Using the TimesTen In-Memory Database for Real-time Business Intelligence

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Keywords:

Oracle, TimesTen, In-Memory Database, Real-time, Business Intelligence, Exalytics

Introduction

In-memory processing technologies, and particularly various kinds of in-memory database, are very much a hot topic at the moment with several vendors promoting products and systems that utilise in-memory processing and storage to provide major performance benefits.

In this presentation I will:

- Give a short overview of a mature in-memory database technology, the Oracle TimesTen In-Memory Database (referred to simply as TimesTen in the rest of this document).

- Explain some recent enhancements to TimesTen which enable it to be effectively utilised in a Business Intelligence / Analytics environment.

- Look at how the Oracle Exalytics In-Memory Machine utilises in-memory technologies and particularly TimesTen to deliver breakthrough performance for Oracle Business Intelligence Enterprise Edition (OBIEE).

- Briefly examine the integration between OBIEE and TimesTen in the context of Exalytics.

As I discuss these topics I will highlight some real-world examples of the benefits of using in-memory technologies to accelerate Business Intelligence functions.

TimesTen Overview

Entire DB in Memory *Microsecond* response time	**Incredibly Fast**
Transactions, Logging, Checkpointing, Replication	**Persistent**
SQL , PL/SQL, OCI, JDBC, ODBC	**Standard**
Simple install and config ... Embeddable	**Easy**

TimesTen is an in-memory relational database. It combines the very high performance typically associated with in-memory technologies with all the attributes expected of a relational database; tables, indexes, SQL query language, the usual APIs – OCI, JDBC, ODBC, PL/SQL, fully transactional with persistence and recoverability, high availability etc.

In addition to being a complete, self contained, high performance in-memory database TimesTen also, in its Oracle In-Memory Database Cache (IMDB Cache) incarnation, provides rich functionality to enable it to act as a relational data cache front ending an Oracle Database. This configuration can be used to provide performance acceleration and enhanced availability for the most demanding data centric applications where the total dataset is too large to be physically, or perhaps economically, accommodated entirely in-memory.

TimesTen has been commercially available since 1998 (it was the first commercially available in-memory database) and since then has seen 15 years of continuous innovation. The product (and company) was acquired by Oracle in 2005.

The original focus for TimesTen was extreme OLTP processing where very low, consistent response times were critical; telecommunications, financial services and intelligence/military systems were early adopters of the technology. On a typical commodity Intel/Linux server TimesTen can deliver query/DML response times in the low single digit of microseconds (millionths of a second) and throughput of several million transactions per second.

More recently work has been done to add new functionality to TimesTen to bring the benefits of in-memory storage and processing to Real-time Analytics and Business Intelligence workloads.

TimesTen Features for Business Intelligence

The TimesTen 11.2.2 release (released in November 2011) added a number of important features related to BI and Analytical workloads.
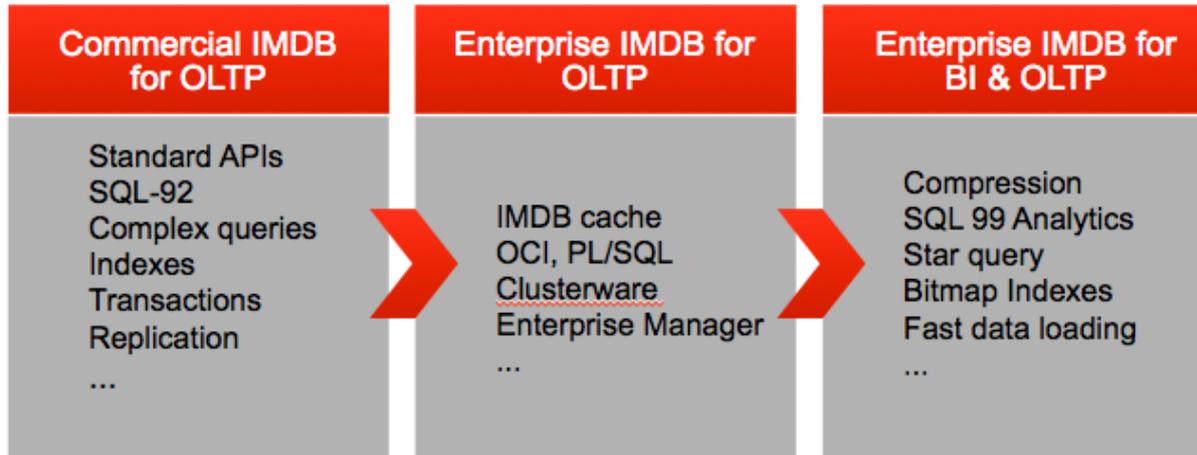
Perhaps the most notable of these features was columnar compression. This is a dictionary based compression mechanism that can deliver huge storage savings when a dataset contains many duplicate values (as is common in typical BI datasets). Typical compression ratios of 4x to 6x are seen with up to 20x being possible in some cases. In addition, for some query types the use of compression can result in a performance benefit due to the reduction in the amount of data that must be scanned.

