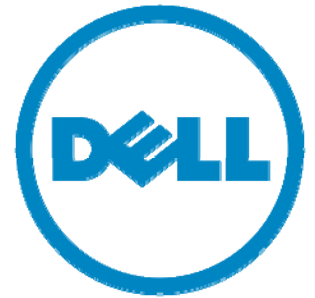

Monitoring and Diagnosing Oracle RAC Performance with Oracle Enterprise Manager



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Dell Oracle Solutions Engineering

About Author

- Kai Yu

Senior System Engineer, Dell Oracle Solutions Engineering Lab

- 15 years Oracle DBA and Solutions Engineering
- Specialized in Oracle RAC, Oracle EBS and OVM
- Oracle Technology articles author and frequent presenter
- IOUG Oracle RAC SIG President (2009-2010)
- IOUG Collaborate 10//11 Boot Camps Owner

- Orlando Gallegos

Dell Oracle Solutions Engineering Lab

- 5 years Oracle DBA and Solutions Engineering
- Specialized in system, networking and storage migrations



Agenda

- Performance Management: Challenges and Solutions
- Database Performance Monitoring and Diagnosis Tools
- RAC Database Monitoring and Diagnosis with Enterprise Manager
- Examples of RAC Performance Monitoring & Diagnosis
- QA



Performance Management: Challenges and Solutions

- Performance Management Challenges
 - Complexity of Applications and the Workloads
 - Complexity of RAC Architecture
 - Servers, OS, network, storage, Oracle RAC/Database
 - High Requirements and Expectations of Database Performance
 - Performance Management for 24 x 7 Operation
 - Catch the performance problem in real time
 - Diagnose the performance problem afterwards
 - Manage a large number of production databases
- Performance Management : from ART to Engineering
 - Common Performance Problems Symptoms
 - Slow response time
 - Low database throughput bottlenecks

Performance Management: Challenges and Solutions

- Performance Management Work Flow
 - Non-stop monitoring and statistics collecting
 - Identifying the bottlenecks and issue alerts
 - Diagnosing the root cause of the bottlenecks
 - Coming up the tuning recommendations
 - Combine proactive and reactive approaches
- Performance Monitoring and Statistics Collecting
 - Real time monitoring
 - Historical performance playback
 - Automatic monitoring and performance alerts
 - Performance Statistics Gathering
 - system, sessions, SQL execution, Wait events, DB time
 - Store the statistics for performance analysis and diagnosis

RAC Performance Management: Challenges and Methods

- Diagnosis of Performance Issues
 - Analyze the collected statistics
 - Identify the root cause of performance issues
 - Recommend the correction method and quantify the benefits
 - Notification of diagnosis results through automatic alerts
 - Automatic performance diagnosis: Proactive approach
 - Manual performance diagnosis: Reactive approach
- Performance Management Tools
 - Oracle Database Enterprise Edition
 - Generate cumulative performance data in dynamic views
 - Various Performance features
 - Oracle Diagnostics Pack
 - Built into the core database engine and Enterprise Manager
 - A complete database performance management solution
 - Cluster aware: specific features designed for RAC
 - Including AWR, ADDM and ASH

RAC Performance Management Tools

- Oracle Database Tuning pack
 - SQL Tuning advisor, SQL access Advisor
- Automatic Workload Repository(AWR)
 - AWR collects database statistics through AWR snapshots
 - AWR reports and AWR compare Period report
 - Foundation of all self tuning and management
 - RAC Aware: Instance and Database level
- Active Session History
 - ASH samples the state of all active session every second
 - Help diagnose the short lived performance problem
- Automatic Database Diagnostic Monitor (ADDM)
 - Examine and analyze statistics data captured by AWR
 - Diagnosis through ADDM findings
 - Root cause analysis, Correction recommendations
 - Impact and benefits analysis

RAC Performance Management Tools

- Automatics ADDM run vs Manual ADDM run
- ADDM for RAC: cluster-wide performance analysis
issue on the entire cluster and instance level
global resources such as global cache, interconnect traffic
- Enterprise Manager
 - Primary tool for DBAs to manage the RAC databases
 - Provide a display console of database performance statistics
 - Provide a central console for RAC performance management
 - Graphical User interface for other tuning tools:
 - Run AWR, ASH and ADDM, SQL tuning
 - Display the results from AWR, ASH, ADDM, SQL tuning
 - Preferred method for RAC database monitoring and diagnosis
 - Enterprise Manager Grid Control vs Database Control
 - Rest of presentation examines how to manage performance using Enterprise Manager

