

The Self-Managing Database: Where Technology Meets The Customer

*An Oracle White Paper
December 2004*

The Self-Managing Database: Where Technology Meets The Customer

Introduction	3
Qualcomm: Customer Background	3
Database Deployment	4
Database Installation	4
Database Configuration and Upgrade	4
Data Load	5
Performance Management	5
Automatic Database Diagnostics Monitor (ADDM)	5
SQL Tuning	7
Automatic Memory Management	9
Storage Management	10
Space and Object Management	11
Segment Shrink	11
Mass Deployment and Software Management	12
Qualcomm: Work Ahead	12
Conclusion	12

The Self-Managing Database: Where Technology Meets The Customer

“Due to using 10g manageability, we can actually cut down the complexity; use the same number of resources to actually manage more.” —

Robert Leaman

Director of System Architecture, Deutsche Post

INTRODUCTION

Oracle Database 10g is industry's first truly self-managing database. By automating a number of complex, day-to-day administrative tasks, Oracle Database 10g is helping customers reduce management cost and deliver better quality of service. Oracle Database 10g introduced a number of features designed to provide optimal performance, security and availability out of the box.

This paper outlines real world success stories of how Oracle Database 10g manageability is transforming modern businesses and helps them successfully cope with the challenges of proving more with less. It provides an overview of the key Oracle Database 10g self-managing features and highlights real-world scenarios where they have benefited customers.

While the paper includes success stories from a number of customers, it places special focus on the experiences of an industry leader Oracle customer, Qualcomm, to illustrate how Oracle Database 10g manageability enhancements help reduce management costs and increase productivity of IT organizations.

QUALCOMM: CUSTOMER BACKGROUND

Qualcomm, a pioneer and world leader of Code Division Multiple Access (CDMA) digital wireless technology, has been engaged with the Oracle database manageability team long before Oracle Database 10g became a product. In its early development phase, it was important for Oracle to get customer input and validate many of the requirements that were intended for the product. Arvind Gidwani, Senior Manager of the IT department at Qualcomm, along with his team, has spent numerous hours evaluating, testing and learning the new Oracle technology.

“Oracle 10g gives you everything you need to manage the grid. That’s where the cost savings are. Without Oracle 10g, it will be difficult to quantify the real cost of managing your enterprise grid.” —

**Arvind Gidwani, Senior Manager IT,
Qualcomm**

Qualcomm has chosen the Oracle 10g family of products as the foundation for a grid-computing environment that, eventually, will span the organization. The company is working with the Oracle Database 10g, with Real Application Clusters (RAC) and Oracle Grid Control as the basis for managing more than 300 distributed databases. Its strategy has been to move to the grid in manageable steps, with zero disruption to the production environment. The initial phase involved the selection of one business application, moving it onto the grid in a development environment and learning from that experience to grid enable the entire IT infrastructure.

DATABASE DEPLOYMENT

Database Installation

Qualcomm’s environment is a large, distributed collection of 300+ databases around the world, which requires constant updating and maintenance. Anywhere from installations, upgrades and patch applications, Qualcomm DBAs were faced with a multitude of recurring, time consuming tasks. With Oracle Database 10g and the deployment of Enterprise Manager 10g, they were able to implement a new software maintenance methodology. Aimed at automating all repetitive tasks, this approach proved to be a key factor in their overall goal of reducing the time and cost of software install, upgrade and maintenance.

They not only met their goal, with over 50% timesavings on software maintenance they exceeded their target. This amount of savings is attributed to many of the Oracle Database 10g new features.

Oracle Universal Installer (OUI) now performs pre-requisites checks making sure you meet the installation requirements before the software is laid out. Many of the operating system patches were discovered by Qualcomm at this time and were applied in mass to all their systems.

The Oracle installation is much faster and more robust than ever. As customer environments can differ, there are infinite combinations that the installer must support. OUI 10g elegantly handled all their environments. Special cases were flagged as warnings, or intuitive error messages, followed by recommendations.

