Optimize Oracle Business Intelligence Analytics with Oracle 12c In-Memory Database option

Prepared by:
Kai Yu  🎯  ORACLE®
ACE Director
Senior Principal Architect,
Dell Oracle Solutions Engineering

@ky_austin
About Author

Kai Yu, Senior Principal Architect, Dell Database Engineering

- 20 years Oracle DBA/Apps DBAS and Solutions Engineering
- Specializing in Oracle RAC, Oracle VM and Oracle EBS
- Oracle ACE Director, Oracle papers author/presenter
- 2011 OAUG Innovator of Year, 2012 Oracle Excellence Award: Technologist of the Year: Cloud Architect by Oracle Magazine
- Co-author Apress Book “Expert Oracle RAC 12c”
My Work: Dell Integrated Systems for Oracle Business Analytics

- Ready Infrastructure Solution

Diagram:
- (1 x S60) 1GbE Switch (Management)
- Management Server (R320)
- OBIEE Server (R730)
- Top of Rack (2 x S6000) 40GbE Switches (Public & Private)
- Oracle Database 12c (2 x R920)
- 2 x Brocade 6510 16Gbps Fibre Channel SAN Switches
- Active/Active DAAD-HA
- 2 x Brocade 6510 16Gbps FC Switches
- 2 x Dell Acceleration Appliances for Databases (HA)
- Database Server (R920)
- OBIEE Server (R730)
- Management Server (R320)
- KMM
- Database Server (R920)
- 2 x S6000 40GbE TOR Switches (Public & Private)
- 1 x S60 Management Switch
- 1 x S60 Management Switch
- 1 x S60 Management Switch

Dell Integrated Systems for Oracle Business Analytics - Ready Infrastructure Solution
Agenda

- Oracle 12c Database In-Memory Option
- Oracle Business Intelligence Enterprise Edition 11g
- Oracle Exalytics In-Memory vs 12c In-Memory Database
- Oracle OBIEE with Oracle 12c In-Memory Database
- Questions
Oracle 12c In-Memory Option

This is a subtitle or bulleted list
Oracle 12c In Memory Option

Oracle 12c Database Introduced Database In-Memory option:
- Accelerates analytics by orders of magnitude.
- Speeding up mixed-workload OLTP.
- Transparent to applications.

Dual-Format of Architecture in Oracle 12
- Oracle traditional row based:
  - Row format data stored in storage
  - Row format data stored in buffer cache in SGA
  - Good for OLTP (insert/update/delete) operations
- Oracle 12c introduced In-memory option
  - Introduced with Oracle 12.1.0.2
  - Column format In-Memory column storage in SGA
  - A New component of Oracle Database SGA.
  - Coexist with database buffer cache (row format)
  - Good for OLAP applications
Oracle 12c In-Memory Option

- The Dual Format Architecture can be illustrated as

- The In-Memory Column Store:
  - A new component called In-Memory Area in SGA

    SQL> alter system set inmemory_size = 100G scope=spfile;

    SQL> startup
    ORACLE instance started.
    Total System Global Area 2.6521E+11 bytes
    Fixed Size                7662672 bytes
    Variable Size             2.7380E+10 bytes
    Database Buffers          1.2992E+11 bytes
    Redo Buffers              529207296 bytes
    In-Memory Area            1.0737E+11 bytes
    Database mounted.
    Database opened.

    Alter SYSTEM SET INMEMORY_QUERY=DISABLE
    Alter SYSTEM SET INMEMORY_QUERY=ENABLE
Oracle 12c In-Memory Option

- Select contents to populate the In-Memory column store:
  - Tablespace level: alter tablespace data MEMORY;
  - Table level: alter table sales INMEMORY PRIORITY CRITICAL;
    alter table sales INMEMORY NO INMEMORY(prod_id)
- background process to populate in-memory store:

  ```
  oracle 14737 1 0 14:30 ? 00:00:17 ora_w004_pocdb1
  oracle 14759 1 0 14:30 ? 00:00:15 ora_w005_pocdb1
  oracle 14763 1 0 14:30 ? 00:00:12 ora_w006_pocdb1
  oracle 14765 1 0 14:30 ? 00:00:12 ora_w007_pocdb1
  oracle 17515 1 0 14:38 ? 00:00:06 ora_w008_pocdb1
  oracle 19344 1 0 14:43 ? 00:00:06 ora_w009_pocdb1
  oracle 19346 1 0 14:44 ? 00:00:00 ora_w00a_pocdb1
  oracle 112632 1 0 13:26 ? 00:00:22 ora_w000_pocdb1
  oracle 112634 1 0 13:26 ? 00:00:22 ora_w001_pocdb1
  ```