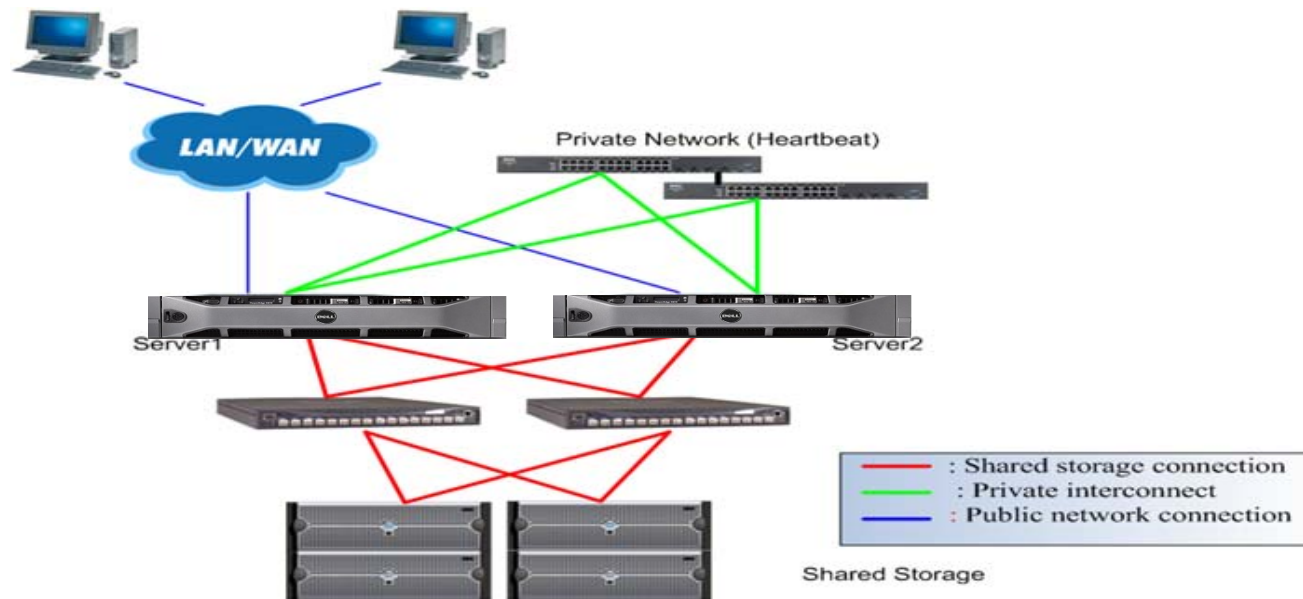
Video Demo: RAC Performance Monitoring and Diagnosis with Enterprise Manager

- Length of Video: 15 minutes
- Contents: 11g R2 RAC Database Performance Monitoring and Diagnosis using Oracle Enterprise Manager Grid Control 11g
 - Multiple Levels of RAC Performance Monitoring
 - Cluster Database, Database Instance, Cluster
 - Real time monitoring
 - Historical Performance Playback
 - Collecting Performance Statistics
 - AWR
 - ASH
 - Diagnosis of Performance Problem:
 - Proactive Diagnosis by ADDM
 - Manually Run ADDM for Reactive Diagnosis



Examples of RAC Performance Monitoring & Diagnosis

- Goal : Use Enterprise Manager Determine bottlenecks occurring on the cluster and implement changes to improve performance
 - Test Environment configuration
 - Server: Two Dell PE R815 server
 - Storage: Dell | EMC CX4-120
- Two Interconnect Switches
Two Fiber Channel Switches

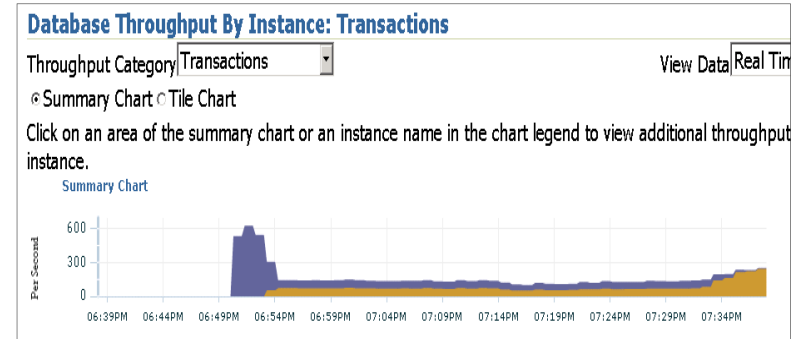
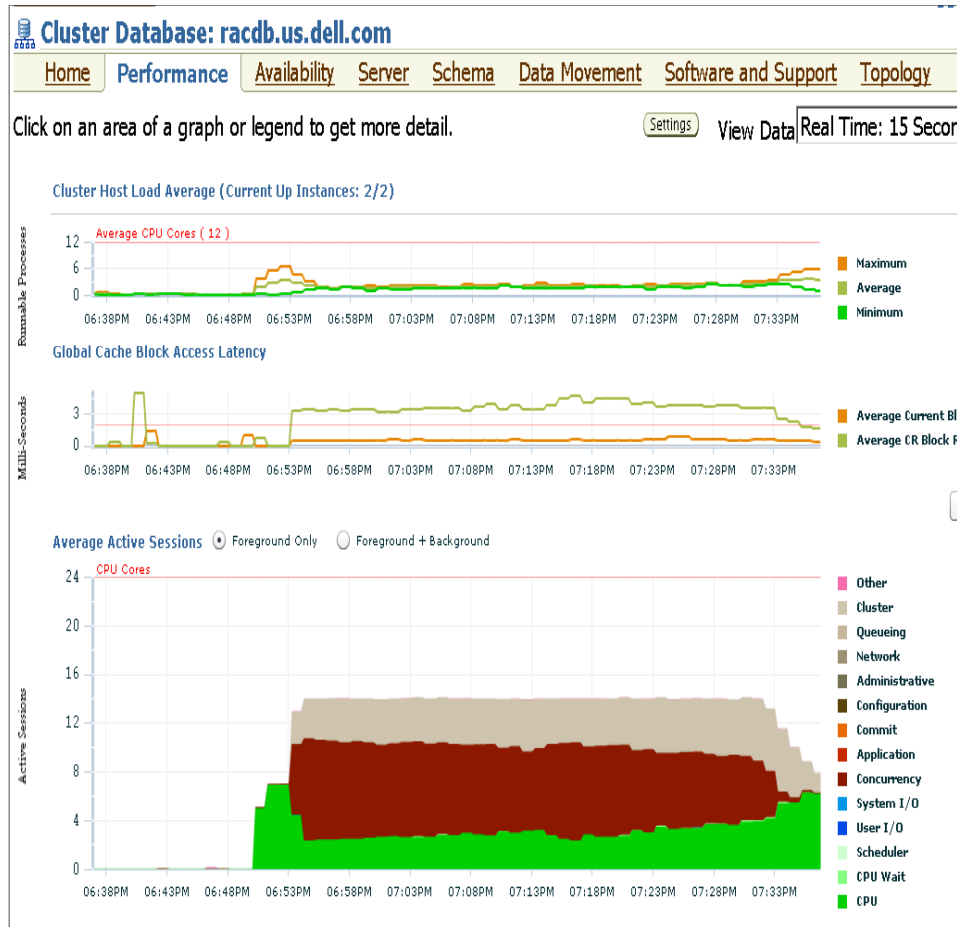


