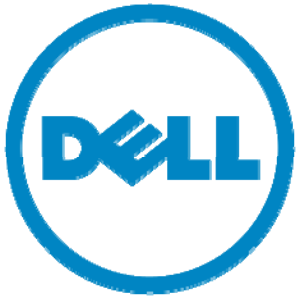
Monitoring and Diagnosing Oracle RAC Performance with Oracle Enterprise Manager



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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 thought 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

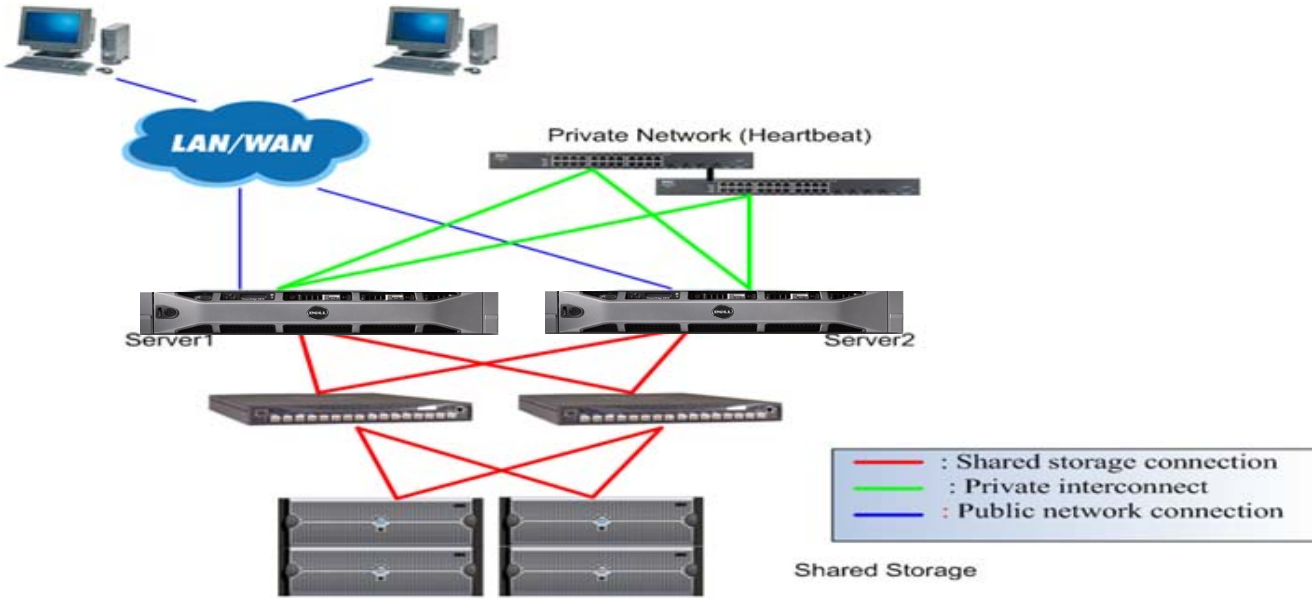
- Length of Video: 15 minutes
- Contents: 11g R2 RAC Database Performance Monitoring and Diagnosis using Oracle Enterprise Manager Grid Control 11g
  - Multiple Levels of RAC Performance Monitoring
    - Cluster Database, Database Instance, Cluster
    - Real time monitoring
    - Historical Performance 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