Database Configuration and Upgrade

Requiring minimum user input, Database Configuration Assistant (DBCA) eliminates the need to plan in detail the parameters and structure of your database. DBCA also makes recommendations about database settings based on user input therefore, it helps database administrators optimize database configuration with minimal effort. Duplicating databases across an enterprise is a significantly easier task.

Creation and configuration of databases is done at Qualcomm using the Oracle recommended DBCA. There is no easier way to save and duplicate configurations across an enterprise as large as Qualcomm's, than using DBCA.

Similarly, for upgrades Qualcomm is using the Database Upgrade Assistant (DBUA). DBUA is a graphical user interface tool that interactively steps the user through an upgrade process and configures the database to run with the new Oracle Database version 10g. DBUA completely automates the upgrade process by performing all the tasks otherwise done manually. Asked how Qualcomm performs upgrades to Oracle Database 10g, Arvind Gidwani said with no hesitation: "Using DBUA. We wouldn't do it any other way". Why? Minimizing the chance for user errors and guidance every step, are key benefits.

In addition, the configuration of the management framework, Oracle Enterprise Manager Grid Control, is much simplified and requires very little or no additional customization. With out of the box settings, Grid Control along with a database were deployed at Qualcomm in a few hours, a process that used to take days.

Data Load

Oracle Data Pump is a feature of Oracle Database 10g that enables very fast bulk data and metadata movement between Oracle databases. Oracle Data Pump provides high-speed parallel Export and Import utilities as well as a web-based Enterprise Manager graphical interface.

Nextel, an Oracle customer and a principal provider of fully integrated wireless communications services, is successfully realizing the benefits of using DataPump. Their standard procedure for backing up the database includes running a daily full database export. The entire process used to take 2-4 hours, for a 1 TB database, using the latest tape library technology and drives with multiple channels. Using Data Pump this process takes only 10-15 minutes, more than 8 times the performance improvement. With virtually no tuning, DataPump helps cutting down the time for backup and contributes to a more solid recovery solution, should it need to be performed.

PERFORMANCE MANAGEMENT

Automatic Database Diagnostics Monitor (ADDM)

Oracle Database 10g introduced the Automatic Database Diagnostic Monitor (ADDM), a self-diagnostic engine built right into the database. ADDM examines data automatically captured in a statistics repository and performs analysis on the system. It can determine the major performance issues on a proactive basis, recommends solutions and quantifies expected benefits. ADDM, the "brain" of the Oracle Database, takes a holistic approach to analyzing the performance of a

"After upgrading NDWFIN database from 9i to 10g, database jobs/queries run 6 times faster." —

Hasantha Medde-Witage,

**Sr. Infrastructure Services Engineer,
Nextel**

system, using time as a common currency between components. With Oracle Database 10g the performance diagnostics process is much simplified, optimally suited for rapidly growing and complex environments.

“We could not have asked for anything better than ADDM. It accurately identified our performance problem and guided us in changing the maintenance window times. Amazing!” —

Gautam Reddy, Dell Corporation

Oracle has been working with Dell Corporation for months, as a part of the special customer engagement. This program was aimed at building long-term customer relationships, for early adoption and product feedback. When Dell first migrated their systems to Oracle Database 10g they experienced performance problems they hadn't seen before. Luckily, ADDM was there to help and they were very impressed. ADDM immediately identified that during their highest load time period the default automatic statistics collections were also run, competing for resources within the same resource consumer group. Dell systems are designed to do ETL type of operations after the processing of daily online work. Therefore, the heaviest load time of the day overlapped in this case with the Oracle default management window. By modifying the management window times and moving it outside of their busy period helped both the load times and the automatic management operations.