Examples of RAC Performance Monitoring & Diagnosis

- Oracle RAC Database: Two Node 11g R2 RAC database
- Enterprise Manager 11g R1 for performance monitoring
- Example1
 - Workload: PL/SQL batch jobs concurrently run on both nodes.
 - . Loop for 200000 times:
 - select rows of customer table(most copy in other node)
 - update rows to establish the master copy in local node
 - . Insert into customer table using sequence value
 - end loop
 - workload.sh: executes update.sql on two instances at same time
- Goal
 - Monitor real time performance and diagnose performance issue using historical data
 - Show how to use ADDM and AWR to tune the RAC Database.

Examples of RAC Performance Monitoring & Diagnosis

- First Run: Real Time Performance:
Batch time: 64 minutes, average throughputs: 137 per sec








ADDM findings:

ADDM Performance Analysis

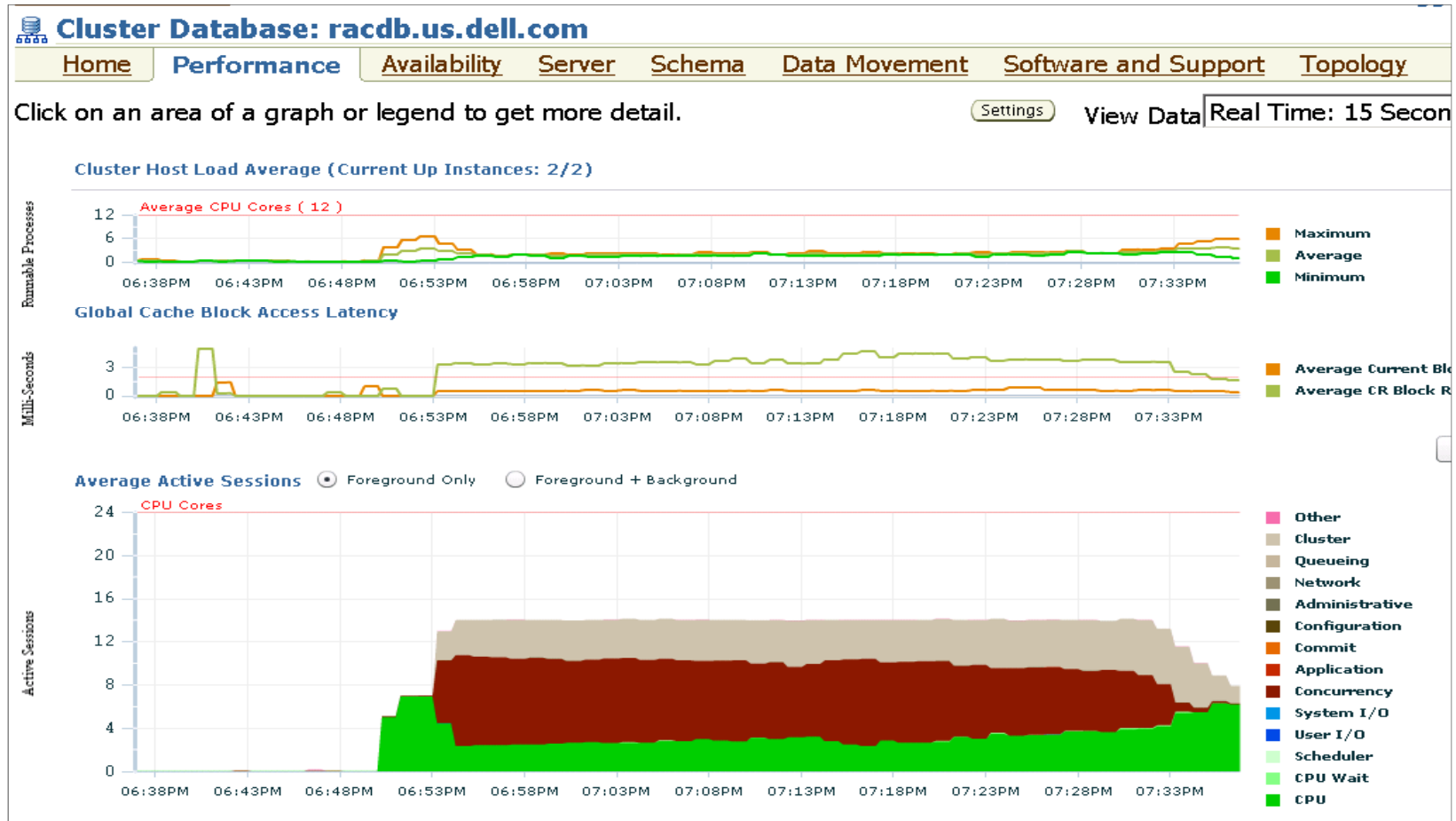
Task Name ADDM:721351302_1264

Task Owner	SYS	Average Active Sessions	11.6	Period Start Time	Aug 28, 2010 7:00:26 PM	End Time	Aug 28, 2010 7:45:07
------------	-----	-------------------------	------	-------------------	-------------------------	----------	----------------------