Other BI related functionality added in the 11.2.2 release includes:

- OLAP operators including GROUPING SETS, CUBE and ROLLUP

- Analytical functions including ranking and statistical functions with/without partitions and sliding windows

- Optimisations for in-memory star schema processing

- An index advisor to recommend the best set of indexes to optimise a given workload

- Several bulk data loading features and optimisations

- A utility to analyse tables and data in an Oracle database and to generate scripts to import those tables, and their data, into TimesTen with data type optimisation, automatic compression recommendations etc.
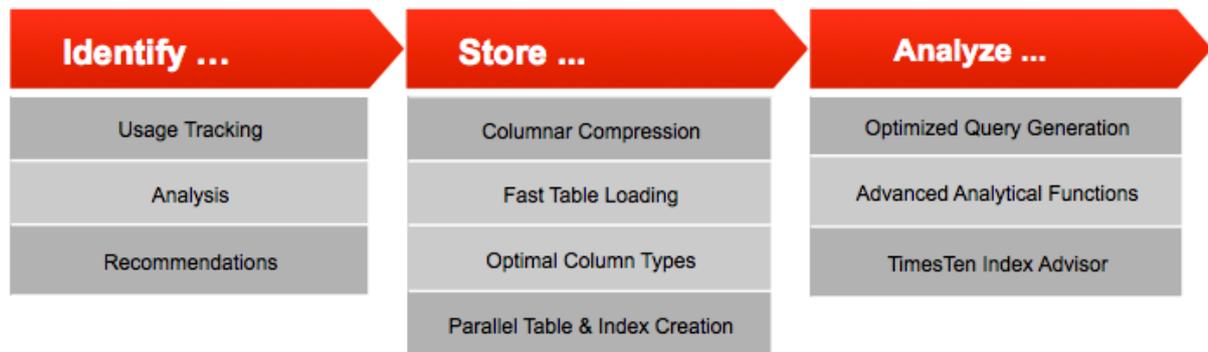
The Oracle Exalytics In-Memory Machine

As part of Oracle's continued move towards integrated and optimised hardware and software solutions - the 'Engineered Systems' approach – the Exalytics In-Memory Machine was launched at Oracle Open World 2011. Exalytics is a Business Intelligence / Analytics machine analogous to the Exadata Database Machine.

Exalytics makes extensive use of in-memory technologies, including TimesTen, enabling it to deliver the best possible performance for Business Intelligence and Analytical applications.

Exalytics hardware is focused on in-memory capability. The system has 40 CPU cores and 1 TB (X2-4) or 2 TB (X3-4) of RAM and supports up to 2.4 TB of PCIe Flash storage in addition to regular disk storage.

Integration between OBIEE and TimesTen

In Exalytics, OBIEE has been enhanced to utilise and benefit from many of TimesTen's capabilities.

Identify ...	Store ...	Analyze ...
Usage Tracking	Columnar Compression	Optimized Query Generation
Analysis	Fast Table Loading	Advanced Analytical Functions
Recommendations	Optimal Column Types	TimesTen Index Advisor
	Parallel Table & Index Creation	

- The BI Server performs detailed usage tracking for all queries in the BI workload.

- The Summary Advisor uses this usage information to recommend and (re)generate the optimal set of aggregates to deliver the best performance for that workload.

- Storage of aggregates or full table data in TimesTen makes use of TimesTen columnar compression, native data types, fast data loading mechanisms and parallel index creation to maximise data loading throughput.

- Queries generated by BI server that are targeted at TimesTen are tailored to TimesTen's capabilities.

- The queries can utilise the analytical functions supported by TimesTen.

- Queries against both aggregates and full table data can be easily optimised using the TimesTen Index Advisor.

Conclusions

In-memory technology has come of age and is now mainstream. It is spreading from its traditional heartland of OLTP systems into many other areas of which BI and Analytics is a major growth area.

The business benefits to be gained from utilising in-memory technology are significant; BI dashboards, reporting and analytics become 'real-time' enabling faster response to changing operational conditions.

The TimesTen In-Memory Database has many capabilities that make it well suited to use in a BI / Analytics environment.

The Exalytics In-Memory Machine is an excellent example of the use of a range of in-memory technologies, including TimesTen, to deliver a high performance and cost efficient BI / Analytics platform.

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