Performance Tuning using the SQL Access Advisor

An Oracle White Paper
June 2006

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EXECUTIVE OVERVIEW

Probably every DBA or person responsible for managing a computer system, would like to improve query response times and the throughput of their system. However, as anyone who has ever tried to do this will tell you, it is not easy. This white paper introduces the SQL Access Advisor in Oracle Database 10g, which helps you tune your database by recommending indexes and materialized views.

INTRODUCTION

There are many techniques that can be used to tune a computer system, some involve changing the hardware and many involve software changes; at the operating system, application and database level.

The problem when tuning a database is that when it is performed manually, it can be quite a time consuming operation, typically taking days and if it proves to be a challenge, weeks or even months to achieve optimum performance. A major concern is that as you are tuning, are you using a representative example of how the database is actually being used. If not, then you may be creating objects that will not improve system response time.

If you have explored all of the traditional tuning options, and performance could still be improved, then consider using the SQL Access Advisor in Oracle Database 10*g*, which will recommend indexes and materialized views to create, retain or drop, based on the supplied workload. Alternatively, if you are just starting out building a new system and you are not sure which indexes or materialized views you may need, then the SQL Access Advisor can help here also.

HOW TO USE THE SQL ACCESS ADVISOR

The SQL Access Advisor is run from Advisor Central in Enterprise Manager, as shown in Figure 1. There are a number of advisors that can be launched and

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[1] Some of the features referenced below are part of separately licensed Diagnostic and Tuning packs. Please refer to the appendix at the end of the document for more details.

monitored from here, as their tasks are executing. The screen at Advisor Central does not refresh automatically, therefore regularly click on the refresh button near the top right of the screen so that you know you are seeing the latest status.

Figure 1 Advisor Central
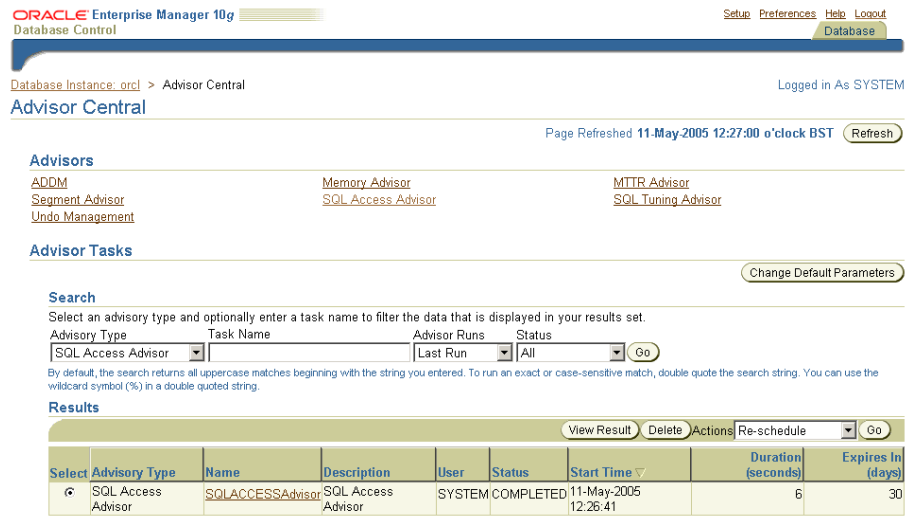
There are only a few steps that have to be completed in order to generate recommendations. All the information about this tuning process, such as what is to be tuned, the recommendations and actions are held inside a *task* and in Enterprise Manager, the task is simply a storage mechanism that only requires a name to get started.

Since there is no limit to the number of tasks that you can create. It is possible to create tasks to model a number of different scenarios. For example, you could configure one task to represent your daily environment, another task for your overnight batch work and then compare the recommendations from each task to see if they have anything in common. Tasks do not have to be deleted; therefore you can build up a view of your system over a period of time and can compare a task that represents your typical daily activity now, to one that you created say six months ago and see if anything has changed.