Impact (%)	Finding	Affected Instances	Occurrences (2 period)
	62.6 Top SQL Statements	2 of 2	3 of 14
	47.5 Sequence Usage	2 of 2	2 of 14
	41.6 Unusual "Concurrency" Wait Event	2 of 2	2 of 14
	27.7 Global Cache Messaging	2 of 2	2 of 14
	25 Buffer Busy - Hot Objects	2 of 2	2 of 14

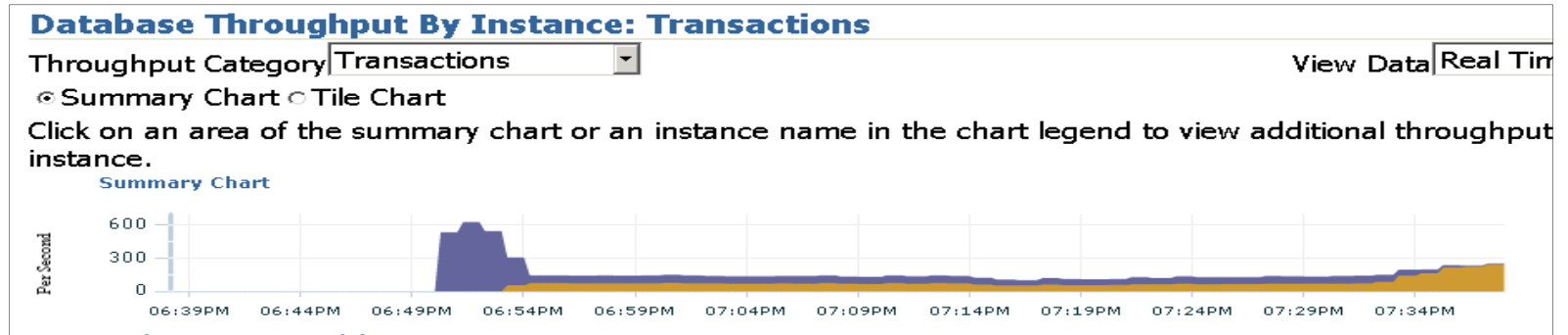
Examples of RAC Performance Monitoring & Diagnosis

- First Run: Real Time Performance:
Batch time: 64 minutes, average throughputs: 137 per sec



Examples of RAC Performance Monitoring & Diagnosis

- First Run: Real Time Performance:
Batch time: 64 minutes, average throughputs: 137 per sec



ADDM findings:

ADDM Performance Analysis				
Task Name ADDM:721351302_1264				
Task Owner	SYS	Average Active Sessions	11.6	Period Start Time
				Aug 28, 2010 7:00:26 PM
				End Time
				Aug 28, 2010 7:45:07
Impact (%) ▾	Finding		Affected Instances	Occurrences (2 period)
62.6	Top SQL Statements		2 of 2	3 of 14
47.5	Sequence Usage		2 of 2	2 of 14
41.6	Unusual "Concurrency" Wait Event		2 of 2	2 of 14
27.7	Global Cache Messaging		2 of 2	2 of 14
25	Buffer Busy - Hot Objects		2 of 2	2 of 14

Examples of RAC Performance Monitoring & Diagnosis


ADDM Tuning Recommendations:

TOP SQL

Performance Finding Details: Top SQL Statements

Finding SQL statements consuming significant database time were found. These statements offer a good opportunity for performance improvement. [Finding History](#)

Impact (Active Sessions) 7.29

Percentage of Finding's Impact (%)  62.6

Period Start Time Aug 28, 2010 7:00:26 PM

End Time Aug 28, 2010 7:45:07 PM


Filtered No [Filters](#)

Recommendations

[Schedule SQL Tuning Advisor](#)

[Select All](#) | [Select None](#) | [Show All Details](#) | [Hide All Details](#)

[Select Details](#) **Category** [Benefit \(%\)](#)

☐ [Hide](#) SQL Tuning  47.7

Action Investigate the INSERT statement with SQL_ID "3uumxkvzugsx7" for possible performance improvements. You can supplement the information given here with an ASH report for this SQL_ID.
SQL Text `INSERT INTO CUSTOMER VALUES(ID.NEXTVAL, 'AS', 'SO')`
SQL ID 3uumxkvzugsx7

Rationale The SQL spent only 13% of its database time on CPU, I/O and Cluster waits. Therefore, the SQL Tuning Advisor is not applicable in this case. Look at performance data for the SQL to find potential improvements.


Rationale Database time for this SQL was divided as follows: 100% for SQL execution, 0% for parsing, 0% for PL/SQL execution and 0% for Java execution.

Use a large cache
for the hot sequence

Performance Finding Details: Sequence Usage

Finding Sequence cache misses were consuming significant database t

Impact (Active Sessions) 5.53

Percentage of Finding's Impact (%)  47.5

Period Start Time Aug 28, 2010 7:00:26 PM


End Time Aug 28, 2010 7:45:07 PM

Filtered No [Filters](#)

Recommendations

[Show All Details](#) | [Hide All Details](#)

[Details](#) **Category** [Benefit \(%\)](#)

☐ [Hide](#) Application Analysis 

Action Investigate application or look at top SQL to find hot sequences. Use a larger cache size sequences. Try avoiding the use of the ORDER setting if running RAC.

