



Dynamic Database Solutions

Mitigating Performance Degradations

Jul 22, 2010

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Dynamic Database Solutions

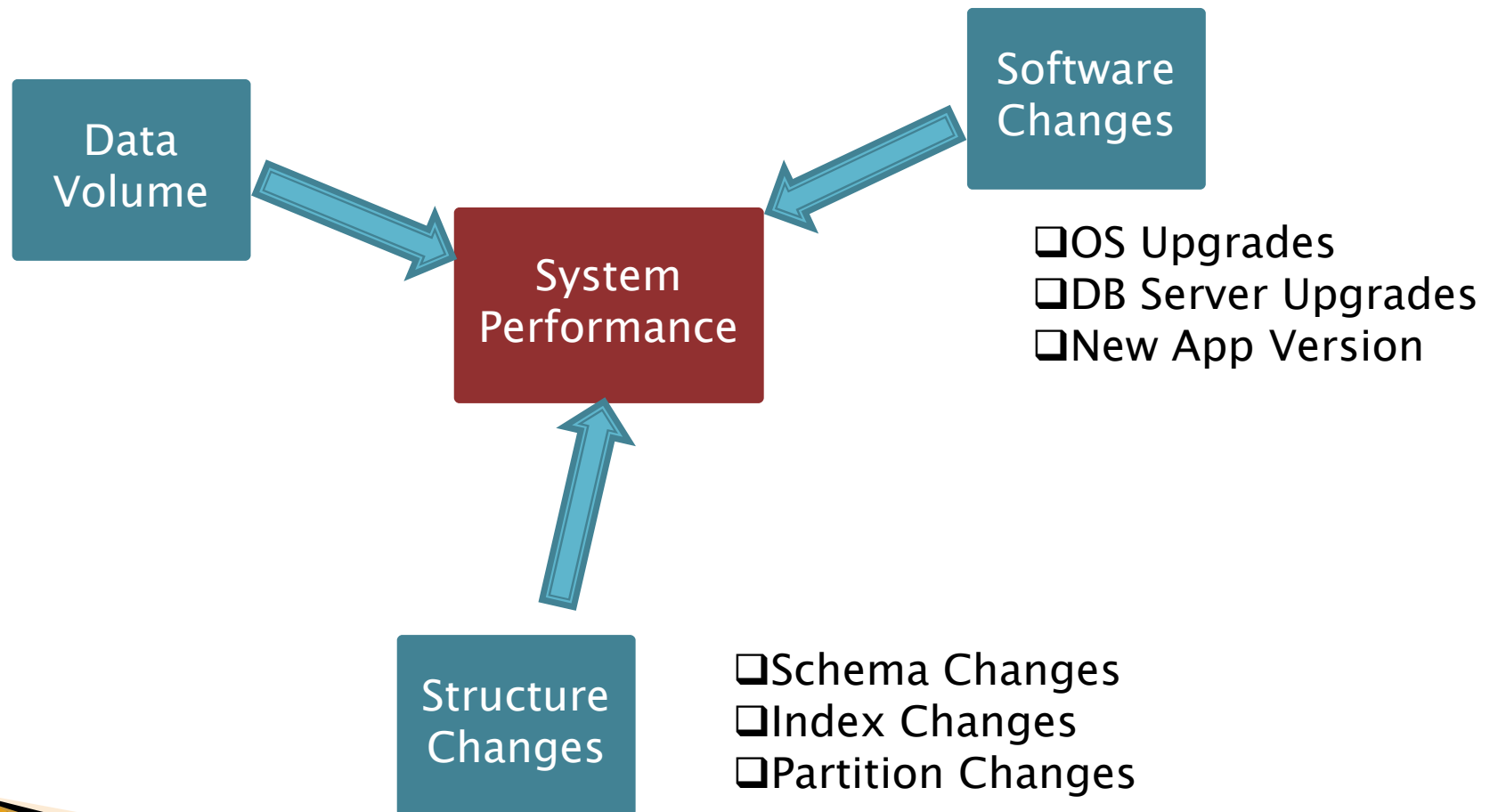
Overview

- ▶ Performance Paradigm
 - What causes performance degradation?
- ▶ SQL Plan Management
 - Ensure the best query execution plan
- ▶ Oracle Database Resource Manager
 - Protect your valuable system resources
- ▶ Alternatives
 - What if this doesn't solve your problem?
 - What if you're not running 11g?
 - What if you're running a 3rd party application?