Templates

The SQL Access Advisor is supplied with several default templates, where the template defines all the rules as to how the recommendations are to be generated such as which mode to use, whether only indexes are to be created, how the new objects should be named etc. There is an extensive list of task parameters that are described in the SQL Tuning Guide.

When you define a task then it can se saved as a template, to be used in the future for another task, which can be very useful when you may want to modify

the tuning parameters for a task slightly differently, to see if that has any effect on the recommendations. When the SQL Access Advisor is first started, as illustrated in Figure 2, a previously saved template can be selected or you can use the default one.

Figure 2 Select a Template
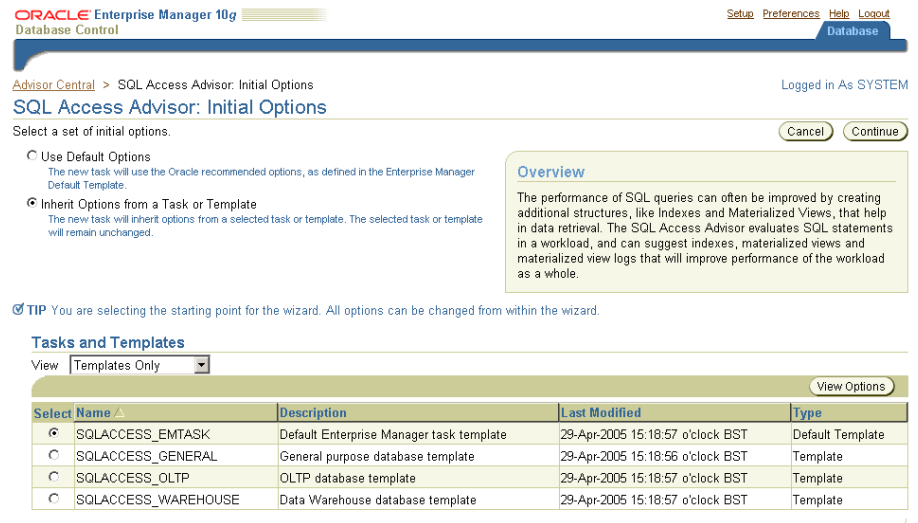
Selecting the Workload

Obtaining a good set of recommendations from the SQL Access Advisor is very dependent on having a representative workload for your system. Database tuners will tell you that this is one of the most challenging aspects of database tuning, as gathering this data is not easy.

The SQLAccess Advisor allows the following workload sources:

- Current contents of the SQL cache

- User-defined via a table containing SQL statements

- SQL Tuning Set from the Workload Repository

- Hypothetical workload, by referencing schemas(s) in the database

- Oracle 9i Summary Advisor workload (command line only)

- Manually add SQL statements to a workload (command line only)

With all these workload sources, the database tuner now has plenty of opportunity to gather a representative workload for the tuning process.

In Figure 3 we see the first screen in the SQL Access Advisor where the workload source is specified.

Using the SQL Cache

When the SQL cache is selected the entire contents are extracted, minus any SQL statements that refer to Oracle owned objects, such as those in SYS or SYSTEM. Additionally, if your database contains schemas for multiple applications, then you may need to filter the workload by clicking on the *Show Advanced Options* link.