- Features to accelerate query execution: In-Memory Scan, In-Memory Storage Index, SIMD Vector Processing, In-Memory Joins, In Memory Aggregation
- In Memory Option: Application transparent, no need to modify application.
- How to determine if In-Memory option takes effect. Look the INMEMORY key work in query plan such as:

```
PLAN_TABLE_OUTPUT
<table>
<thead>
<tr>
<th>TABLE ACCESS INMEMORY FULL</th>
<th>EDAPIHDR_BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARTITION LIST JOIN-FILTER</td>
<td>EDAPILIN_BASE</td>
</tr>
<tr>
<td>TABLE ACCESS INMEMORY FULL</td>
<td>EDAPIQ_BASE</td>
</tr>
</tbody>
</table>
```
Oracle Business Intelligence
Enterprise edition 11g

This is a subtitle or bulleted list
Oracle Business Intelligence Enterprise edition 11g

- Oracle OBIEE: Business intelligence and Analytics Platform and common infrastructure for reports, scorecards, dashboards, ad-hoc analysis, OLAP analysis
  - OBIEE 11g Interactive Dashboards solution for Interactive Dashboards
  - Ad hoc Analysis and Interactive Reporting
  - Oracle BI Mobile for Mobile Analytics
  - Oracle Business Intelligence Publisher for Enterprise Reporting.

[Image of Oracle Business Intelligence dashboard]
Oracle Exalytics In-Memory vs 12c In-Memory Database
Oracle Exalytics In-Memory Machine

Oracle Engineered System for Extreme Analytics: Delivers extreme in-memory analytics performance, two main components together

- Optimized Oracle Business Intelligence Foundation Suite
- Oracle TimesTen In-Memory Database for Exalytics

Oracle Exalytics In-Memory Machine features

- Single X86-64 server: 4 X Intel Xenon E7-4800 processors, 2 TB RAM, 2 QDR 40Gb/s Infiniband Ports, 2X 10Gbps Ethernet ports, 6 X 400G Flash PCI-e
- Oracle Business Intelligence Foundation Suite including Oracle Essbase
- Oracle TimesTen In-Memory Database for Exalytics
- Exalytics In-Memory Software

Difference between TimesTen In-Memory Database vs Oracle 12c In-Memory

- TimesTen In-Memory Database for Exalytics is a full memory database designed to run Analytics.
- TimesTen In-Memory Database runs on the same server as OBIEE
- Tightly connected between BI and TimesTen In-Memory Database
- Oracle 12c In-Memory is a feature added to Oracle Database
- Oracle 12c In-Memory works for both OLAP and OLTP mixed workload
Oracle OBIEE with Oracle 12c In-Memory Database
Oracle OBIEE with Oracle 12c In-Memory Database

- **Oracle BI server Architecture**
  - Oracle BI server connects to Oracle Database through ODBC/JDBC
  - Oracle BI present a logic schema view independent of physical database
  - BI server translates the logic SQL to physical SQL
  - Oracle BI Administration tools shows the three layers: Presentation, Business Model and Mapping, Physical
POC: Accelerates BI with Oracle 12c In-Memory

- Basic Idea:
  - On physical level BI reports usually involve a large full table scan and complex join operation.
  - Full table scan operation is very expensive in large storage IO operation.
  - Load the partially or the entire table to In-Memory store to reduce the storage IO for the full table scan.

- How to identify the tables to load into In Memory store: in manual way
  - Start with the slow report and find the presentation layer the report reads
  - Through the mapping from presentation layer to the physical layer to identify the physical SQL for the report
  - Through the physical SQL to identify the underneath full table scan operation.
  . The rest presentation use the EDI Queue report as an example to use the process.
An Example: Accelerate BI Report with Oracle 12c

- Identify Physical SQL layer for the report:
  - From the Dashboard report definition to identify the presentation layer Fact EDI Queue.
  - Through the presentation layer to find the Business Model and mapping on Fact EDI Queue and identify the physical database view: FACT_EDI_QUEUE_V as shown below:
An Example: Accelerate BI Reports with Oracle 12c

- Review the definition of the physical View:
  - View name: FACT_EDI_QUEUE_V and found underneath physical tables
  - Identified four large tables:
    EDAPIHDR_BASE, EDAPIQ_BASE, EDAPIQ_BASE
    VEN_LOC_BASE