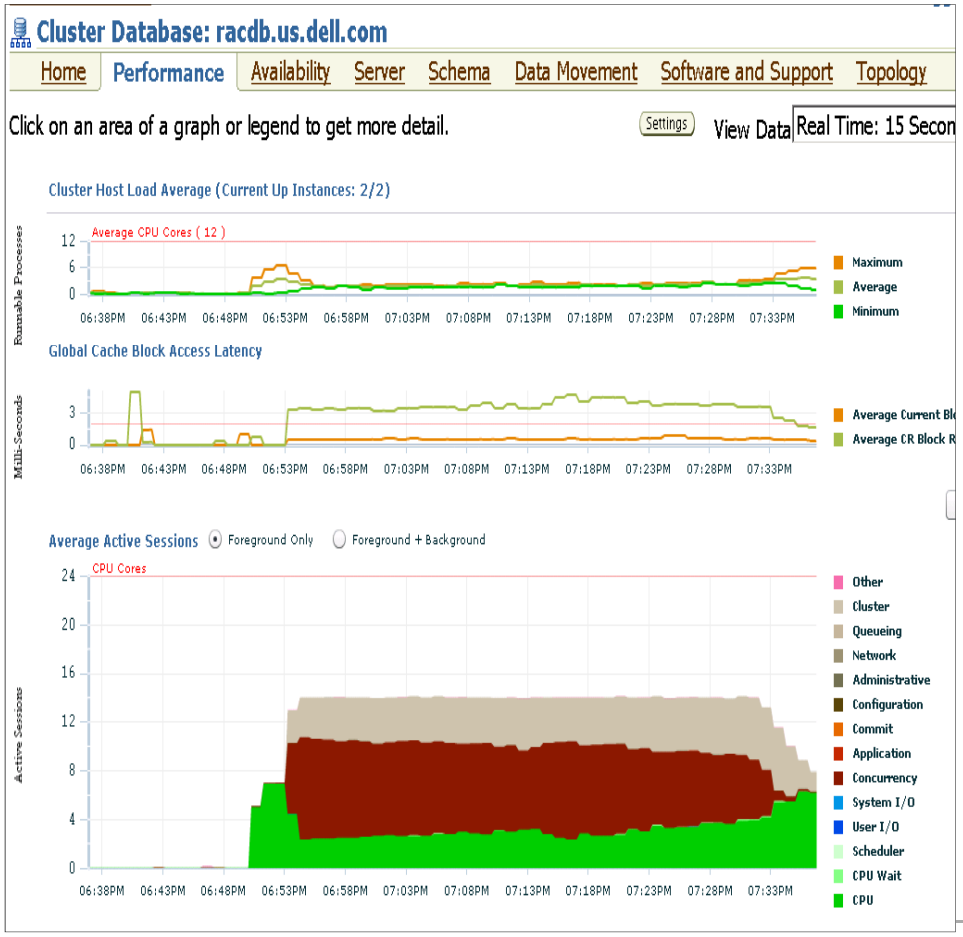


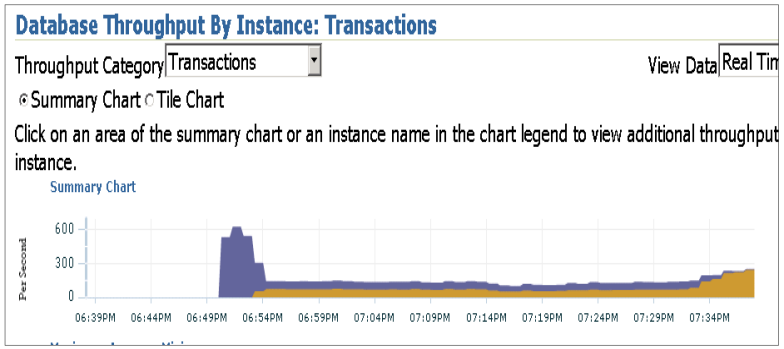
Examples of RAC Performance Monitoring & Diagnosis

- 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.

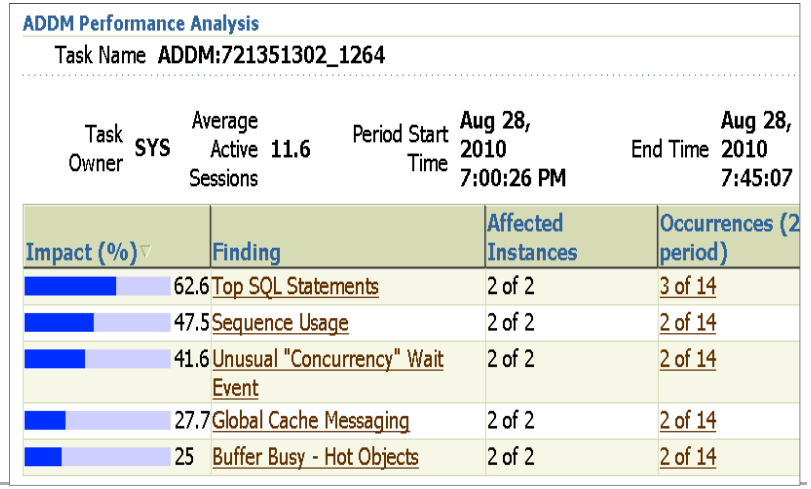
Examples of RAC Performance Monitoring & Diagnosis

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





ADDM findings:



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

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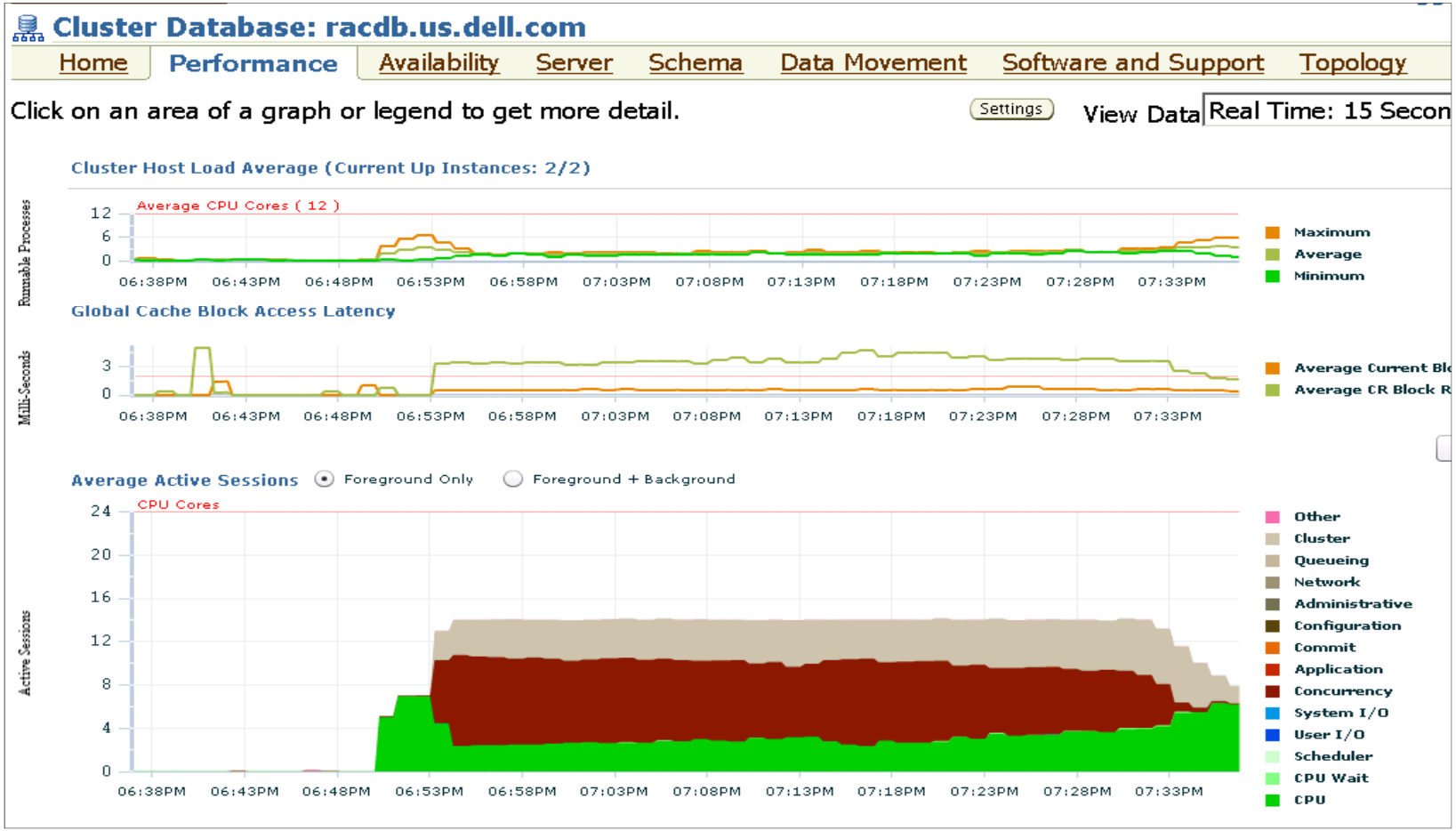
  Batch time: 64 minutes, average throughputs: 137 per sec



Examples of RAC Performance Monitoring & Diagnosis

- First Run: Real Time Performance:
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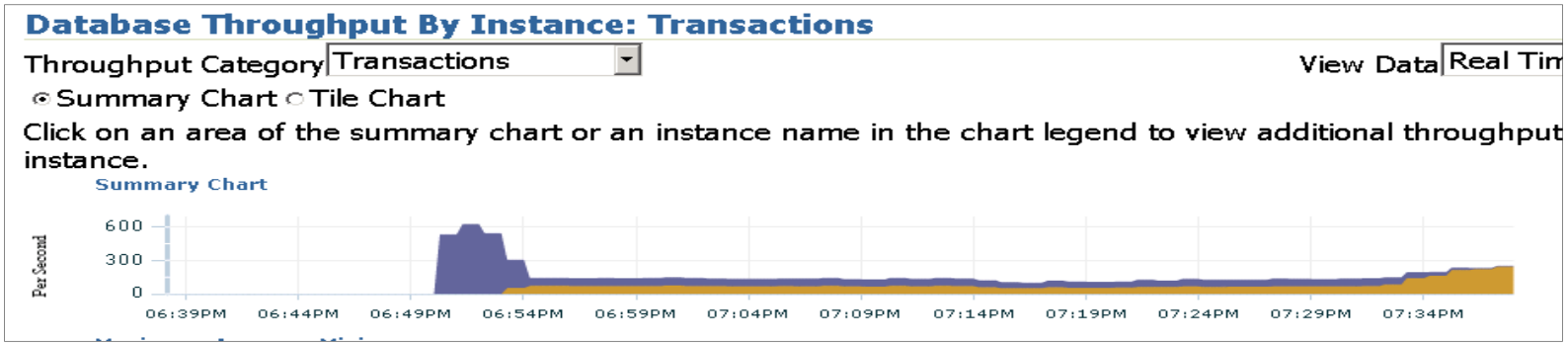

ADDM findings:

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
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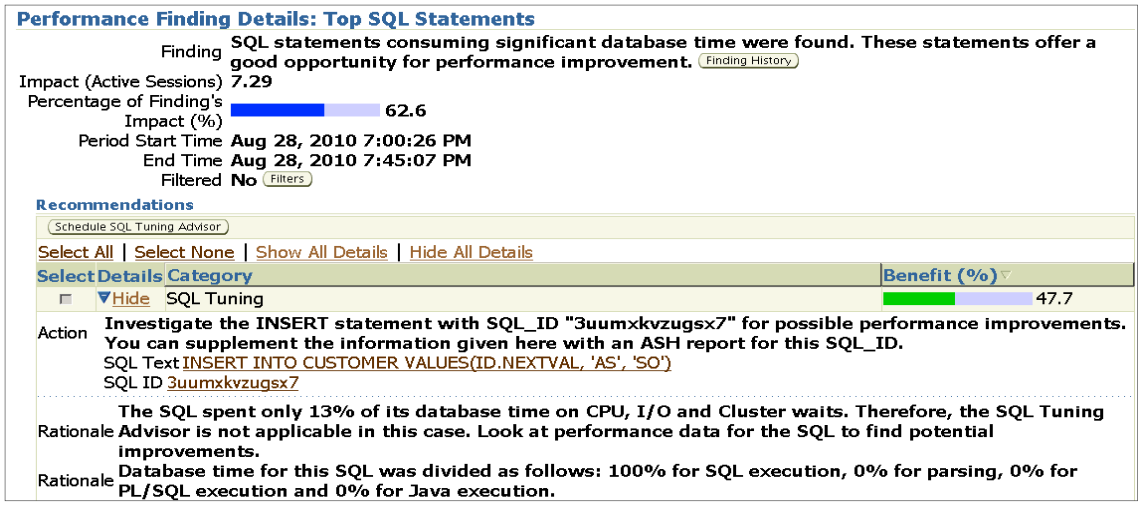
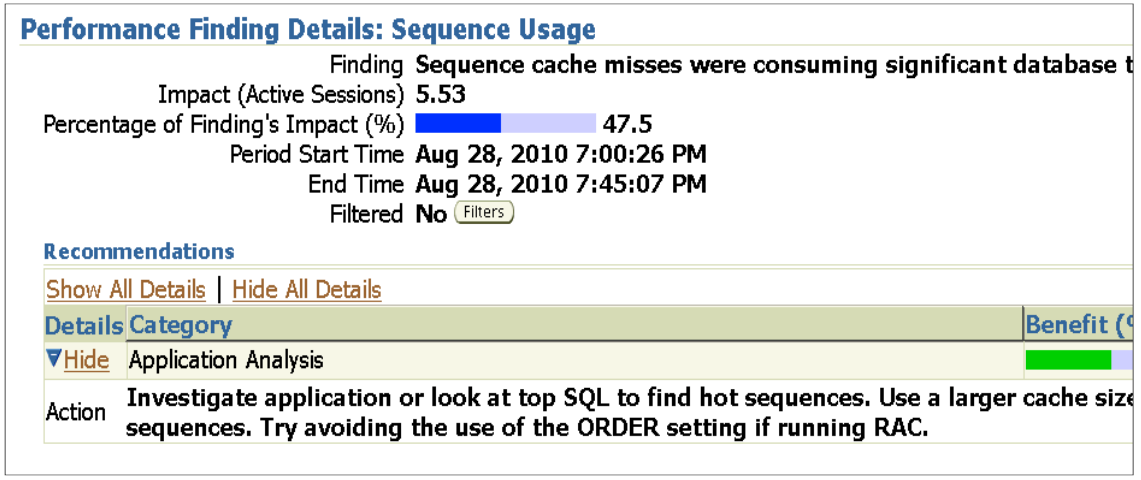
Examples of RAC Performance Monitoring & Diagnosis

ADDM Tuning Recommendations:

TOP SQL



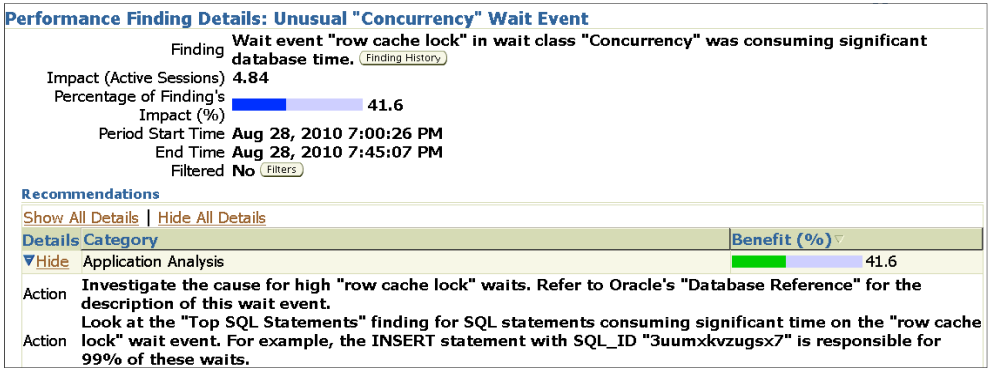
Use a large cache for the hot sequence



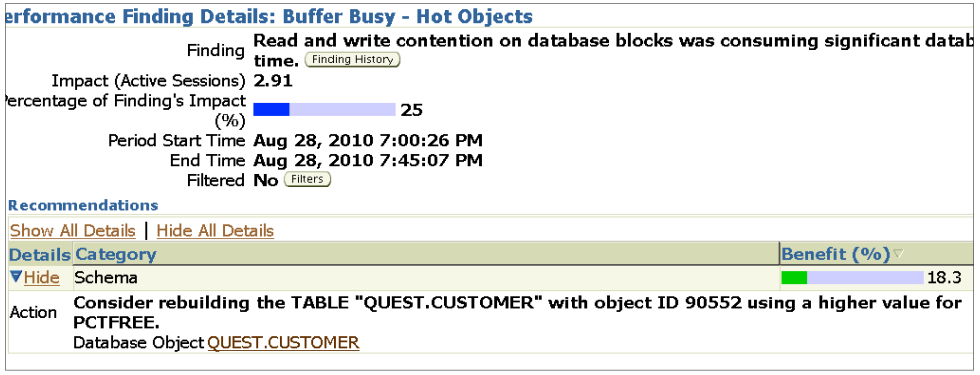
Examples of RAC Performance Monitoring & Diagnosis

ADDM Recommendations

Investigate
“row cache lock” wait



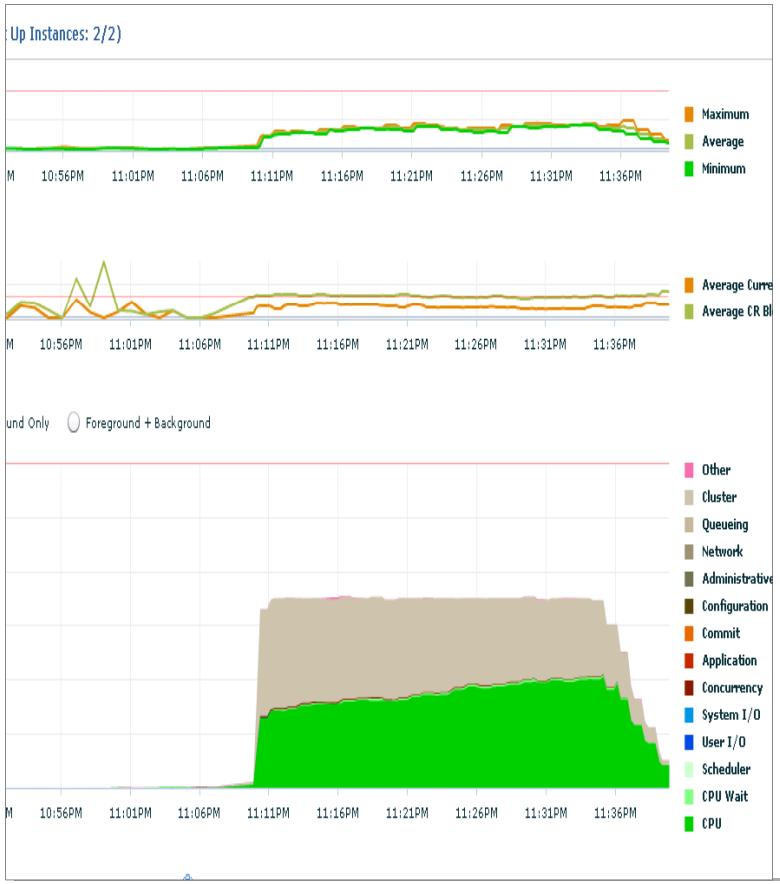
Use a higher value for
Pctfree Of customer table

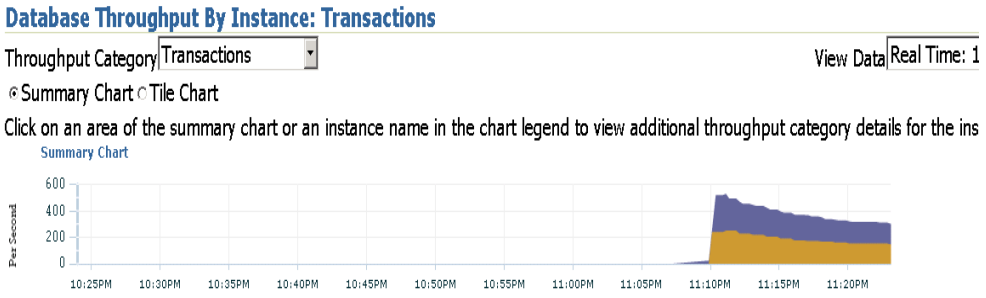


create sequence id start with 1 increment by 1 nomaxvalue cache 9000;
Rebuild table customer use higher PCTFREE value (20)

