Monitoring and Diagnosing Oracle RAC Performance with Oracle Enterprise Manager

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About Author

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  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:

**ADDM Performance Analysis**

<table>
<thead>
<tr>
<th>Task Owner</th>
<th>SYS</th>
<th>Average Active Sessions</th>
<th>Period Start Time</th>
<th>End Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>11.6</td>
<td>Aug 28, 2010 7:00:26 PM</td>
<td>Aug 28, 2010 7:45:07</td>
</tr>
</tbody>
</table>

- **Impact (%)**
  - 62.6% Top SQL Statements
  - 47.5% Sequence Usage
  - 41.6% Unusual "Concurrency" Wait Event
  - 27.7% Global Cache Messaging
  - 25% Buffer Busy - Hot Objects

- **Finding**
  - Affected Instances
  - Occurrences (2 period)
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

**Database Throughput By Instance: Transactions**

**ADDM findings:**

<table>
<thead>
<tr>
<th>Task Name</th>
<th>ADDM:721351302_1264</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Owner SYS</td>
<td></td>
</tr>
<tr>
<td>Average Active Sessions</td>
<td>11.6</td>
</tr>
<tr>
<td>Period Start Time</td>
<td>Aug 28, 2010 7:00:26 PM</td>
</tr>
<tr>
<td>End Time</td>
<td>Aug 28, 2010 7:45:07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact (%)</th>
<th>Finding</th>
<th>Affected Instances</th>
<th>Occurrences (2 period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>62.6</td>
<td>Top SQL Statements</td>
<td>2 of 2</td>
<td>3 of 14</td>
</tr>
<tr>
<td>47.5</td>
<td>Sequence Usage</td>
<td>2 of 2</td>
<td>2 of 14</td>
</tr>
<tr>
<td>41.6</td>
<td>Unusual &quot;Concurrency&quot; Wait Event</td>
<td>2 of 2</td>
<td>2 of 14</td>
</tr>
<tr>
<td>27.7</td>
<td>Global Cache Messaging</td>
<td>2 of 2</td>
<td>2 of 14</td>
</tr>
<tr>
<td>25</td>
<td>Buffer Busy - Hot Objects</td>
<td>2 of 2</td>
<td>2 of 14</td>
</tr>
</tbody>
</table>
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
Examples of RAC Performance Monitoring & Diagnosis

ADDM Tuning Recommendations:

**TOP SQL**

Run SQL advisor
Recommend an index

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)

<table>
<thead>
<tr>
<th>Instance#</th>
<th>1st Run</th>
<th>2nd Run</th>
<th>3rd Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>65</td>
<td>28</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instance#</th>
<th>1st Run</th>
<th>2nd Run</th>
<th>3rd Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>77</td>
<td>156</td>
<td>3856</td>
</tr>
<tr>
<td>1</td>
<td>60</td>
<td>146</td>
<td>4156</td>
</tr>
</tbody>
</table>