- Populate In-Memory Column store with these four tables:
  - SQL:
    - `alter table APD_BASE.EDAPILIN_BASE inmemory priority high;`
    - `alter table APD_BASE.EDAPIQ_BASE inmemory priority high;`
    - `alter table APD_BASE.EDAPIHDR_BASE inmemory priority high;`
    - `alter table APD_BASE.VEN_LOC_BASE inmemory priority high;`

- Check size of the segments in the In-Memory
  - SQL:
    - `select SEGMENT_NAME, INMEMORY_SIZE from v$im_segments;`
    - SEGMENT_NAME     INMEMORY_SIZE
      VEN_LOC_BASE       1279648
      EDAPIQ_BASE       291168512
      EDAPIHDR_BASE     961496576
      VEN_LOC_BASE       1279648
      EDAPILIN_BASE     930710528
      VEN_LOC_BASE       1279648
An Example: Accelerates BI Reports with Oracle 12c

- Compare the Query plans on: FACT_EDI_QUEUE_V

<table>
<thead>
<tr>
<th>Not In-Memory</th>
<th>In-Memory</th>
</tr>
</thead>
</table>

```sql
SQL> explain plan for select count(*) from APD_STAR.FACT_EDI_QUEUE_V;
Explain plan.

SQL> select plan_table_output
2  from table(dbms_xplan.display('plan_table',null,'basic'));
PLAN_TABLE_OUTPUT

Plan hash value: 1571279316

<table>
<thead>
<tr>
<th>id</th>
<th>Operation</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SELECT STATEMENT</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SORT AGGREGATE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>PART JOIN Filter create</td>
<td>BF0000</td>
</tr>
<tr>
<td>4</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TABLE ACCESS FULL</td>
<td>DIM_PERIOD</td>
</tr>
</tbody>
</table>

PLAN_TABLE_OUTPUT

6  | HASH JOIN           | DIM_REGION_CCN |
7  | TABLE ACCESS FULL   |                |
8  | HASH JOIN           |                |
9  | PART JOIN Filter create | BF0001 |
10 | HASH JOIN           |                |
11 | PART JOIN Filter create | BF0002 |
12 | HASH JOIN           |                |
13 | TABLE ACCESS FULL   | DIM_VENDOR     |
14 | PARTITION LIST ALL  |                |
15 | TABLE ACCESS FULL   | VEN_LOC_BASE   |
16 | PARTITION LIST JOIN-FILTER | |

PLAN_TABLE_OUTPUT

17 | TABLE ACCESS INMEMORY FULL | EDAPIHDR_BASE |
18 | PARTITION LIST JOIN-FILTER |                |
19 | TABLE ACCESS INMEMORY FULL | EDAPILIN_BASE |
20 | PARTITION LIST JOIN-FILTER |                |
21 | TABLE ACCESS INMEMORY FULL | EDAPTQ_BASE   |
```
An Example: Accelerate BI Reports with Oracle 12c

- Compare the Query plans on FACT_EDI_QUEUE_V

Not In-Memory

In-Memory

```sql
SQL> explain plan for select count(*) from APD_STAR.FACT_EDI_QUEUE_V;
Explained.

SQL> select plan_table.output
2   from table(dbms_xplan.display('plan_table',null,'basic'));

PLAN_TABLE_OUTPUT

plan hash value: 1571279316

<table>
<thead>
<tr>
<th>id</th>
<th>Operation</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SELECT STATEMENT</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SORT AGGREGATE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>PART JOIN FILTER CREATE</td>
<td>:BF0000</td>
</tr>
<tr>
<td>4</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TABLE ACCESS FULL</td>
<td>DIM_PERIOD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>id</th>
<th>Operation</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>TABLE ACCESS FULL</td>
<td>DIM_REGION_CCN</td>
</tr>
<tr>
<td>8</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>PART JOIN FILTER CREATE</td>
<td>:BF0001</td>
</tr>
<tr>
<td>10</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>PART JOIN FILTER CREATE</td>
<td>:BF0002</td>
</tr>
<tr>
<td>12</td>
<td>HASH JOIN</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>PARTITION LIST ALL</td>
<td>DIM_VENDOR</td>
</tr>
<tr>
<td>14</td>
<td>TABLE ACCESS FULL</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>PARTITION LIST JOIN-FILTER</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>id</th>
<th>Operation</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>TABLE ACCESS FULL</td>
<td>EDAPIHDR_BASE</td>
</tr>
<tr>
<td>18</td>
<td>PARTITION LIST JOIN-FILTER</td>
<td>EDAPIHDR_BASE</td>
</tr>
<tr>
<td>19</td>
<td>TABLE ACCESS FULL</td>
<td>EDAPILIN_BASE</td>
</tr>
<tr>
<td>20</td>
<td>PARTITION LIST JOIN-FILTER</td>
<td>EDAPILQ_BASE</td>
</tr>
<tr>
<td>21</td>
<td>TABLE ACCESS INMEMORY FULL</td>
<td></td>
</tr>
</tbody>
</table>
```
An Example: Accelerate BI Reports with Oracle 12c