Performance Paradigm

»» The Bermuda Triangle of
Performance Degradation

What Impacts Performance?



How To Mitigate Performance

▶ To Improve Performance

- Buy more hardware
- Hire a performance tuning guru
- Do-It-Yourself performance tuning
- Reduce the data volume

▶ To Maintain Performance

- Use SQL Plan Management to counteract query plan degradation
- Use Database Resource Manager to ensure that maximal resources are allocated to the most important tasks.

SQL Plan Management

» From Stored Outlines to SQL Profiles to SQL Plan Management

History Overview

Oracle 8i

Oracle 9i

Oracle 10g

Oracle 11g

Stored
Outlines

SQL Profiles

SQL Plan
Management

❑ Plan Stability

❑ Limited Self-Tuning

❑ Auto Deactivate

❑ Self-Tuning

❑ Plan Baselines

❑ Plan History

SQL Plan Baselines

- ▶ SQL Plan Baselines are used to capture changes caused by:
 - New optimizer version
 - Changes to optimizer statistics and optimizer parameters
 - Changes to schema and metadata definitions
 - Changes to system settings
 - SQL profile creation
- ▶ Containing:
 - Set of hints
 - Plan hash value
 - Plan-related information

Creating a Plan

- ▶ First a baseline needs to be established by
 - Capture a plan automatically by setting the `OPTIMIZER_CAPTURE_SQL_PLAN_BASELINES` initialization parameter to `TRUE` (Default = `FALSE`)
 - Load from existing plans
 - *From SQL Tuning Sets and AWR snapshot*
 - *From the Cursor Cache*
 - Plans are automatically accepted and enabled. Set the `OPTIMIZER_USE_SQL_PLAN_BASELINES` parameter to `FALSE` to disable this behavior (Default = `TRUE`).

Selecting a Plan

- ▶ A SQL plan will be selected through this logic.
 - Each time the database compiles a SQL statement, the optimizer does the following:
 1. *Uses a cost-based search method to build a best-cost plan*
 2. *Tries to find a matching plan in the SQL plan baseline*
 3. *Does either of the following depending on whether a match is found:*
 - If found, then the optimizer proceeds using the matched plan
 - If not found, then the optimizer evaluates the cost of each accepted plan in the SQL plan baseline and selects the plan with the lowest cost

Evolving a Plan

- ▶ SQL Plan Management can evolve a plan by:
 - Using the PL/SQL function `DBMS_SPM.EVOLVE_SQL_PLAN_BASELINE` to evolve a plan captured into the baseline.
 - Manually loading new plans from a SQL Tuning Set or the Cursor Cache into the Plan history. These plans are automatically accepted.

Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com >

Logged in As SYS

SQL Plan Control

SQL ProfileSQL PatchSQL Plan Baseline

Refresh

A SQL Plan Baseline is an execution plan deemed to have acceptable performance for a given SQL statement.

Settings

Capture SQL Plan Baselines [TRUE](#)
Use SQL Plan Baselines [TRUE](#)
Plan Retention(Weeks) [Configure](#)

Jobs for SQL Plan Baselines

Load JobsPendingCompleted

Search

SQL Text [Go](#)

By default, the search returns all uppercase matches beginning with the string you entered. To run an exact or case-sensitive match, double quote the search string. You can use the wildcard symbol (%) in a double quoted string.

[Load](#) [Unpack](#)

[Enable](#) [Disable](#) [Drop](#) [Evolve](#) [Pack](#) Fixed - Yes [Go](#) [Previous](#) 1-25 of 108 [Next 25](#)

[Select All](#) | [Select None](#)

Select	Name	SQL Text	Enabled	Accepted	Fixed	Auto Purge	Created	Last Modified
<input type="checkbox"/>	SYS_SQL_PLAN_384ebbc5d8a279cc	select * from emp where hiredate = '17-dec-1980'	YES	YES	NO	YES	Jul 22, 2010 8:31:22 AM	Jul 22, 2010 8:31:22 AM
<input type="checkbox"/>	SYS_SQL_PLAN_e80b75d0a898ad96	SELECT * from table(dbms_xplan.display_sql_plan_b...	YES	YES	NO	YES	Jul 22, 2010 8:11:49 AM	Jul 22, 2010 8:11:49 AM
<input type="checkbox"/>	SYS_SQL_PLAN_2a229199f59a06ad	select emd_url from mgmt_targets where target_na...	YES	YES	NO	YES	Jul 22, 2010 8:11:12 AM	Jul 22, 2010 8:11:12 AM
<input type="checkbox"/>	SYS_SQL_PLAN_67d2db2fed88afee	SELECT CHAR_VALUE FROM SYSTEM.PRODUCT_PRIVS WHERE ...	YES	YES	NO	YES	Jul 22, 2010 8:09:05 AM	Jul 22, 2010 8:09:05 AM