• 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

- Example 12 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

<table>
<thead>
<tr>
<th>Status</th>
<th>Duration</th>
<th>Instance ID</th>
<th>SQL ID</th>
<th>User</th>
<th>Parallel</th>
<th>Database Time</th>
<th>IO Requests</th>
<th>Start</th>
<th>Ended</th>
<th>SQL Text</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9.1m</td>
<td>1</td>
<td>QWPSK97ZUJK</td>
<td>QUEST</td>
<td>16</td>
<td>65.1m</td>
<td>36K</td>
<td>2:48:20 PM</td>
<td>4:00:20 PM</td>
<td>SELECT l_endtime, SUM(l_time_executed)</td>
</tr>
<tr>
<td></td>
<td>0.2m</td>
<td>1</td>
<td>FWC30161069</td>
<td>QUEST</td>
<td>24</td>
<td>0.6m</td>
<td>45K</td>
<td>2:48:10 PM</td>
<td>2:48:10 PM</td>
<td>SELECT l_endtime, SUM(l_time_executed)</td>
</tr>
<tr>
<td></td>
<td>1.8m</td>
<td>1</td>
<td>8U600865X392</td>
<td>SYSTEM</td>
<td>16</td>
<td>11m</td>
<td>3802</td>
<td>2:52:27 PM</td>
<td>2:54:01 PM</td>
<td>BEGIN DBMS_WORKLOAD_REPOSITIO</td>
</tr>
<tr>
<td></td>
<td>5.8m</td>
<td>1</td>
<td>2S5R390AHMY</td>
<td>QUEST</td>
<td>16</td>
<td>55.2m</td>
<td>36K</td>
<td>2:40:41 PM</td>
<td>2:48:16 PM</td>
<td>SELECT c_count, COUNT(*) AS count AS outlist F</td>
</tr>
<tr>
<td></td>
<td>5.7m</td>
<td>1</td>
<td>2S5R390AHMY</td>
<td>QUEST</td>
<td>16</td>
<td>54.8m</td>
<td>36K</td>
<td>2:40:34 PM</td>
<td>2:48:17 PM</td>
<td>SELECT c_count, COUNT(*) AS count AS outlist F</td>
</tr>
<tr>
<td></td>
<td>1.4m</td>
<td>1</td>
<td>8U600865X392</td>
<td>SYSTEM</td>
<td>16</td>
<td>13190</td>
<td>1320</td>
<td>2:43:09 PM</td>
<td>2:44:24 PM</td>
<td>BEGIN DBMS_WORKLOAD_REPOSITIO</td>
</tr>
<tr>
<td></td>
<td>16.6m</td>
<td>1</td>
<td>461032346925</td>
<td>QUEST</td>
<td>16</td>
<td>4:31m</td>
<td>31K</td>
<td>2:04:12 PM</td>
<td>2:40:40 PM</td>
<td>SELECT s_name, COUNT(*) nummulti FR</td>
</tr>
</tbody>
</table>
Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM

Performance Finding Details: Undersized instance memory

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

<table>
<thead>
<tr>
<th>Finding</th>
<th>Impact (Active Sessions)</th>
<th>Percentage of Finding's Impact (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.94</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Period Start Time: Aug 25, 2010 1:00:02 PM
Period End Time: Aug 25, 2010 1:39:03 PM

Recommendations

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

Findings Path

Expand All | Collapse All

Findings

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

<table>
<thead>
<tr>
<th>Finding Impact Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category: Top Instances</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Impact (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>racdb.us.dell.com</td>
<td>69.78</td>
</tr>
<tr>
<td>racdb1</td>
<td>10.22</td>
</tr>
</tbody>
</table>
Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM

Performance Finding Details: Undersized PGA

The PGA was inadequately sized in some instances, causing additional I/O to temporary tablespaces to consume significant database time.

<table>
<thead>
<tr>
<th>Finding Details</th>
<th>Percentage of Finding's Impact (%)</th>
<th>Period Duration (minutes)</th>
<th>Period Start Time</th>
<th>Impact (Active Sessions)</th>
<th>Finding History</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9.5</td>
<td></td>
<td>Sep 1, 2010 7:26:59 AM EDT</td>
<td>11.5</td>
<td></td>
</tr>
</tbody>
</table>

Recommendations

- **Show All Details**
- **Hide All Details**

Details Category

- **Hide Examine instance ADDM**
- **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 Breakdown

<table>
<thead>
<tr>
<th>Instance Impacts</th>
<th>Name/A</th>
<th>Impact (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>owi.kaigrid.dblab.com_ow1</td>
<td>33.67</td>
</tr>
<tr>
<td></td>
<td>owi.kaigrid.dblab.com_ow2</td>
<td>68.43</td>
</tr>
</tbody>
</table>

Logged in As SYSTEM
Examples of RAC Performance Monitoring & Diagnosis

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

<table>
<thead>
<tr>
<th>Query</th>
<th>1st Run (sec)</th>
<th>2nd Run (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction # 1</td>
<td>327.27</td>
<td>314.91</td>
</tr>
<tr>
<td>Transaction # 2</td>
<td>1005.14</td>
<td>927.97</td>
</tr>
<tr>
<td>Transaction # 3</td>
<td>23.64</td>
<td>17.52</td>
</tr>
</tbody>
</table>

• Real Time monitoring of transactions
• Deep dive diagnostics of the application environment
• Quick identification and location of problems
To learn more about how Dell can help you drive an Efficient Enterprise visit:

- Dell’s onsite TSR for a free quote
- Michael Dell’s keynote on Wednesday at 8 a.m.
- One of Dell’s 20 conference sessions
- [www.dell.com/oracle](http://www.dell.com/oracle)