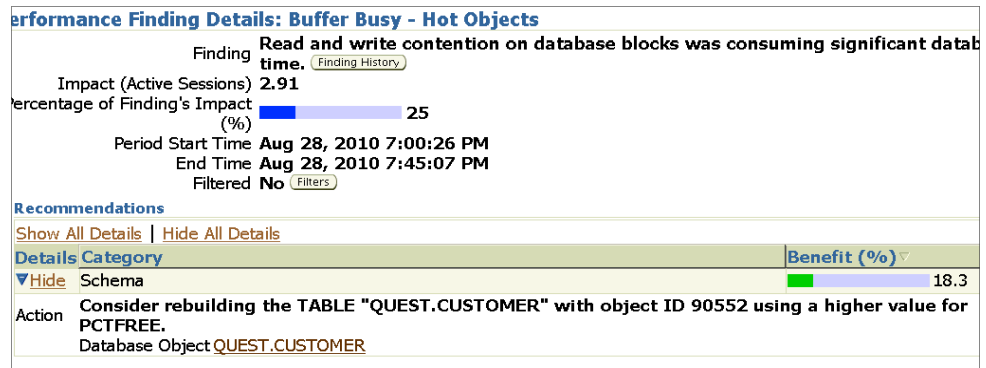
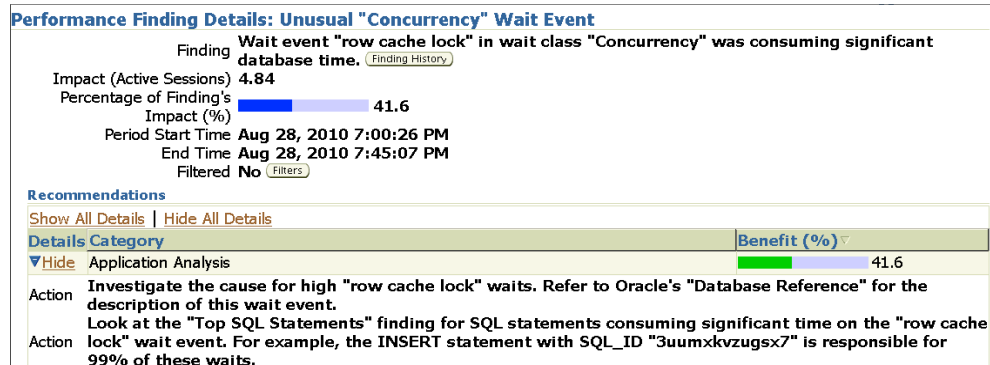


Examples of RAC Performance Monitoring & Diagnosis

ADDM Recommendations

Investigate
“row cache lock” wait

Use a higher value for
Pctfree Of customer table

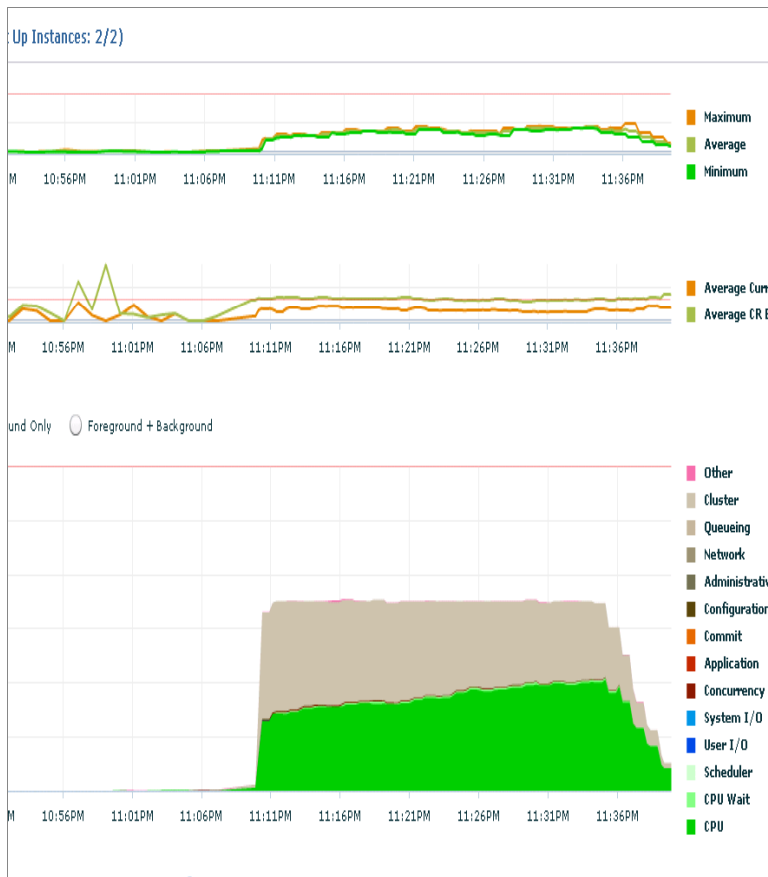


create sequence id start with 1 increment by 1 nomaxvalue cache 9000;
Rebuild table customer use higher PCTFREE value (20)



Examples of RAC Performance Monitoring & Diagnosis

- Second Run: Real Time Performance:
Batch time: 28 minutes, average throughputs: 300 per sec



Database Throughput By Instance: Transactions

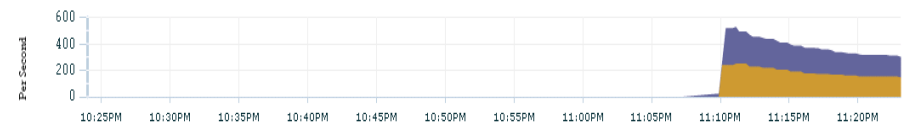
Throughput Category: Transactions

View Data Real Time: 1

Summary Chart Tile Chart

Click on an area of the summary chart or an instance name in the chart legend to view additional throughput category details for the ins

Summary Chart



ADDMM findings:

ADDMM Performance Analysis

Task Name ADDM:721351302_1269

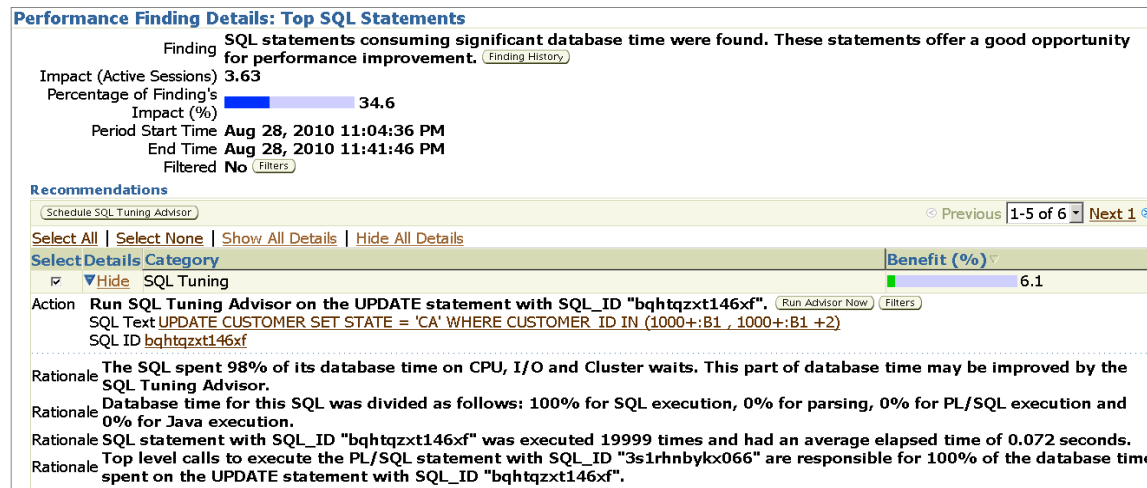
Task Owner SYS Average Active 10.5 Period Start Time Aug 28, 2010 11:04:36 PM End Time
Sessions

Impact (%)	Finding	Affected Instances	Occurrences (24)
46.8	Global Cache Messaging	2 of 2	5 of 15
42.2	Buffer Busy - Hot Objects	2 of 2	5 of 15
34.6	Top SQL Statements	2 of 2	5 of 15

Examples of RAC Performance Monitoring & Diagnosis

ADDM Tuning Recommendations:

TOP SQL



Run SQL advisor
Recommend
an index

Statistics Finding Summary				
Object Name	Object Type	Schema	Problem	References
CUSTOMER	TABLE	QUEST	MISSING	5

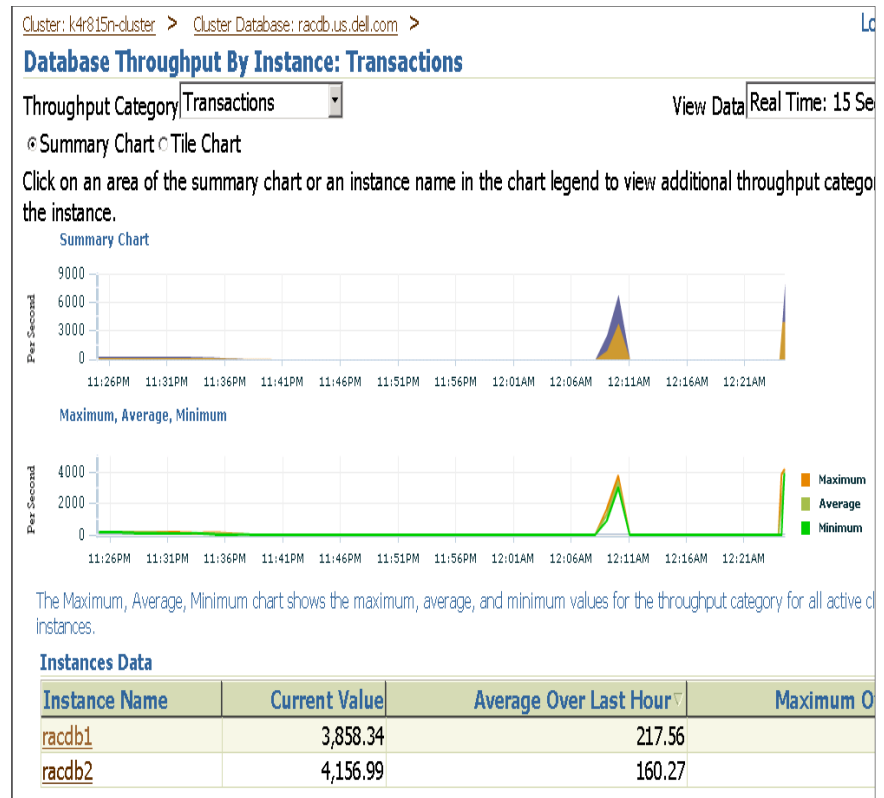
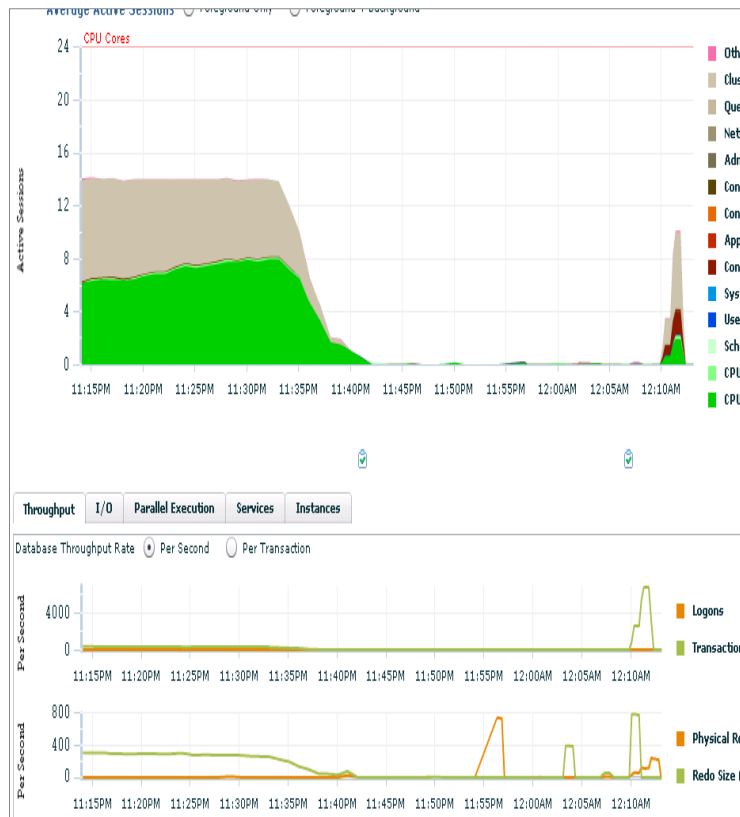
Index Finding Summary			
Table Name	Schema	References	Index Columns
CUSTOMER	QUEST	5	CUSTOMER_ID