Plan Example

ORACLE Enterprise Manager 11g
Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com >

Logged in As SYS

SQL Plan Control

Return

SQL Plan Baseline Details

SQL handle: SYS_SQL_6f5cb241384ebbc5
SQL text: select * from emp where hiredate = '17-dec-1980'

Plan name: SYS_SQL_PLAN_384ebbc5d8a279cc
Enabled: YES Fixed: NO Accepted: YES Origin: AUTO-CAPTURE

Plan hash value: 3956160932

| Id | Operation | Name | Rows | Bytes | Cost (%CPU) | Time |

| 0 | SELECT STATEMENT | | 1 | 37 | 3 (0) | 00:00:01 |
|* 1 | TABLE ACCESS FULL | EMP | 1 | 37 | 3 (0) | 00:00:01 |

Predicate Information (identified by operation id):

1 - filter("HIREDATE">=TO_DATE(' 1980-12-17 00:00:00', 'syyyyy-mm-dd
hh24:mi:ss'))

Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com >

Logged in As SYS

SQL Plan Control

SQL Profile SQL Patch **SQL Plan Baseline**

Refresh

A SQL Plan Baseline is an execution plan deemed to have acceptable performance for a given SQL statement.

Settings

Capture SQL Plan Baselines [TRUE](#)

Use SQL Plan Baselines [TRUE](#)

Plan Retention(Weeks) [Configure](#)

Jobs for SQL Plan Baselines

Load Jobs Pending Completed

Search

SQL Text [Go](#)

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[Load](#) [Unpack](#)

[Enable](#) [Disable](#) [Drop](#) [Evolve](#) [Pack](#) Fixed - Yes [Go](#) [Previous](#) 1-25 of 109 [Next 25](#) [Go](#)

[Select All](#) | [Select None](#)

Select	Name	SQL Text	Enabled	Accepted	Fixed	Auto Purge	Created	Last Modified
<input type="checkbox"/>	SYS_SQL_PLAN_384ebbc5e1baf87d	select * from emp where hiredate = '17-dec-1980'	YES	NO	NO	YES	Jul 22, 2010 8:33:40 AM	Jul 22, 2010 8:33:40 AM
<input type="checkbox"/>	SYS_SQL_PLAN_384ebbc5d8a279cc	select * from emp where hiredate = '17-dec-1980'	YES	YES	NO	YES	Jul 22, 2010 8:31:22 AM	Jul 22, 2010 8:31:22 AM
<input type="checkbox"/>	SYS_SQL_PLAN_e80b75d0a898ad96	SELECT * from table(dbms_xplan.display_sql_plan_b...	YES	YES	NO	YES	Jul 22, 2010 8:11:49 AM	Jul 22, 2010 8:11:49 AM
<input type="checkbox"/>	SYS_SQL_PLAN_2a229199f59a06ad	select emd_url from mgmt_targets where target na...	YES	YES	NO	YES	Jul 22, 2010 8:11:12 AM	Jul 22, 2010 8:11:12 AM

Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com >

Logged in As SYS

SQL Plan Control

Return

SQL Plan Baseline Details

SQL handle: SYS_SQL_6f5cb241384ebbc5
SQL text: select * from emp where hiredate = '17-dec-1980'

Plan name: SYS_SQL_PLAN_384ebbc5e1baf87d
Enabled: YES Fixed: NO Accepted: NO Origin: AUTO-CAPTURE

Plan hash value: 428519187

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	37	2 (0)	00:00:01
1	TABLE ACCESS BY INDEX ROWID	EMP	1	37	2 (0)	00:00:01
* 2	INDEX RANGE SCAN	EMP_HIREDATE	1		1 (0)	00:00:01

Predicate Information (identified by operation id):

2 - access("HIREDATE">=TO_DATE(' 1980-12-17 00:00:00', 'syyyy-mm-dd hh24:mi:ss'))

Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com >

Logged in As SYS

SQL Plan Control

Cancel OK

Evolve SQL Plan Baselines

Plans that have not yet been accepted can be evolved (verified) to confirm they are suitable plan baselines.

