Monitoring and Diagnosing Oracle RAC Performance with Oracle Enterprise Manager

Kai Yu, Orlando Gallegos
Dell Oracle Solutions Engineering

Oracle OpenWorld 2010, Session S316263
3:00-4:00pm, Thursday 23-Sep-2010
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 to determine bottlenecks occurring on the cluster and implement changes to improve performance.

• Test Environment configuration
  – Server: Two Dell PE R815 servers
  – 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
- Example 1
  - 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:

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Average Active Sessions</th>
<th>Period Start Time</th>
<th>End Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDM:721351302_1264</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>

- 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
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 Performance Analysis**

<table>
<thead>
<tr>
<th>Task Owner</th>
<th>Average Active Sessions</th>
<th>Period Start Time</th>
<th>End Time</th>
<th>Impact (%)</th>
<th>Finding</th>
<th>Affected Instances</th>
<th>Occurrences (2 period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS</td>
<td>11.6</td>
<td>Aug 28, 2010 7:00:26 PM</td>
<td>Aug 28, 2010 7:45:07</td>
<td>62.6</td>
<td>Top SQL Statements</td>
<td>2 of 2</td>
<td>3 of 14</td>
</tr>
<tr>
<td>SYS</td>
<td></td>
<td></td>
<td></td>
<td>47.5</td>
<td>Sequence Usage</td>
<td>2 of 2</td>
<td>2 of 14</td>
</tr>
<tr>
<td>SYS</td>
<td></td>
<td></td>
<td></td>
<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>SYS</td>
<td></td>
<td></td>
<td></td>
<td>27.7</td>
<td>Global Cache Messaging</td>
<td>2 of 2</td>
<td>2 of 14</td>
</tr>
<tr>
<td>SYS</td>
<td></td>
<td></td>
<td></td>
<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

### ADDM findings:

**ADDM Performance Analysis**

- **Task Name**: ADDM:721351302_1269
- **Task Owner**: SYS
- **Average**: Active Sessions 10.5
- **Period Start Time**: Aug 28, 2010 11:04:36 PM
- **End Time**:

<table>
<thead>
<tr>
<th>Impact (%)</th>
<th>Finding</th>
<th>Affected Instances</th>
<th>Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>46.8</td>
<td>Global Cache Messaging</td>
<td>2 of 2</td>
<td>5 of 15</td>
</tr>
<tr>
<td>42.2</td>
<td>Buffer Busy - Hot Objects</td>
<td>2 of 2</td>
<td>5 of 15</td>
</tr>
<tr>
<td>34.6</td>
<td>Top SQL Statements</td>
<td>2 of 2</td>
<td>5 of 15</td>
</tr>
</tbody>
</table>
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 to improve the performance significantly
  - SQL and database objects tuning can reduce cluster wait time and CPU time.
Examples of RAC Performance Monitoring & Diagnosis

- Example 1: 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>4tpsfi97zuik</td>
<td>QUEST</td>
<td>16</td>
<td>65.1m</td>
<td>36K</td>
<td>2:45:20 PM</td>
<td>2:45:20 PM</td>
<td>SELECT l_enddev, SUM(l_extend_delete)</td>
</tr>
<tr>
<td></td>
<td>9.2m</td>
<td>1</td>
<td>1fwece3Gimbaum</td>
<td>QUEST</td>
<td>16</td>
<td>1.6k</td>
<td>45K</td>
<td>2:48:19 PM</td>
<td>2:48:19 PM</td>
<td>SELECT l_enddev, SUM(l_extend_delete)</td>
</tr>
<tr>
<td></td>
<td>1.6m</td>
<td>1</td>
<td>8u6086xk3rpod</td>
<td>SYSTEM</td>
<td>16</td>
<td>1.1m</td>
<td>2002</td>
<td>2:52:27 PM</td>
<td>2:54:01 PM</td>
<td>begin DBMS_WORKLOAD_REPOSITIO</td>
</tr>
<tr>
<td></td>
<td>5.6m</td>
<td>1</td>
<td>2skr5p9ahmy1</td>
<td>QUEST</td>
<td>16</td>
<td>55.2m</td>
<td>36K</td>
<td>2:40:41 PM</td>
<td>2:40:41 PM</td>
<td>SELECT c_count, count(*) as c_count FROM F</td>
</tr>
<tr>
<td></td>
<td>5.7m</td>
<td>1</td>
<td>2skr5p9ahmy1</td>
<td>QUEST</td>
<td>16</td>
<td>54.8m</td>
<td>30K</td>
<td>2:40:34 PM</td>
<td>2:40:34 PM</td>
<td>SELECT c_count, count(*) as c_count FROM F</td>
</tr>
<tr>
<td></td>
<td>1.3m</td>
<td>1</td>
<td>8u6086xk3rpod</td>
<td>SYSTEM</td>
<td>16</td>
<td>1.1m</td>
<td>1299</td>
<td>2:49:09 PM</td>
<td>2:49:24 PM</td>
<td>begin DBMS_WORKLOAD_REPOSITIO</td>
</tr>
<tr>
<td></td>
<td>36.6m</td>
<td>1</td>
<td>46s0g83qgul18f</td>
<td>QUEST</td>
<td>16</td>
<td>4.3m</td>
<td>91K</td>
<td>2:04:12 PM</td>
<td>2:40:40 PM</td>
<td>SELECT g_name, count(*) as g_name FROM F</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.

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.

Finding Impact Breakdown

Category | Top Instances

Instance Impacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Impact (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>racdb.us.dell.com.racdb1</td>
<td>89.78</td>
</tr>
<tr>
<td>racdb.us.dell.com.racdb2</td>
<td>10.22</td>
</tr>
</tbody>
</table>
Examples of RAC Performance Monitoring & Diagnosis

Performance Tuning Recommendation by ADDM

Finding Details: Undersized PGA

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

Recommendations

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

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

Finding Impact Breakdown

Category | Top Instances

Instance Impacts

Name | Impact (%)
--- | ---
raw_kagrid_dblelab.com_ow1 | 33.57
raw_kagrid_dblelab.com_ow2 | 86.43
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
Thank You and QA
Visit Kai Yu’s Oracle Blog at http://kyuoracleblog.wordpress.com/