In Memory Data Processing Systems

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INTRODUCTION

Owing to the dramatic dropping of the price of memory, people are installing more memory in servers for higher performance. This chapter will classify in memory data processing systems into several categories, including main memory (relational) databases, in memory data grids or file systems, in memory big data analytic systems, and in memory noSQL databases. The chapter also presents to readers major products and systems of each category.

BACKROUND

When the whole dataset is loaded into main memory, it is expected that transactions and queries could get executed much faster. Data processing systems designed around memory resident datasets gain a momentum recently due to the demanding requirements of applications, i.e., higher throughputs and faster response times.

MAIN FOCUS OF THE CHAPTER

This section will give an introduction of in memory data processing systems category by category, including major products in the market and prototypes from academia. Main memory database systems (or in memory database system, IMDS) are the vanguards to leverage the big memory for higher data processing performance (Li & Patel, 2013; Balkesen, Teubner, Alonso, & Özsu, 2013).

By leveraging the large memory capacity, compression techniques, as well as various optimization techniques, main memory database systems usually could obtain a performance boost of more than one order of magnitude over traditional database systems. SAP has conducted a benchmarking (SAP HANA - b, 2012) to show the advantages of its HANA in memory database. The 100 TB (terabytes) sales and distribution data set is compressed by 20 times into 3.78 TB and distributed onto a cluster of 16 nodes, each of which is equipped with 4 CPUs, 512GB (gigabytes) of RAM, and 3.3 TB of disk storage. In the

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experiments, they achieved an average response time of less than 2 seconds on most queries, and remained lengthy queries could be finished in around 5 seconds.

MMDB (Main Memory Database) Primarily for OLTP (Online Transaction Processing)

Altibase is one of leading vendors in the MMDB market. *Altibase HDB*™ database (Altibase, 2013) has a hybrid architecture, which combines in memory processing and on disk storage together in a single unified engine. For enterprise adoption of main memory database systems in critical use, Altibase HDB™ has built in replication and high availability support, which provide needed system reliability. The database has been used by companies from telecom, and finance industries. Their customers include China Telecom, China Unicom, China Mobile, SK Telecom and Ericsson, E*TRADE, Solomon, Samsung Securities and several of the top Japanese investment banks. Altibase HDB™ is used as the data engine for real time rating, online charging, high frequency trading etc.

SolidDB (IBM SolidDB, 2013) is the flagship product of Solid Information Technology, which was acquired by IBM in 2007. SolidDB is a fully functional main memory database system, it can be used as a standalone database to power real time business; on the other hand, it can also be used as a front end cache of backend disk resident database, such as IBM's DB2. By caching critical data of backend databases into SolidDB Universal Cache, SolidDB accelerates accesses to the databases, especially read only queries. Extreme availability is the top concern for enterprise adopting of MMDB in their operations. SolidDB maintains two copies of the data synchronized at all times. In case of system failure, applications can resume access to SolidDB in less than a second without loss of data. The two using modes, as well as various features of SolidDB render it the strongest competitor of Oracle's Timesten for OLTP applications.

Timesten (Oracle Timesten, 2013), just as what has been conveyed by its name, tries to deliver more than one order of magnitude of performance boost by re-architect the whole database with main memory as the major storage device. Timesten has set the standard of main memory database systems for OLTP applications. Oracle has acquired Timesten in 2005 to enrich its product lines, filling the vacancy of real time OLTP databases. Timesten and SolidDB are true competitors in the sense that they employ similar technologies, provide similar functionalities, and aim at OLTP applications.

eXtremeDB IMDS (In memory database system) is the database product of McObject. It is a 64bit database management system, and can scale beyond 1TB of managed data. McObject has benchmarked eXtremeDB on a SGI Altrix 4700 system with 80 dual-core 1.6 GHZ Itanium 2 processors (160 cores total) and 4 TB NUMA RAM, which is hosted by Louisiana Immersive Technologies Enterprise (LITE), the system runs SUSE Linux Enterprise Server 9. With the help of multi version concurrency control protocol and other optimization techniques, eXtremeDB achieved an astonishing throughput of 87,781,589 simple SELECT queries per second when using native DB API, JOIN and SUBQUERY operations reached a peak of 11,134,130 queries per second and 2,514,055 queries per seond respectively (McObject eXtremeDB, 2012). Although the benchmark is not as complex as TPC-C (TPC-a, 2013), the results are still encouraging. eXtremeDB has several advantages, including in memory processing for high performance, 64bit architecture for highly scalability, multi version concurrency control for high performance on multi cores, and hybrid storage support. eXtremeDB enables persistent storage for selected records types (disk based or flash based). Besides the basic