Name	SQL Text
SYS_SQL_PLAN_384ebbc5e1baf87d	select * from emp where hiredate = '17-dec-1980'

Verify Performance ☒ Yes ☐ No

Time Limit ☒ Auto ☐ Unlimited ☐ Specify (minutes)

Action ☒ Report and Accept ☐ Report only

Cancel OK

Database | Setup | Preferences | Help | Logout

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[About Oracle Enterprise Manager](#)

Plan Example

```
-----
                        Evolve SQL Plan Baseline Report
-----

Inputs:
-----
PLAN_LIST  = SYS_SQL_PLAN_384ebbc5e1baf87d
TIME_LIMIT = DBMS_SPM.AUTO_LIMIT
VERIFY     = YES
COMMIT     = YES

Plan: SYS_SQL_PLAN_384ebbc5e1baf87d
-----
Plan was verified: Time used .1 seconds.
Passed performance criterion: Compound improvement ratio >= 3.55.
Plan was changed to an accepted plan.

      Baseline Plan      Test Plan      Improv. Ratio
      -----
Execution Status:      COMPLETE      COMPLETE
Rows Processed:         1             1
Elapsed Time(ms):       0             0
CPU Time(ms):           1             0
Buffer Gets:            7             2             3.5
Disk Reads:             0             0
Direct Writes:          0             0
Fetches:                0             0
Executions:             1             1

-----
                        Report Summary
-----

Number of SQL plan baselines verified: 1.
Number of SQL plan baselines evolved: 1.

Return
```

Summary

- ▶ Automatic SQL Plan Management that adapts to most changes, except radical schema changes.
- ▶ Only 2 parameters used:
 - OPTIMIZER_CAPTURE_SQL_PLAN_BASELINES
 - OPTIMIZER_USE_SQL_PLAN_BASELINES
- ▶ Pay close attention to the SYSAUX tablespace. It's been used to store the plans. Automatic purge policy is in place, but only runs once a week.
- ▶ **Only available in 11gR1 and later**
- ▶ Stored Outlines and SQL Profiles are being depreciated.

Summary

- ▶ More automation by using SQL Plan Baseline with SQL Tuning Advisor.
- ▶ Freeze SQL Plans by using the FIXED parameter.
- ▶ Export and Import SQL Plans.
 - Fine tune SQL in a UAT environment or near production and then export plans via data pump and then import into production.

Finally

- ▶ SQL Plan Management
- ▶ SQL Tuning Advisor
- ▶ SQL Tuning Sets
- ▶ SQL Profiles
- ▶ AWR
- ▶ ADDM

Are separately licensed features

- ▶ Reference: E10821-05 Oracle Performance Tuning Guide 11g *Release 2 (11.2)*

Oracle Database Resource Manager

» Throttle Down Your Resource
Hogs

Overview

- ▶ Database Resource Manager is designed to address the following problems:
 - Excessive overhead
 - Inefficient scheduling
 - Inappropriate allocation of resources
 - Inability to manage database-specific resources, such as parallel execution servers and active sessions