As expected, new functionality of Oracle database is often tested and stressed on Oracle's internal production systems. The Oracle Bug Database is one such system that was one of the first systems upgraded to Oracle Database 10g. Here are some examples of how ADDM was instrumental during the tuning phase, following the upgrade: ADDM automatically highlighted some high load SQL, which occurred on a regular basis (4 hour cycles) and consumed large amounts of resources. Using the Enterprise Manager interface Oracle DBAs monitored the user id that was executing this SQL. The SQL was coming from a generic account and the DBA quickly decided to disable that account. Another user id, highlighted as running high load SQL, was found to be running 5 concurrent copies of the same program looking at the same data at the same time, again on a periodic basis. It turned out that the user was running some reports and was not even aware that five copies were running at the same time. The problem was easily resolved and resources were never again used unnecessarily. Overall, with the complete tuning recommendations that ADDM provided, the Oracle Bug Database is running much more efficiently, with lower CPU usage than any prior versions. A machine that the DBA claimed had been “CPU-bound for the last 18 months” now runs consistently at around 75% utilization.

Qualcomm also recognized that one of the most powerful components of the Oracle Database 10g is the Automatic Database Diagnostics Monitor. With the default setup, the Qualcomm DBAs have simply let the database do its job. ADDM not only pinpoints the problem areas, it also clearly identifies areas that are not a problem. Let's take a look at how Qualcomm leveraged this technology to fine-tune their environment, a system that had recently been migrated to Oracle Database 10g. There were a number of problems with the system right after the upgrade. The top one, in terms of impact overall, was some high load SQL that was not performing as expected. Drilling down into the top problem revealed more details

about SQL statements that were consuming high amount of database time, such as the actual SQL text, SQL ID associated with it and maximum possible benefit in case it was tuned.



Figure 1

As advised by ADDM, our customer ran the SQL Tuning Advisor, and Figure1 shows the results of that tuning session. They very quickly learned that an index thought to be present was actually dropped by mistake, and made a big difference in performance. With a single click, the DBA was able to re-create the index and observed noticeable performance improvement.

The self-managing database and Oracle Enterprise Manager interface work hand-in-hand to help administrators, such those at Nextel, Dell or Qualcomm, eliminate problems with minimal manual labor. The steps to optimize the costliest queries, a complex process that also requires multiple iterations, are now done in significantly less time.

"I use ADDM report and ADDM recommendations to fix the problems on all 10g databases. But there are not many problems with my 10g databases, only a minimum number of issues." —

Hasantha Medde-Witage,

Sr. Infrastructure Services Engineer,
Nextel

SQL Tuning

In Oracle Database 10g, the SQL tuning process has been automated by introducing a new feature called the Automatic SQL Tuning. Designed to work in any type of environment, the Automatic SQL Tuning is exposed via an advisor called the SQL Tuning Advisor. The SQL Tuning Advisor takes in one or more SQL statements and produces tuning advice, such as creating an index or applying a

SQL Profile, a set of additional statistics that can improve an execution plan without changing the SQL.

“SQL Profiles changed the way we do tuning today. What a powerful option! We didn't have to modify a single line in the application SQL to get outstanding performance.” —

Gautam Reddy, Dell Corporation

Dell has been using the SQL Tuning Advisor to tune their problematic SQL statements. In most cases, these statements were identified by ADDM, and then the SQL Tuning Advisor guided them through solutions. Simply by having ADDM run periodically, high-load SQL statements can be identified for a later, more detailed, analysis using the SQL Tuning Advisor. For Dell DBAs, it is no longer a challenge to find high resource consuming workload, which in the past was one of the most time consuming operations. Once identified and collected, this workload can easily run through the SQL Tuning Advisor for further recommendations. One of the most powerful recommendations, used by Dell today, is the SQL Profile, to help generate a better execution plan. The Dell team is enjoying the benefits of such functionality: with no application SQL changes they observed a radical, 30 times better performance.

One of the top manageability challenges for yet another Oracle customer, Deutsche Post, had been tuning and optimization. Many of their applications are what Robert Leaman, Director of System Architecture at Deutsche Post, called them “black box financial applications, controlling applications which we don't write”. To them, the new capabilities of Oracle Database 10g and especially the SQL Profiling of the Automatic Tuning Optimizer, are priceless. They “will optimize these statements without having the source code searched”, concluded Leaman when talking about the SQL Tuning Advisor. For mission critical applications, such as Deutsche Post's, optimizing SQL without touching a single line of code translates to an all-around more efficient support system that meets customer expectations 24x7.