Figure 3 SQL Access Advisor Workload Source
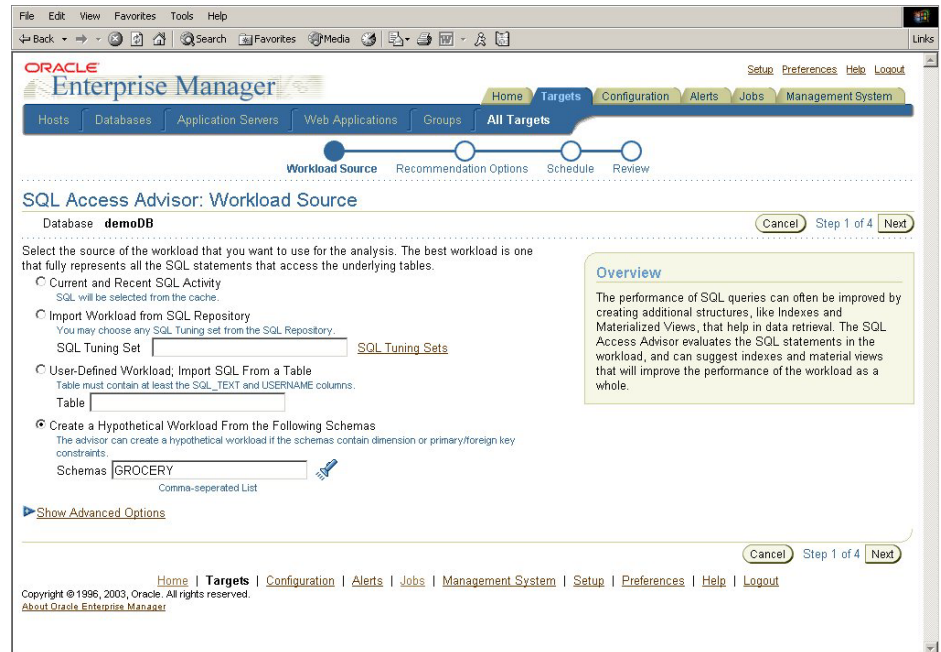
SQL Tuning Set

Within Server Manageability there is a repository of workloads, which are known as SQL Tuning sets. The SQL Access Advisor can select any one of these and since they can be created from problems identified by the other Advisors and Top SQL, they can be an excellent workload source to use for tuning.

Hypothetical Workload

If your system is being initially designed, then you may not have any workloads available. In this case, you can use the *hypothetical* workload, where you specify one or more schemas, and from their structure, the SQL Access Advisor will generate what it thinks a workload may represent.

User-Defined Workload

There are times when you may already know the SQL statements that will comprise your workload and you can specify them manually. Perhaps you extracted the SQL generated from your tool or even wrote it by hand. If you place these SQL statements in a table, it can then be used to create a workload.

There is a specific format for the user-defined tables, which is described in the SQL Tuning Guide. This table contains many columns, but it is not necessary to specify a value for every column

Filtering the Workload

Depending on the source of the workload, it is very easy to create one that contains far more data than you require, especially if it comes from say the current contents of the SQL cache. In this scenario, if you have many applications running, then you would extract SQL statements for all of those applications, but you may be only interested in tuning some of them. Therefore all workloads can be filtered by any of the following:

- Application or module name

- Number of SQL statements

- Only queries during a specified time window

- User who executes the statements

- Tables that either must or must-not be referenced in a query

What is to be Recommended

Once the workload exists, a set of recommendations can then be generated and in Figure 4 we see how this is done from within Oracle Enterprise Manager. Here we have the ability to say what types of recommendations are required, only indexes, only materialized views, both or evaluation only.

If *evaluation* mode is selected, then no new recommendations will be generated, instead the SQL Access Advisor details which indexes and materialized views have been used.

Next there is also the ability to say in which mode the advisor should run, *limited* or *comprehensive*. Depending on the complexity of the workload, the number of possible solutions with respect to the indexes and materialized views that could be created can be quite significant. There are times, when you may not be interested in looking at all of these solutions and only considering the most important ones. This can be achieved by using the *limited* mode. Results will be shown quicker and then the SQL Access Advisor can be run again in *comprehensive* mode to see if any additional recommendations are possible.

Clicking on the *Advanced Options* shown in Figure 4 will also allow you to specify any number of other criteria during the recommendation process,which includes:

- space restrictions that the recommendations must work within

- default tablespace and schema into which the indexes and materialized views will be placed