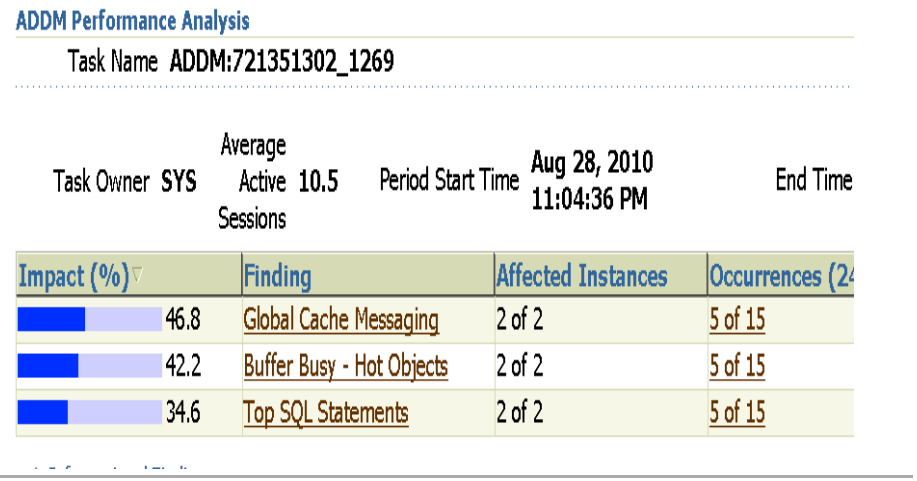
Examples of RAC Performance Monitoring & Diagnosis

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





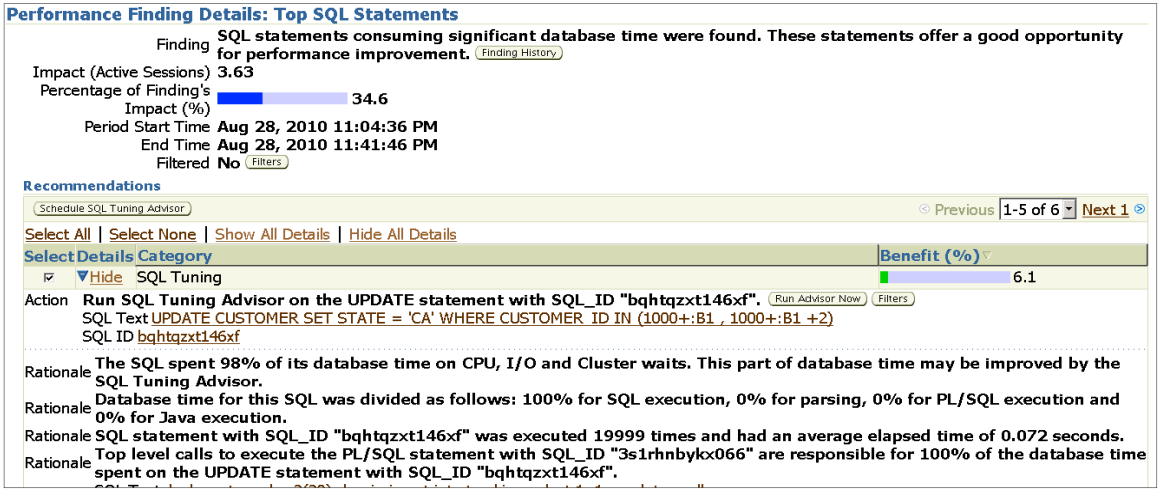
ADDM findings:



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): 3.63
Percentage of Finding's Impact (%): 34.6
Period Start Time: Aug 28, 2010 11:04:36 PM
End Time: Aug 28, 2010 11:41:46 PM
Filtered: No (Filters)

Recommendations

Schedule SQL Tuning Advisor | Previous 1-5 of 6 Next 1

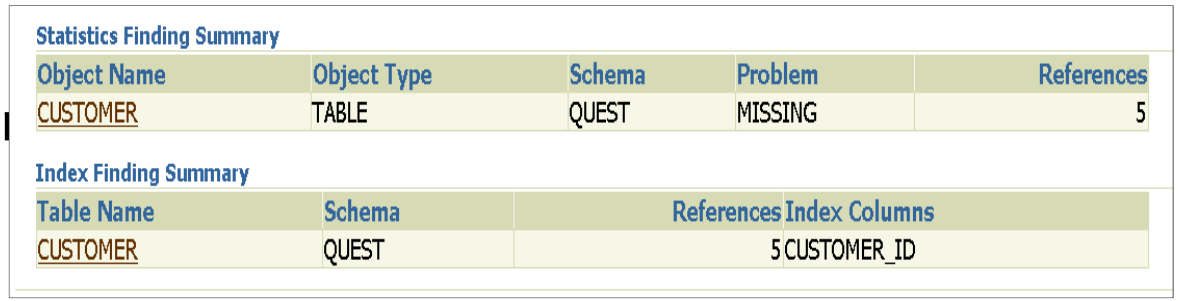
Select All | Select None | Show All Details | Hide All Details