Another key component of Oracle Database 10g is the SQL Access Advisor. Given a number of SQL sources (such as SQL cache, user-defined SQL statements stored in a table or in a repository or hypothetical workload created by referencing schemas(s) in the database) and a number of filtering options, SQL Access Advisor can recommend indexes or materialized views you may need for your environment.

The Britannia Building Society, second largest mutual building society in the UK, relies on materialized views and indexes in several of their systems to guarantee fast query response times. Before their introduction, queries could run anywhere from 30 minutes to 2 hours. Once the materialized views and indexes were created, Britannia found that the queries that used to take 2 hrs, were now taking 10 minutes or, the queries that used to take 1-2 minutes, returned results instantly.

“Using the SQL Access Advisor, we discovered that we were able to further tune our already optimized systems with ease and in a very short period of time.” —

David Martland,

Data Architect Designer, Britannia Building Society

Using conventional methods, a tuning exercise would have taken days. However, using the SQL Access Advisor, within a matter of minutes the DBA had a set of recommendations to review and what they discovered was very informative. The recommendations confirmed that all the materialized views and indexes that they had created were being used. In addition, for one of the systems SQL Access Advisor recommended 5 new indexes and provided the expected performance benefit of each index. After a review, the top 2 indexes in terms of performance benefit were implemented, which resulted in a further performance improvement to the system. Reports that used to take several hours were now returning results in approximately 15 minutes. Recommendations for the other system were for the creation of three bitmapped indexes on a database from a 3rd party supplier. Discussions are now taking place with the supplier to see if these indexes can be included in their design. The SQL Access Advisor also suggested a new materialized view, which was missed during implementation. With the complex systems that are required today, it's very easy for improvements in the database to be missed, and without the SQL Access Advisor, Britannia may not have realized for some time, that this missing materialized view could have been degrading performance.

The SQL Access Advisor allowed the Britannia DBAs to easily decide which, if any of the recommendations, to implement and gives them complete control over the process. Once a decision was made, the required recommendations were implemented using Oracle Enterprise Manager with a click of a button.

Automatic Memory Management

Oracle9i introduced the option to completely automate the management of Program Global Area (PGA) memory. Administrators merely needed to specify the maximum amount of PGA memory available to an instance using a new initialization parameter, PGA_AGGREGATE_TARGET. The database server automatically distributes this memory among various active queries in an intelligent manner ensuring maximum performance and most efficient utilization of memory.

In Oracle Database 10g, DBAs can also specify the total amount of SGA memory available to an instance using the new parameter SGA_TARGET. The database server then automatically distributes the available memory among various SGA components as required.

Many of our key customers are successfully using the automatic configuration of memory. They are taking the approach of “enable it and forget about it”, as it was indeed intended. This database component is completely self-managing. Once enabled, it requires no management.

Nextel, for example, enabling the automatic SGA management is standard procedure. According to Hasantha Medde-Witage, a Sr. Infrastructure Services Engineer in the Infrastructure Services group, they are successfully enabling this

functionality on all their production systems. In the past, the approach Nextel took was to oversize the SGA and the closely monitor the usage. Using Oracle9i Memory Advisors they made one step towards automation, allowing the Oracle database to suggest appropriate memory values. But they still had to check the usage periodically and ensure the memory was sized properly. This method simply does not scale, if you have a large number of databases you manage, which was the case with Nextel. Hasantha's team welcomed Oracle Database 10g completely automatic memory management. Their systems are no longer oversized and the same resources can be used to handle a much larger volume of work. For peace of mind, Hasantha still monitors some performance metrics, using alerts. This way they can be more proactive and plan for changes ahead of time.