- specify the priority to be used for tuning the SQL statements such as average elapsed time or average disk reads

whether to include drop recommendations that drop objects

Figure 4 SQL Access Advisor Recommendation Options
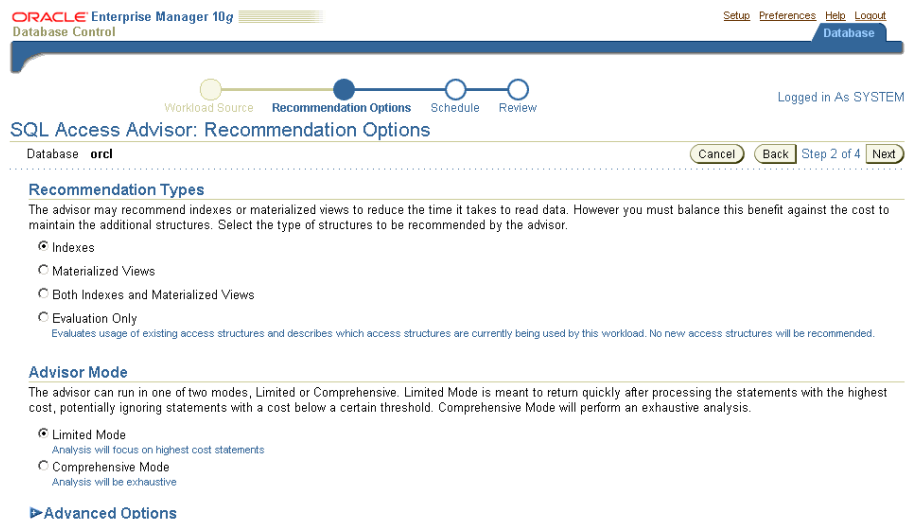
Generating the Recommendations

Once all of the information has been supplied the recommendations can be generated. In Enterprise Manager, a job will be submitted and its progress can be monitored from *Advisor Central,* which is shown in Figure 1.

Once the recommendations have been generated, they will remain until the task is deleted, which by default is 30 days. Thus giving the database tuner plenty of time to review the suggestions from the SQL Access Advisor. This means that the recommendation process can be repeated many times, trying different workloads and options to see what effect this has on the suggested recommendations.

When the SQL Access Advisor is used from within Enterprise Manager, the recommendations can be viewed by:

- Summary of Recommendations

- Recommendations by workload cost benefit

- SQL Statements by workload cost benefit

This gives the database tuner the ability to see which recommendations will give the best improvement to the workload or individual SQL statements can be viewed to see how they can be specifically tuned, and the impact that will have on system performance.

When the task is first selected from Advisor Central, The first screen that is presented is the Summary Recommendation screen, which is shown in Figure 5. Here we can see an overview of the workload cost and query execution time before and after implementation of the recommendations. These estimates can help decide whether to implement the recommendations.

*Figure 5   Summary Recommendation Screen*
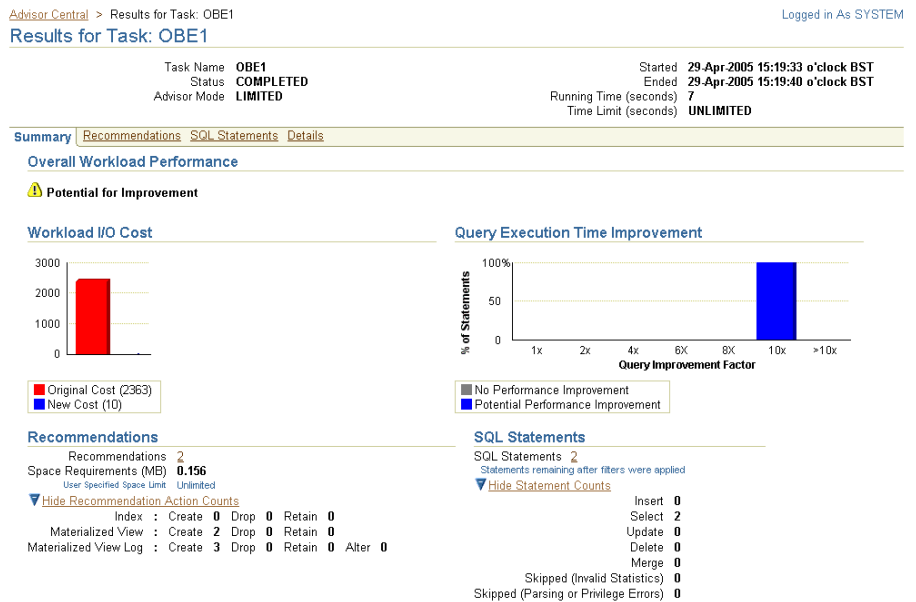
From this summary screen, two possible drill-downs on the recommendations are available; *Recommendations by Workload Cost* (Figure 6) and by *SQL Statement* (Figure 7), which are displayed by clicking on the appropriate tab. Below in Figure 6 we see the *Recommendations by Workload Cost Benefit*. In this example we can see that there are 6 recommendations, where the improvement to the workload will be between 3% and 19%.