- Compare the Query plans execution time on FACT_EDI_QUEUE_V
  
  **Not In–Memory**

  ```sql
  SQL> set timing on
  SQL> set time on
  12:35:36 SQL> select count(*) from APD_STAR.FACT_EDI_QUEUE_V;
  
  COUNT(*)  
  --------  
  51638519
  Elapsed: 00:04:02.80
  ```

  **In–Memory**

  ```sql
  14:51:55 SQL> select count(*) from APD_STAR.FACT_EDI_QUEUE_V;
  
  COUNT(*)  
  --------  
  51638519
  Elapsed: 00:02:15.11
  ```

- Compare the Dashboard report execution:
  
  Not In–Memory: 9 minutes 31 seconds
  In-Memory: 7 minutes 50 seconds
Leverage In-Memory Advisor

- Oracle In-Memory Advisor
  - Help to answer the questions: Why of your tables and/or partitions should you mark for In-Memory column store
  - An Oracle new feature, licensed as part of the Database Tuning pack
  - MOS note: 1965343.1 Oracle In-Memory Advisor

- Two whitepapers: Oracle Database In-Memory Advisor and Oracle Database In-Memory Advisor Best practices published in February 2015

The In-Memory Advisor estimates analytic processing performance improvement factors based upon the following:

- Eliminating user I/O waits, cluster transfer waits, buffer cache latch waits,
- Certain query processing advantages related to specific compression types.
- Decompression cost heuristics per specific compression types.
- SQL plan selectivity, number of columns in the result set, etc.

- Process:
  - Download
  - Through the mapping from presentation layer to the physical layer to identify the physical SQL for the report
  - Through the physical SQL to identify the underneath full table scan operation.
Leverage In-Memory Advisor

- Download and Install In-Memory Advisor
  - Download `imadvisor.zip` from Oracle, copy to DB server and unzip it
    - Installed in SQLPLUS with `sysdba` privilege
    - `SQL> @instimadv.sql`
    - Do you currently have a valid Oracle Tuning Pack license with this database (Y/N)?
    - Create a new user called IMADVISOR
    - Need to provide the connection string (from TNSNAME entry)
    - Need to specify the users that will use this tool for tuning:
      - Please enter a comma separated list of Oracle Database users to whom you wish EXECUTE on the DBMS_INMEMORY_ADVISOR package to be GRANTed? such as APD_STAR user
      - You can GRANT EXECUTE ON DBMS_INMEMORY_ADVISOR to additional users as needed.
Leverage In-Memory Advisor

- Running In-Memory Advisor
  - Run script `imadvisor_analyze_and_report.sql` as a user with the privilege to execute the DBMS_INMEMORY_ADVISOR package:
    ```sql
    SQL> @imadvisor_analyze_and_report
    ```
  - Specify the IM task name
  - The IM Advisor generates a report as `imadvisor_<taskname>.html` file in the current working directory
  - The sql file is generated as `imadvisor_sql_<taskname>.sql`
  - Enter value for `im_task_name`: `test`
  - IM Task name Specified: `test`
  - Enter begin time for report: ...
  - Enter value for `begin_time`: `-1:30`
  - Report begin time specified: `-1:30`

  - Enter duration in minutes starting from begin time:
    - Defaults to SYSDATE - begin_time
    - Enter value for duration: `60`
    - Report duration specified: `60`

  Using 2015-MAR-13 09:33:13.000000000 as report begin time
  Using 2015-MAR-13 10:33:13.000000000 as report end time

  IM Advisor: Adding Statistics..
Leverage In-Memory Advisor

Output of In-Memory Advisor

- imadvisor_taskname.html
  - summary of the Total Database Time analyzed
  - percentage for Database Time for Analytics Processing
  - In-Memory sizes vs the estimated benefit
  - Recommending the top objects to place in memory
  - And compression type and estimated benefit

- imadvisor_taskname.sql
  A script file that contains the SQL which can be run on the target to modify the objects recommended to be placed In-Memory
  You can modify the SQL DDLs to fine tune
Acknowledgement:

I would like to thank Rodrigo Radtke for his great help on Oracle OBIEE and dashboard applications.
Please complete the session evaluation

We appreciate your feedback and insight

You may complete the session evaluation either on paper or online via the mobile app