"Of the many features in 10g, which are going to help us a long way in the future, ADDM, automatic shared memory tuning and the automatic tuning optimizer are the ones I'd like to put up at the forefront." —

Robert Leaman

Director of System Architecture, Deutsche Post

Deutsche Post, yet another example of a committed Oracle customer, was involved in providing early feedback used to derive some of the functionality and user interface to memory management. They are now enabling the automatic management of both PGA and SGA with confidence, and save significant database administrator time. They no longer need to allocate special resources to fine-tune memory pools and at the same time performance is not impacted.

With perfectly tuned memory of their Oracle 8i and Oracle9i systems, Qualcomm expected to see some initial performance degradation when upgrading to Oracle Database 10g. Much to their surprise, the upgraded systems using the Automatic SGA tuning experienced no noticeable performance degradation. In fact, after performing some of their routine testing, they realized that the performance was better with no additional tuning. The Automatic SGA management introduced with version 10g helped another customer reduce the time spent in tuning the various memory pools and delivered performance that exceeded expectations.

STORAGE MANAGEMENT

The new Oracle Database 10g Automatic Storage Management (ASM) functionality provides file system and volume manager capabilities built into the Oracle database kernel. ASM simplifies storage management tasks, such as creating/laying out databases and disk space management. ASM virtualizes the database storage into disk groups and spreads data evenly across all available storage resources.

ASM provides a common interface across all server and storage platforms to enable DBAs to better manage the storage resources for the database. It provides the ease of access of a file system and the performance of raw I/O.

Nextel has chosen to use ASM for their production systems. Nextel's setup consists of 8 Oracle Disk Groups, each group using five 30GB EMC disks. After upgrading and deploying the new database on ASM they immediately began to see significant I/O improvement. ASM not only radically simplified their storage management tasks, it also delivered the advertised performance. Nextel compared data files creation using a regular file system, with the creation while on ASM. The rate

increased from 1 GB per min to 4 GB per min, a 4 times increase of I/O throughput. Other notable changes were the database jobs or queries that now run as much as 6 times faster. Nextel attributes part of this performance increase to ASM.

The Qualcomm team is also evaluating ASM as a storage solution for reduced cost of ownership. In addition to leveraging the ease of storage management that comes built-in with ASM, Qualcomm systems are expected to be much more efficient and deliver optimal performance.

SPACE AND OBJECT MANAGEMENT

Segment Shrink

The Oracle Database 10g introduced the ability to perform an in-place reorganization of data, called Segment Shrink. By performing Shrink, data in the table is compacted and full table scans can read fewer blocks, therefore runs faster.

Segment Shrink is an online and in-place operation. This is a key advantage over performing Online Table Redefinition for compaction and reclaiming space. A DBA may schedule segment shrink for one or all the objects in the database as nightly jobs without requiring any additional space to be provided to the database.

The Shrink operation can be done on demand, as determined by a DBA, or it can be a recommendation from a new Oracle Database 10g component, the Segment Advisor. The Segment Advisor analyses a table or tablespace and advises on segments that could benefit from a Shrink operation. These operations can be especially powerful in space constraint situations and many Oracle customers are leveraging them on a periodic basis. With Oracle Database 10g Release2 Oracle has automated the Segment Advisor in the maintenance window and administrators will only require to review its recommendations and decide what and when to implement them.

Efficient space management sits up high on Qualcomm's list of goals. With many improvements in this area, Oracle Database 10g proved to be the right technology. Qualcomm is successfully using locally managed tablespaces for all their tablespaces. This implementation simplifies administration, a welcomed change to Qualcomm's environment. They are also evaluating and quickly realizing the benefits of the Segment Advisor. Configured to run automatically on a periodic basis, using the Segment Advisor DBAs will be able to just examine the recommendations and implement them on the spot.

Transposable tablespaces is no doubt one of their favorite management features. Having used import/export or schema copy techniques in the past, Qualcomm has now cut their recovery time from 3-4 hours to 5 minutes. It is not only extremely easy to use, it is also very fast.