Figure 6   Recommendation by Workload Cost
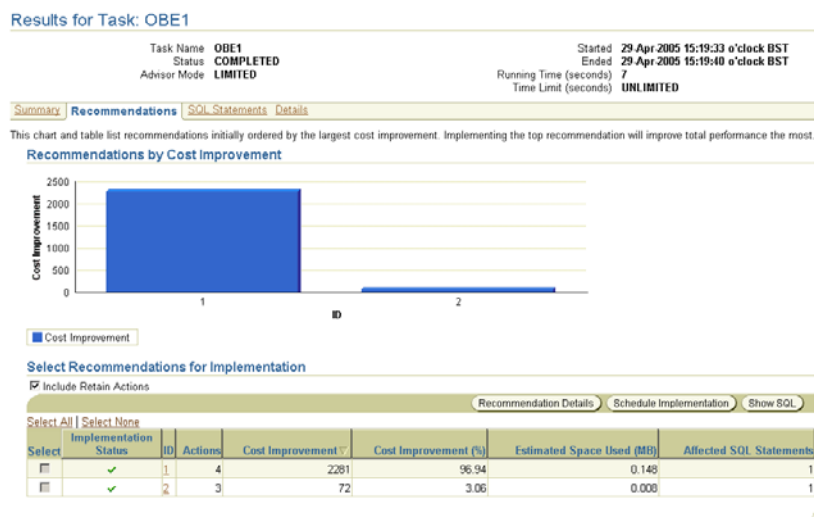
Instead, you may prefer to view the recommendations with respect to the SQL statements in the workload as illustrated in Figure 7.

Figure 7 Recommendation by SQL Statement
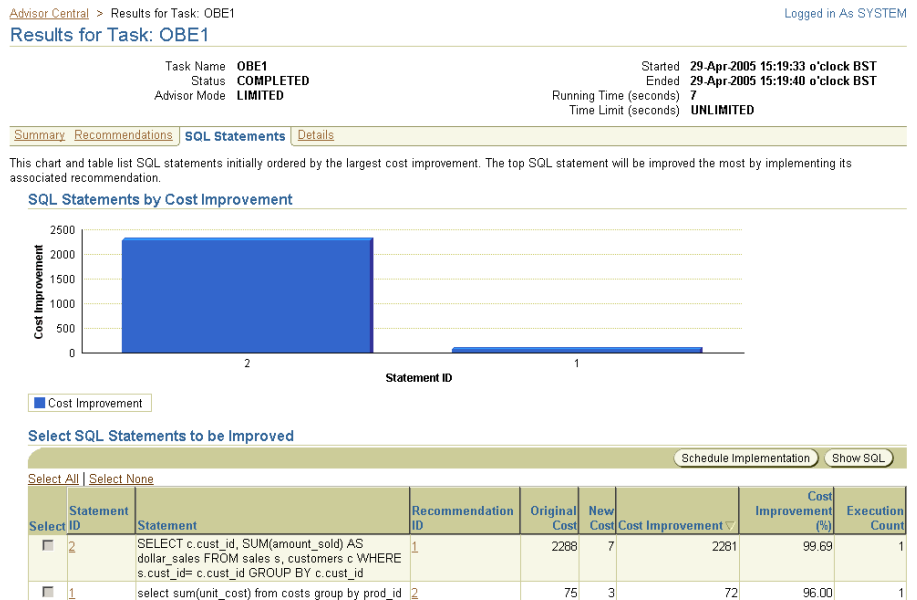
Although this example shows a one to one mapping between SQL statements in the workload and recommendation, multiple SQL statements can use the SQL Access Advisor recommendations.