create index customer_id on customer(CUSTOMER_ID)



Examples of RAC Performance Monitoring & Diagnosis

- Third Run: Real Time Performance:
Batch run time: 1 minute, average throughputs: 8000 per sec



Examples of RAC Performance Monitoring & Diagnosis

- Performance Comparisons of three runs:

Time to complete the test (mins) Throughputs (transactions/second)

Instance#	1st Run	2nd Run	3rd Run
1	64	27	1
2	65	28	1

Instance#	1st Run	2nd Run	3rd Run
1	77	156	3856
1	60	146	4156

- Summary:

- Use EM to monitor and diagnose the RAC database performance
- Identified the root cause of major waiting time and recommended the tuning solution improve the performance significantly
- SQL and database objects tuning can reduce cluster wait time and CPU time.

Examples of RAC Performance Monitoring & Diagnosis

- Example12 Data warehouse Work Load
 - TPCCH test running two streams:
 - › 1st Test: Use EM to diagnose bottleneck
 - › 2nd Test: Final results

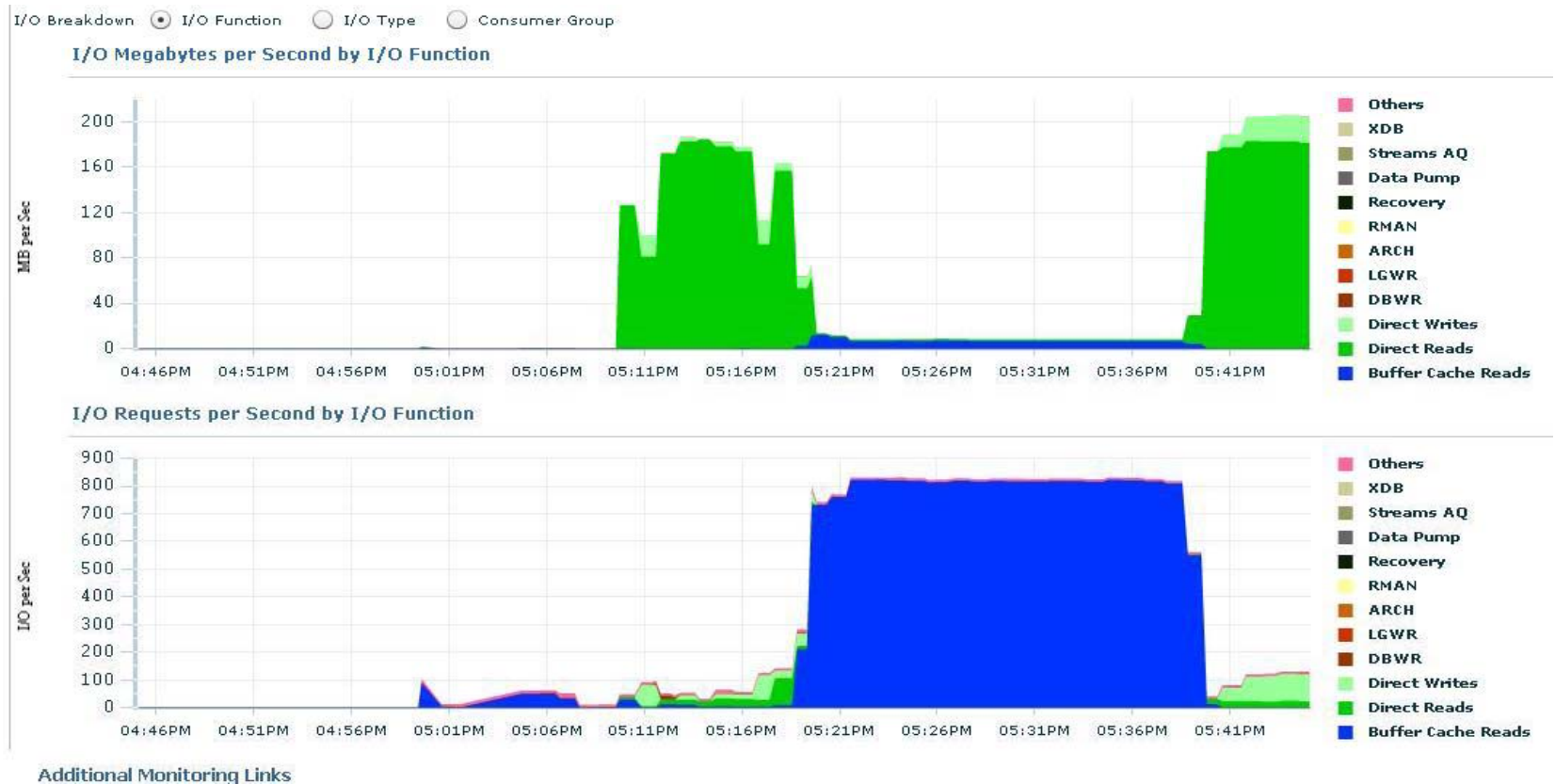
First Run: Partitioned table



Top Activity

Examples of RAC Performance Monitoring & Diagnosis

- Data warehouse performance analysis



Examples of RAC Performance Monitoring & Diagnosis

SQL monitoring and evaluation

ORACLE Enterprise Manager 11g
Database Control

[Setup](#) [Preferences](#) [Help](#) [Logout](#)
Cluster **Database**

Cluster Database: owi.kaiqrid.dblab.com >

Logged in As SYSTEM

Monitored SQL Executions

Active in last 1 hour ▼										
Refresh 10 seconds ▼ Stop Refresh										
Status	Duration	Instance ID	SQL ID	User	Parallel	Database Time	IO Requests	Start	Ended	SQL Text
	9.1m	1	4ttpsft97zujk	QUEST	16 2	59.1m	39K	2:46:20 PM		SELECT l_orderkey, SUM(l_extendedp
	9.2m	1	1fwcc9b0mbzum	QUEST	16 2	1.5h	45K	2:46:19 PM		SELECT l_orderkey, SUM(l_extendedp
	1.6m	1	8u809k64x3nzd	SYSTEM		1.1m	2002	2:52:27 PM	2:54:01 PM	begin DBMS_WORKLOAD_REPOSITC
	5.6m	1	2skr5pf9ahmy1	QUEST	16 2	55.2m	36K	2:40:41 PM	2:46:19 PM	SELECT c_count, count(*) as custdist F
	5.7m	1	2skr5pf9ahmy1	QUEST	16 2	54.8m	36K	2:40:34 PM	2:46:17 PM	SELECT c_count, count(*) as custdist F
	1.3m	1	8u809k64x3nzd	SYSTEM		1.1m	1329	2:43:09 PM	2:44:24 PM	begin DBMS_WORKLOAD_REPOSITC
	36.5m	1	46z0g83gud18f	QUEST	16 2	4.3h	91K	2:04:12 PM	2:40:40 PM	SELECT s_name, count(*) numwait FR

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Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM

Grid Control 11g [Home](#) [Targets](#) [Deployments](#) [Alerts](#) [Compliance](#) [Jobs](#) [Reports](#) [My Oracle Support](#)


[Hosts](#) | [Databases](#) | [Middleware](#) | [Web Applications](#) | [Services](#) | [Systems](#) | [Groups](#) | [Virtual Servers](#) | [All Targets](#)

[Cluster: k4r815n-cluster](#) > [Cluster Database: racdb.us.dell.com](#) > [Advisor Central](#) > [Automatic Database Diagnostic Monitor \(ADDM\): QUEST.ADDM:721351302_1181](#) > Logged in As SYS

