack

Benefits of Oracle Data Masking Pack

Organizations that have implemented Oracle Data Masking Pack to protect sensitive data in test and development environment have realized significant benefits in the following areas:

- Compliance: By protecting sensitive information when sharing production data with developers and testers, organizations have able to ensure that non-production databases have remained compliant with IT security policies while enabling developers to conduct production-class testing.

- Automation: By automating the masking process, organizations have been able to reduce the burden on DBAs who previously had to maintain manually-developed masking scripts.

These benefits were realized by a major global telecommunications products company that implemented Oracle Data Masking Pack. Their database administrators (DBAs) had developed custom scripts to mask sensitive data in the test and development environments of their human resources (HR) application. As the company was growing and offering new services, their IT infrastructure was also growing thus placing an increased burden on their DBAs. By implementing Oracle Data Masking Pack, the organization was able to use the role-based separation of duties to allow the HR analysts to define the security policies for masking sensitive data. The DBAs then automated the implementation of these

masking policies when provisioning new test or development environments. Thus, the telecommunications company was able to allow business users to ensure compliance of their non-production environments while eliminating another manual task for the DBAs through automation.

Reducing Storage Costs in Test Databases with Data Subsetting

With the growth in the number of database applications, enterprises are faced with the challenge of provisioning non-production environments which are used for application development and testing. They cannot afford to incur the storage expenses of provisioning the same production data in their non-production databases; nor, do they have the tools or the application knowledge to shrink production data to a right-sized development environment. Oracle Test Data Management Pack helps enterprises shrink storage costs by creating reduced size copies of production data for application development and testing while maintaining the referential integrity of the data set.

Data Discovery and Modeling Enterprise Applications

Creating referentially intact data subsets of production data for modern enterprise applications is a daunting task to any organization even with highly skilled DBAs. These enterprise applications are incredibly complex spanning multiple schemas containing thousands of tables governed by myriad of business rules. The reason for the difficulty lies in the large and often complex data models that govern the relationships between the columns of the tables that sometimes span across different schemas.

Oracle Test Data Management Pack automatically discovers these relationships and can store them within an entity called Application Data Model. The pack also ships with pre-defined drivers to capture the data relationships for Oracle Applications such as Oracle Fusion Applications, Oracle eBusiness Suite Applications directly from the application meta-data tables.

Subset Criteria and Definition

Once an Application Data Model is defined, an administrator can define different types of subset operations. For example, subsets may be time-based, e.g., extracting one fiscal year out of all the fiscal year data, or other dimensions, such as geographical region or product lines, or alternatively they may be derived by application, e.g. extract General Ledger data from an ERP application suite.

Once the subset criteria are defined, Oracle Test Data Management Pack then automatically creates the data extraction rules across all the tables based on the relationships maintained in the Application Data Model. For example, if the subset criterion is for a particular fiscal quarter, Oracle Test Data Management Pack identifies the relevant tables and creates the specific extraction rules such as order for a fiscal quarter from order entry tables, associated lines from the order line tables and associated shipments from the order shipment tables. If needed, administrators can augment these with additional criteria using SQL WHERE clauses.

Subset Estimation and Execution

Given the limited storage available to application developers, IT administrators face the problem of having identify the subset criteria in advance that would result in a database that would fit within the

storage constraints of a developer's system. Oracle Test Data Management allows the administrator to define the subset criteria as a parameter without having to specify the exact value. Then, the administrator use the subset estimation function to determine the expected size of the test database for different values of the subset parameters before executing the subset process. In addition, the subset criteria also support a percentage based database creation process by which a defined percentage of the data is randomly sampled and extracted to create the test database.

Oracle Test Data Management provides multiple options for creating test databases from production. In the first option, IT administrators can use the database cloning facility in Oracle Enterprise Manager to copy production data into a test database using RMAN-based live cloning or recreating a test database from a production backup. Then, administrators can execute the subset operation on this production copy to create a reduced size database. When production databases grow to terabyte-size, this option becomes expensive because an equivalent amount of storage as production has to be allocated to the test system. That's where the second option becomes increasingly attractive. In this option, Oracle Test Data Management uses an innovative approach to create a portable Oracle Data Pump file containing the reduced size dataset directly from production without requiring a production copy. Now, this file can be transported into any test database and imported to create the test database, thus saving storage costs significantly.
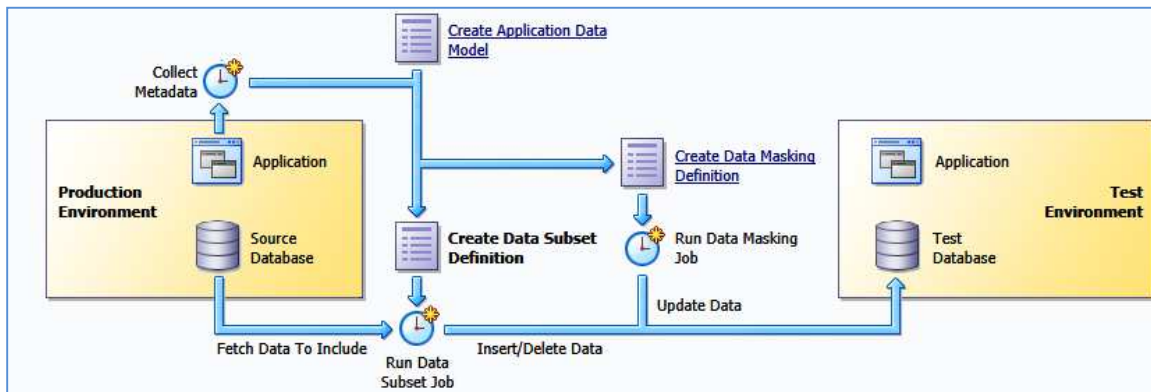

Figure 11. Secure Test Data Management

Benefits of Data Subsetting

Oracle Test Data Management Pack lowers storage costs, increases the efficiency of IT administrators and increases the agility of application development by automating the creation of right-sized test systems for Oracle and non-Oracle databases.

Conclusion

Ensuring the quality and performance of your enterprise applications requires a comprehensive approach to application quality management. This requires thorough testing of all tiers of the application stack prior to deployment. This includes testing both applications and infrastructure, for new application deployments as well as upgrades of existing applications. Comprehensive testing requires validating both application functionality as well as performance under real-world operating

conditions. And to maximize efficiency, it's important to have an effective framework in place to plan and manage your test processes and to leverage test automation to reduce the need for manual testing.

Oracle Enterprise Manager provides a comprehensive set of Application Quality Management solutions which include Application Testing Suite, Real Application Testing, Application Replay, Data Masking Pack and Test Data Management Pack. This best-of-breed Oracle AQM offering allows you to test the entire stack from the application layer to the disk. It provides the only load testing solution on the market that combines both real and synthetic workload testing. And it enables high quality and secure testing with the lowest risk of change. Oracle AQM solutions provide a heterogeneous testing solution that is also optimized for testing Oracle applications. Oracle AQM will help you reduce test cycle times and costs while increasing the quality and performance of your applications.

ORACLE®

Application Quality Management
October, 2011
Authors: Jagan Athreya, Prabhaker Gongloor,
Waleed Ahmed, Mikael Fries

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

oracle.com

Hardware and Software, Engineered to Work Together