Any of these links can be selected to view more detailed information. For example, selecting recommendation 1, we can see in Figure 8, what the SQL Access Advisor is proposing, which is a materialized view to improve the performance for this query. Clicking on *CREATE MATERIALIZED VIEW* will then display the actual statement.

The SQL Access Advisor first makes its recommendations, and then it lets you decide whether to implement all of its recommendations, or only some of them, or none. This is achieved by simply selecting the recommendations you require using either of the screens shown in Figure 6 or Figure 7.

At this stage, you have a choice on how to implement the recommendations. If you prefer to do it yourself, then the SQL Access Advisor will generate a SQL script for you to use. You can then edit this if required, to match your company standards for data naming etc and then implement it at your leisure.

Alternatively, you can schedule a job in Enterprise Manager and it will execute the script to implement these recommendations.

When a recommendation has actually been implemented, a tick will show next to the recommendation as illustrated in Figure 8.

Figure 8 Recommendation 1

CONCLUSION

The SQL Access Advisor provides a very easy to use interface to help tune your systems. There are only a few steps to follow and since it requires very little system knowledge you can obtain recommendations without spending a lot of time gathering information or learning how to use the advisor. Since all data can be retained, it enables you to build up a library or workloads and recommendations, so you can see over a period of time, whether the patterns of usage of your systems are changing. Anyone who has to tune a database should consider using the SQL Access Advisor because its so simple and quick to use. You may even find that it discovers a part of your system needed tuning that you never even thought was a problem.

APPENDIX: ORACLE DIAGNOSTIC AND TUNING PACKS

The sections below describe the Oracle Diagnostic and Tuning packs. These packs can be purchased only with Enterprise Edition. The features in these packs are accessible through Oracle Enterprise Manager Database Control, Oracle Enterprise Manager Grid Control, and APIs provided with Oracle Database software.

Oracle Diagnostic Pack

The Oracle Diagnostic Pack provides automatic performance diagnostic and advanced system monitoring functionality. The Diagnostic Pack includes the following features:

- Automatic Workload Repository

- Automatic Database Diagnostic Monitor (ADDM)

- Performance monitoring (database and host)

- Event notifications: notification methods, rules, and schedules

- Event history and metric history (database and host)

- Blackouts

- Dynamic metric baselines

- Monitoring templates

In order to use the features listed above, you must purchase licenses for the Diagnostic Pack. The Diagnostics Pack functionality can be accessed by Enterprise Manager links as well as through the database server command-line APIs. The use of either interface requires a Diagnostic Pack license.

Enterprise Manager

To determine which links in Enterprise Manager Grid Control and Database Control are part of the Diagnostics Packs, click the Setup link on the top right-hand part of the Enterprise Manager Home page.

- When you click the Setup link, the navigation bar contains the Management Pack Access link. Click this link.

- This will take you to the Management Pack Access page, which allows you to grant and remove access from all the management packs.

  - For Enterprise Manager Database Control, click the Remove Access radio button for the Diagnostic Pack and click Apply.

  - For Enterprise Manager Grid Control, click the appropriate check box for the Diagnostic Pack and click Apply.

This will disable all the links and tabs associated with the Diagnostics Pack in Enterprise Manager. All the disabled links and tabs are part of the Diagnostics Pack and therefore require pack license.

Command-Line APIs

Diagnostics Pack features can also be accessed by way of database server APIs and command-line interfaces:

- The `DBMS_WORKLOAD_REPOSITORY` package is part of this pack.

- The `DBMS_ADVISOR` package is part of this pack if you specify ADDM as the value of the advisor_name parameter, or if you specify for the value of the task_name parameter any value starting with the ADDM prefix.