Resource Manager Elements

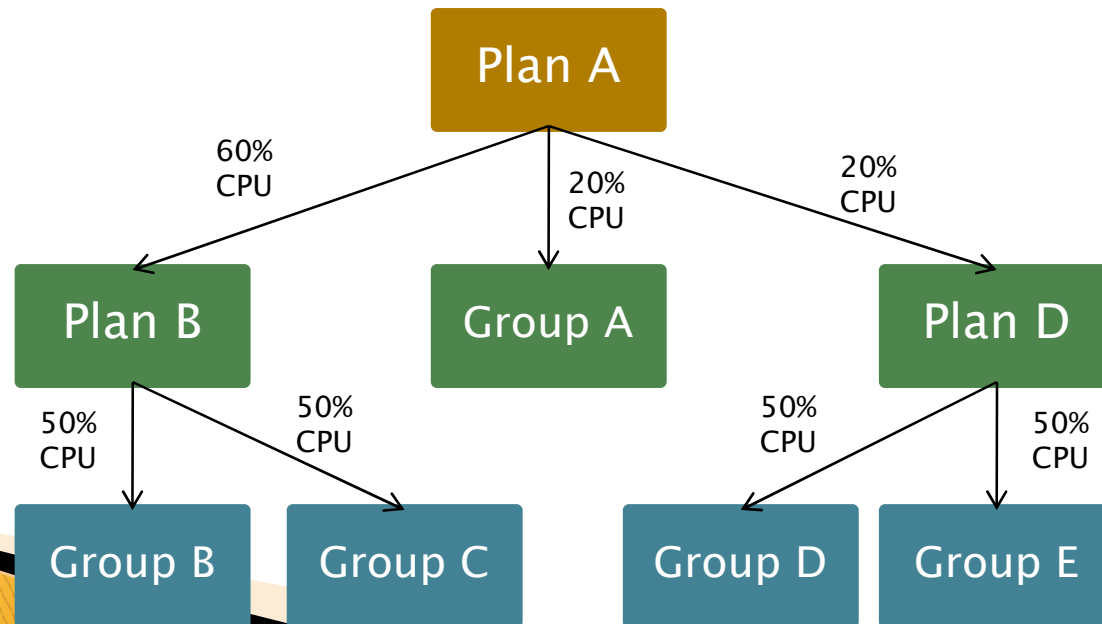
- ▶ **Resource consumer group**
 - A group of sessions that are grouped together based on resource requirements. The Resource Manager allocates resources to resource consumer groups, not to individual sessions.
- ▶ **Resource plan**
 - A container for directives that specify how resources are allocated to resource consumer groups. You specify how the database allocates resources by activating a specific resource plan.
- ▶ **Resource plan directive**
 - Associates a resource consumer group with a particular plan and specifies how resources are to be allocated to that resource consumer group.

Consumer Groups

- ▶ There are three special consumer groups
 - SYS_GROUP
 - *Default group for the users sys and system.*
 - DEFAULT_CONSUMER_GROUP
 - *Default group for all other user accounts.*
 - OTHER_GROUPS
 - *Default group if there's no active plan assigned to the groups above. This group must have an active plan.*
- ▶ User Defined Groups
 - Map sessions to consumer groups based on CPU or I/O consumption thresholds.

Resource Plans

- ▶ Only one resource plan can be active for a consumer group.
- ▶ Resource plans can contain sub-plans and can grow very complex.
 - Remember that each plan level and sub plan level needs to add up to 100% and cannot exceed 100%.



Resource Plan Directives

- ▶ **CPU**
 - Up to 8 levels of consumer group allocations
- ▶ **Active Session Pool with Queuing**
 - Max concurrent sessions per consumer group
- ▶ **Degree of Parallelism Limit**
 - Per session limit, but does not limit system setting
- ▶ **Automatic Consumer Group Switching**
 - Switch groups, typically higher to lower priority.
 - Canceling SQL and Terminating Sessions
- ▶ **Execution Time Limit**
 - Estimate query run-time, trap and reschedule
- ▶ **Undo Pool**
 - Limits the undo for uncommitted transactions per consumer group
- ▶ **Idle Time Limit**
 - Terminating session when exceeded.

Resource Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com >

Logged in As SYS

Resource Plans

Search

Object Name

Go

By default, the search returns all uppercase matches beginning with the string you entered. To run an exact or case-sensitive match, double quote the search string. You can use the wildcard symbol (%) in a double quoted string.

Create

Edit View Delete Actions Activate Go

Select	Plan	Status	Description	Scheduler Windows
<input checked="" type="radio"/>	DEFAULT_MAINTENANCE_PLAN		Default plan for maintenance windows that prioritizes SYS_GROUP operations and allocates the remaining 5% to diagnostic operations and 25% to automated maintenance operations.	MONDAY_WINDOW TUESDAY_WINDOW WEDNESDAY_WINDOW THURSDAY_WINDOW FRIDAY_WINDOW SUNDAY_WINDOW SATURDAY_WINDOW
<input type="radio"/>	DEFAULT_PLAN		Default, basic, pre-defined plan that prioritizes SYS_GROUP operations and allocates minimal resources for automated maintenance and diagnostics operations.	
<input type="radio"/>	INTERNAL_PLAN		Internally-used plan for disabling the resource manager.	
<input type="radio"/>	INTERNAL QUIESCE		Plan for quiescing the database. This plan cannot be activated directly. To activate, use the quiesce command.	
<input type="radio"/>	MIXED_WORKLOAD_PLAN	ACTIVE	Example plan for a mixed workload that prioritizes interactive operations over batch operations.	
<input type="radio"/>	ORA\$AUTOTASK_HIGH_SUB_PLAN		Default sub-plan for high-priority, automated maintenance tasks. This sub-plan is referenced by	

Resource Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com > Resource Plans >