Select	Details	Category	Benefit (%)
☑	Hide	SQL Tuning	6.1

Action: Run SQL Tuning Advisor on the UPDATE statement with SQL_ID "bqhtqzxt146xf". (Run Advisor Now) (Filters)
SQL Text: UPDATE CUSTOMER SET STATE = 'CA' WHERE CUSTOMER_ID IN (1000+:B1 , 1000+:B1 +2)
SQL ID: bqhtqzxt146xf

Rationale: The SQL spent 98% of its database time on CPU, I/O and Cluster waits. This part of database time may be improved by the SQL Tuning Advisor.
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.
Rationale: SQL statement with SQL_ID "bqhtqzxt146xf" was executed 19999 times and had an average elapsed time of 0.072 seconds.
Rationale: Top level calls to execute the PL/SQL statement with SQL_ID "3s1rhnbykx066" are responsible for 100% of the database time spent on the UPDATE statement with SQL_ID "bqhtqzxt146xf".

Run SQL advisor
Recommend
an index



Statistics Finding Summary

Object Name	Object Type	Schema	Problem	References
CUSTOMER	TABLE	QUEST	MISSING	5

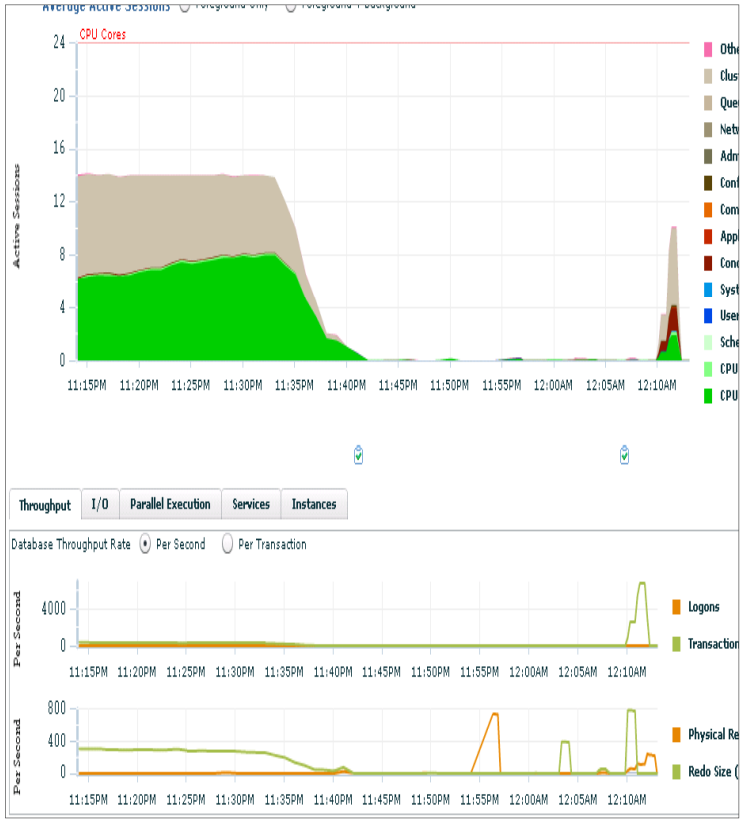
Index Finding Summary

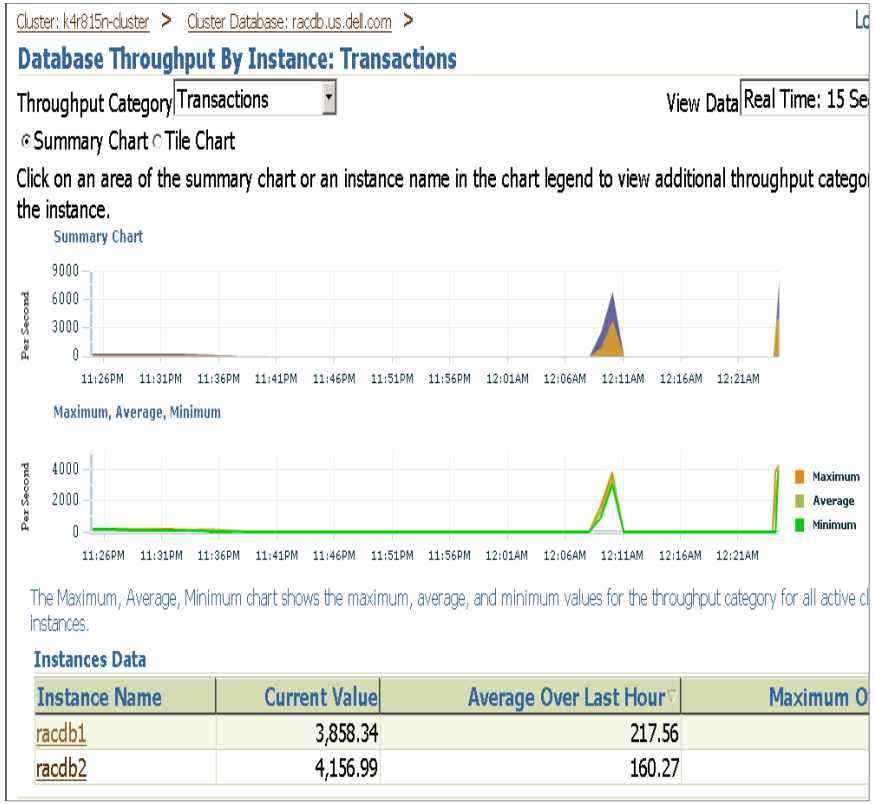
Table Name	Schema	References	Index Columns
CUSTOMER	QUEST	5	CUSTOMER_ID