Performance Finding Details: Undersized instance memory

Finding **The Oracle instance memory (SGA and PGA) was inadequately sized in some instances, causing additional I/O and CPU usage.** [Finding History](#)

Impact (Active Sessions) **1.94**

Percentage of Finding's Impact (%)  **7.3**


Period Start Time **Aug 25, 2010 1:00:02 PM**

End Time **Aug 25, 2010 1:39:03 PM**

Filtered **No** [Filters](#)

Recommendations


[Show All Details](#) | [Hide All Details](#)

Details	Category	Benefit (%)
Hide	Examine instance ADDM	 7.3

Action: **Increase the memory allocated to affected instances. Check the ADDM analysis of affected instances for more details.**

Findings Path



[Expand All](#) | [Collapse All](#)

Findings	Percentage of Finding's Impact (%)	Additional Information
Hide The Oracle instance memory (SGA and PGA) was inadequately sized in some instances, causing additional I/O and CPU usage.	 7.3	

Finding Impact Breakdown

Category [Top Instances](#)

Instance Impacts

Name	Impact (%)
racdb.us.dell.com racdb1	 89.78
racdb.us.dell.com racdb2	 10.22


Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM

Cluster Database: owi.kaigrid.dblab.com > Advisor Central > Automatic Database Diagnostic Monitor (ADDM):SYSTEM.ADDM:1279062280_1630 >

Logged in As SYSTEM

Performance Finding Details: Undersized PGA

Finding	The PGA was inadequately sized in some instances, causing additional I/O to temporary tablespaces to consume significant database time.			Finding History
Impact (Active Sessions)	1.63			
Percentage of Finding's Impact (%)		9.5		
Period Start Time	Sep 1, 2010 7:26:59 AM EDT			
Period Duration (minutes)	11.5			
Filtered	No	Filters		


Recommendations

[Show All Details](#) | [Hide All Details](#)

Details	Category	Benefit (%)
Hide	Examine instance ADDM	 9.5
Action: Increase the size of the PGA on affected instances. Check the ADDM analysis of affected instances for more details.		

Findings Path



[Expand All](#) | [Collapse All](#)

Findings	Percentage of Finding's Impact (%)	Additional Information
▼ The PGA was inadequately sized in some instances, causing additional I/O to temporary tablespaces to consume significant database time.	 9.5	

Finding Impact Breakdown

Category: [Top Instances](#)

Instance Impacts

Name	Impact (%)
owi.kaigrid.dblab.com_ow1	 33.57
owi.kaigrid.dblab.com_ow2	 66.43

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Global Marketing



Examples of RAC Performance Monitoring & Diagnosis

- Performance Comparisons of three runs:
 - Time to complete the tests (sec)

Query	1 st Run (sec)	2 nd Run (sec)
Transaction # 1	327.27	314.91
Transaction # 2	1005.14	927.97
Transaction # 3	23.64	17.52

- Real Time monitoring of transactions
- Deep dive diagnostics of the application environment
- Quick identification and location of problems

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