Logged in As SYS

View Resource Plan: MIXED_WORKLOAD_PLAN

Actions Create Like Go Edit Return

Plan **MIXED_WORKLOAD_PLAN**

Description **Example plan for a mixed workload that prioritizes interactive operations over batch operations.**

Status **Active**

Automatic Plan Switching Enabled **true**

Is Subplan **false**

Associated Scheduler Window(s)

Resource Allocations

Group/Subplan	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
BATCH_GROUP			100					
INTERACTIVE_GROUP		85						
ORA\$AUTOTASK_SUB_PLAN		5						
ORA\$DIAGNOSTICS		5						
OTHER_GROUPS		5						
SYS_GROUP	100							

Directive Values

Group	Maximum Degree of Parallelism	Maximum Number of Active Sessions	Activation Queue Timeout (sec)	Maximum Undo Space (KB)	Maximum Estimated Execution Time (sec)	Max Idle Time (sec)	Max Idle Time if Blocking Another Session (sec)
BATCH_GROUP	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED
INTERACTIVE_GROUP	1	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED
ORA\$DIAGNOSTICS	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED
OTHER_GROUPS	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED
SYS_GROUP	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED	UNLIMITED

Resource Plan Example

ORACLE Enterprise Manager 11g Database Control

Setup Preferences Help Logout

Database

Database Instance: orcl.dobler.com > Resource Plans > Edit Resource Plan: MIXED_WORKLOAD_PLAN

Logged in As SYS

Actions Create Like Go Show SQL Revert Apply

General Parallelism Session Pool Undo Pool Threshold Idle Time

Specify the time duration or the resource limits under which a session can execute in a consumer group. If any of the limits are exceeded, the session can be switched to another consumer group, the session's SQL operation can be canceled, or the session can be killed.

Group	Execution Time Limit (Sec)	I/O Limit (MB)	I/O Request Limit (Requests)	Action	Revert after call?
BATCH_GROUP	UNLIMITED	UNLIMITED	UNLIMITED		<input type="checkbox"/>
INTERACTIVE_GROUP	60	UNLIMITED	UNLIMITED	Switch to Group BATCH_GROUP	<input checked="" type="checkbox"/>
ORA\$DIAGNOSTICS	UNLIMITED	UNLIMITED	UNLIMITED		<input type="checkbox"/>
OTHER_GROUPS	UNLIMITED	UNLIMITED	UNLIMITED		<input type="checkbox"/>
SYS_GROUP	UNLIMITED	UNLIMITED	UNLIMITED		<input type="checkbox"/>

General Parallelism Session Pool Undo Pool Threshold Idle Time

Actions Create Like Go Show SQL Revert Apply

Database | Setup | Preferences | Help | Logout

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Summary

- ▶ Resource Manager is on by default in 11g
- ▶ To avoid surprises when installing or upgrading to 11g, switch the active resource plan from `DEFAULT_PLAN` to `MIXED_WORKLOAD_PLAN`.
- ▶ Carefully plan your resource groups and plan directives.
- ▶ I/O limit switching is available in 11gR1 and later.
- ▶ Reference: **E10595-07** Database Administrator's Guide 11g *Release 2 (11.2)*

Conclusion and Alternatives

»» How ActiveBase Opens Closed
Doors

Conclusion

▶ SQL Plan Management

- Manages SQL plans, but does not optimize SQL queries.
- Protects the database from performance degradation due to common changes to the environment.
- Based on query optimizer cost calculation.
- 11gR1 and later only

▶ Database Resource Manager

- Forces database sessions to play nicely.
- Moves offending sessions out of the way to give priority sessions all the resources possible.
- Protects the system from runaway queries.
- Based on CPU and I/O consumption.
- Latest features are 11gR1 and later only

ActiveBase Performance & Priority

▶ ActiveBase Performance

- Dynamic SQL Optimization via the creative use of a rules-based SQL*Net Proxy that selectively intercepts and evaluates in-bound SQL generated by applications. When sub-optimal SQL is being submitted, the Proxy can re-structure the syntax of the statement to apply performance improvements which would then be executed by the database.

▶ ActiveBase Priority

- Dynamic Server Prioritization via the creative use of a rules-based Session Monitor that can detect when the server load reaches various thresholds (e.g. 80%), which will then throttle down the resources allocated to lesser-important applications. The result is dynamic resource allocation that enables critical applications to maintain SLAs during peak processing periods.

Questions? Comments!

THANK YOU!

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