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
  - TPCH test running two streams:
    - 1st Test: Use EM to diagnose bottleneck
    - 2nd Test: Final results

First Run: Partitioned table

Examples of RAC Performance Monitoring & Diagnosis

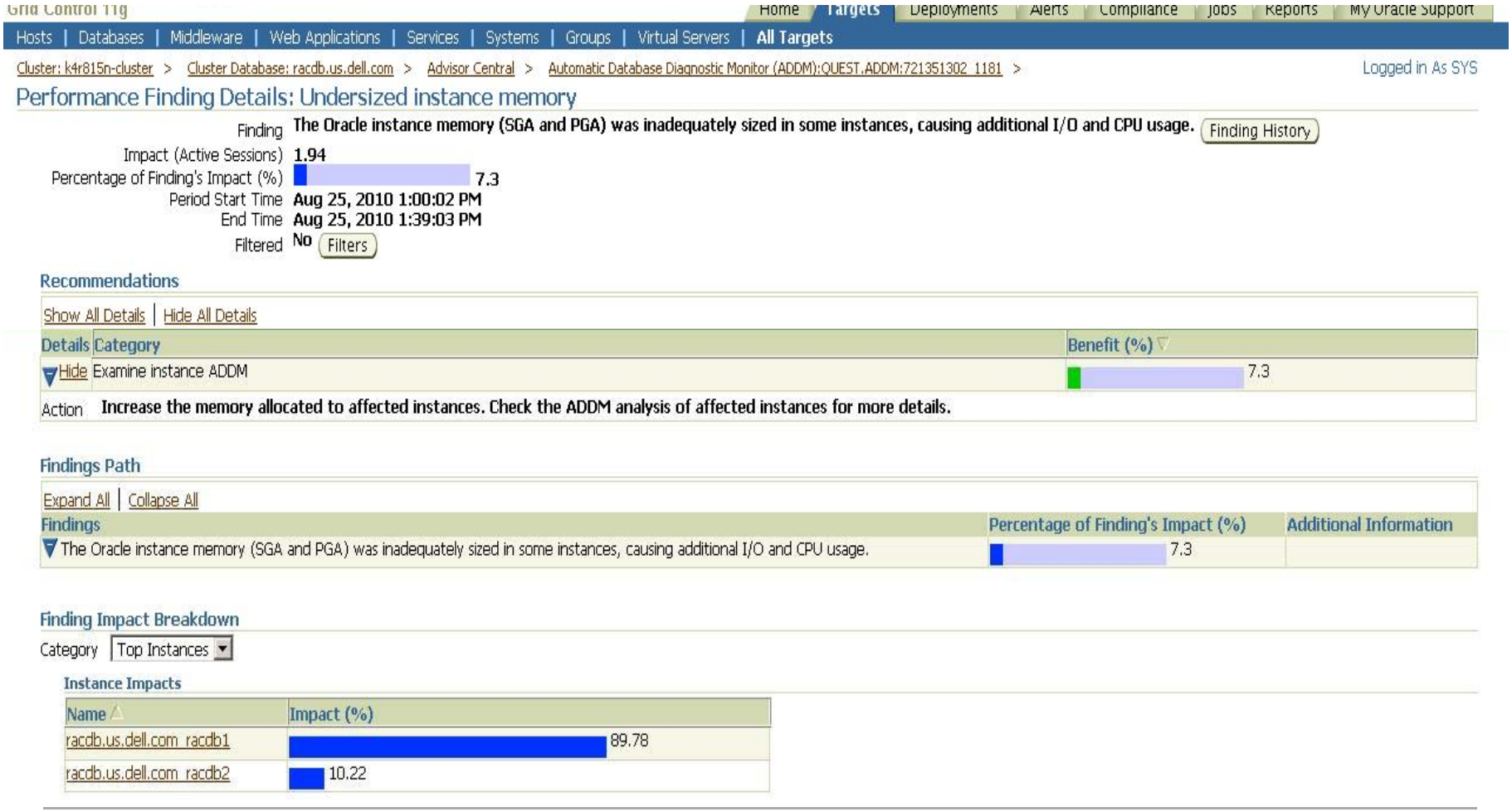
- Data warehouse performance analysis

Examples of RAC Performance Monitoring & Diagnosis

SQL monitoring and evaluation

Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM



Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM

Examples of RAC Performance Monitoring & Diagnosis

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

Query	1st Run (sec)	2nd 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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