- The `V$ACTIVE_SESSION_HISTORY` dynamic performance view is part of this pack.

- All data dictionary views beginning with the prefix `DBA_HIST_` are part of this pack, along with their underlying tables.

- All data dictionary views with the prefix `DBA_ADVISOR_` are part of this pack if queries to these views return rows with the value ADDM in the `ADVISOR_NAME` column or a value of `ADDM*` in the `TASK_NAME` column or the corresponding `TASK_ID`.

- The following reports found in the /rdbms/admin/ directory of the Oracle home directory are part of this pack: awrrpt.sql, awrrpti.sql, addmrtp.sql, addmrpti.sql, awrrpt.sql, awrrpti.sql, addmrpt.sql, addmrpti.sql, ashrpt.sql, ashrpti.sql, awrddrpt.sql, awrddrpi.sql, awrsqrpi.sql, awrsqrpt.sql.

Oracle Diagnostics Pack Enterprise Manager Repository Views

- Monitoring Views

  o MGMT$BLACKOUT_HISTORY

  o MGMT$BLACKOUTS

  o MGMT$ALERT_ANNOTATIONS

  o MGMT$ALERT_NOTIF_LOG

  o MGMT$TARGET_METRIC_COLLECTIONS

  o MGMT$METRIC_COLLECTIONS

  o MGMT$TARGET_METRIC_SETTINGS

  o MGMT$AVAILABILITY_CURRENT

  o MGMT$AVAILABILITY_HISTORY

- o MGMT$ALERT_CURRENT
  - o MGMT$ALERT_HISTORY
  - o MGMT$METRIC_DETAILS
  - o MGMT$METRIC_CURRENT
  - o MGMT$METRIC_HOURLY
  - o MGMT$METRIC_DAILY
- Template Views
  - o MGMT$METRIC_DAILY
  - o MGMT$TEMPLATES
  - o MGMT$TEMPLATE_POLICY_SETTINGS
  - o MGMT$TEMPLATE_METRIC_COLLECTION
  - o MGMT$TEMPLATE_METRIC_SETTINGS

Oracle Tuning Pack

The Oracle Tuning Pack provides database administrators with expert performance management for the Oracle environment, including SQL tuning and storage optimizations. The Oracle Diagnostic Pack is a prerequisite product to the Oracle Tuning Pack. Therefore, to use the Tuning Pack, you must also have a Diagnostic Pack. The Tuning Pack includes the following features:

- SQL Access Advisor
- SQL Tuning Advisor
- SQL Tuning Sets
- Reorganize objects

In order to use the features listed above, you must purchase licenses for the Tuning Pack. The Tuning Pack functionality can be accessed by the Enterprise Manager links as well as through the database server command-line APIs. The use of either interface requires licensing of the Tuning Pack.

Enterprise Manager

To determine which links in Enterprise Manager Grid Control and Database Control are part of the Diagnostics Packs, click the Setup link on the top right-hand part of the Enterprise Manager Home page.

- When you click the Setup link, the navigation bar contains the Management Pack Access link. Click this link.

- This will take you to the Management Pack Access page, which allows you to grant and remove access from all the management packs.

  o For Enterprise Manager Database Control, click the Remove Access radio button for the Tuning Pack and click Apply.

  o For Enterprise Manager Grid Control, click the appropriate check box for the Tuning Pack and click Apply.

This will disable all the links and tabs associated with the Tuning Pack in Enterprise Manager. All the disabled links and tabs are part of the Tuning Pack and therefore require pack license.

Command-Line APIs

Tuning Pack features can also be accessed by way of database server APIs. Use of the following PL/SQL packages requires a license for the Oracle Tuning Pack:

- `DBMS_SQLTUNE`

- `DBMS_ADVISOR`, when the value of the advisor_name parameter is either `SQL Tuning Advisor` or `SQL Access Advisor.`

The following report found in the /rdbms/admin/ directory of the Oracle home directory is part of this pack: sqltrpt.sql.

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Performance Tuning Using the SQL Access Advisor
May 2005
Author: Lilian Hobbs
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

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