“With Oracle 10g Automatic Storage Management, DBAs won't have to worry about optimizing disk IO. ASM will manage the hot spots, relocate data from one point to another, and give that optimal bandwidth that the end user or the application needs.” —

**Arvind Gidwani, Senior Manager IT,
Qualcomm**

“My DBAs spend 80% of their time on daily tasks including performance tuning, database administration and storage management. Oracle 10g offers the flexibility to free up the resources so we can utilize them effectively.”—

**Arvind Gidwani, Senior Manager IT,
Qualcomm**

Mass Deployment and Software Management

Enterprise Manager Grid Control is Oracle's integrated solution for administering and monitoring applications and systems that are based on the Oracle technology stack. With its scalability to thousands of instances, Oracle Enterprise Manager is a critical component of Grid Computing that centralizes the management of multiple, cross platform databases and services. One of the most powerful new options is the management of software inventory. From multi-target installations, inventory, database cloning and patch management, Enterprise Manager simplifies the most time-consuming tasks of laying out the software and maintaining it. IT shops can leverage this technology to consolidate, standardize and optimize large enterprise systems management.

"The greatest impact on the data centers worldwide of implementing Oracle Enterprise Manager 10g is the centralized management and consolidated view of all of our Oracle systems. That is by far the biggest feature. And definitely enables us to do more with less."

-- Joe Crawford VP of Engineering, Digex

To many of our customer, like Nextel or Digex, Grid Control just makes sense. It is an Oracle framework designed to work seamlessly with Oracle targets, from day-to-day management of administration tasks, to mass software deployments. They equally enjoy the benefits Grid Control brings to their organization: central graphical interface, one-stop-shop for all database and hardware configurations, database setup, OS and database performance statistics...etc. The built-in automatic monitoring, alerting and advice, as well as patch management is a time saver for DBAs of all levels. Customers are pleased to be able to re-direct their DBA resources to more complex tasks, such as long term planning, instead of repeating daily maintenance tasks on hundreds of their servers.

QUALCOMM: WORK AHEAD

Qualcomm is today actively evaluating additional self-managing features that can further benefit their environment. They are especially keen in exploring in more depth the Grid Control capabilities, which complete the centralized management of their highly standardized systems. From inventory control to patch management and management of older database versions, Qualcomm is convinced that they can realize additional cost savings with minimal effort.

It is no surprise that Qualcomm has broadly adopted the Oracle Database 10g. It has helped them meet their goals and exceed all expectations. For a company that in the past had to resort to over-sizing, which meant over-spending, the Oracle technology helped them do a lot more with less. The "flexibility to manage resources effectively in a grid environment", as Arvind Gidwani puts it, has allowed them to cut costs, while growing and still providing continued outstanding customer service.

CONCLUSION

Oracle Database 10g automatically adapts, monitors, diagnoses and fixes itself reducing the costs of managing the IT environment. With a simplified install,

greatly reduced configuration, intuitive day-to-day administration and self-management and diagnostics, the Oracle Database 10g manageability features allow DBAs to become more productive and help their organizations scale for Grid Computing.

Customers' wide adoption of Oracle Database 10g speaks loudly about this new technology. Using Oracle Database 10g, DBAs can expect to reduce daily workload, automate recurring tasks and as a result, businesses can reduce the cost of managing enterprise database systems.



The Self-Managing Database: Where Technology Meets The Customer
December 2004

Author: Daniela Hansell
Contributing Authors:

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
www.oracle.com

Copyright © 2004, Oracle. All rights reserved.

This document is provided for information purposes only
and the contents hereof are subject to change without notice.

This document is not warranted to be error-free, nor subject to
any other warranties or conditions, whether expressed orally
or implied in law, including implied warranties and conditions of
merchantability or fitness for a particular purpose. We specifically
disclaim any liability with respect to this document and no
contractual obligations are formed either directly or indirectly
by this document. This document may not be reproduced or
transmitted in any form or by any means, electronic or mechanical,
for any purpose, without our prior written permission.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective owners.