Towards the Maturity of Object-Relational Database Technology: Promises and Reality

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ABSTRACT

Object-relational technology provides a significant increase in scalability and flexibility over the traditional relational databases. The additional object-relational features are particularly satisfying for advanced database applications that relational database systems have experienced difficulties. The key factor to the success of object-relational database systems is their performance. This paper aims to review the promises of Object-Relational database systems, examine the reality, and how their promises may be fulfilled through unification with the relational technology. To investigate the performance implications of using object-relational relative to relational technology, the query-oriented BUCKY benchmark has been previously applied to an early object-relational database system, i.e., Illustra 97. This paper presents the results obtained from implementing and running the BUCKY benchmark on Oracle 10g. The results acquired from the work described in this paper are compared with the results obtained in BUCKY benchmark. This study throws light on the functionality of object-relational databases, where object-relational technology has made improvements but some limitations are identified as well. In general, the performance of relational supersedes that of object-relational database system.

Keywords: Benchmarks, BUCKY, Object-relational Database, Performance, Relational Database

INTRODUCTION

The database system is arguably the most important development in the field of software engineering, and the database systems are now the underlying framework of information systems (Connolly & Begg, 2005). Object-relational (O-R) database systems extend relational database systems (RDBMSs) by adding modelling primitives from object world such as support for user-defined data types, references, inheritance and polymorphism. There is significant demand
for object-relational capabilities; otherwise, vendors would not have uniformly embraced the technology (Stonebraker et al., 1999).

O-R database management systems (ORDBMSs) provide a huge increase in flexibility and support for rich data types compared to the RDBMSs. They are attractive, especially for non-traditional applications, such as geographic information systems, multimedia databases, etc., for which RDBMSs have experienced their shortcomings. Unlike object-oriented database systems, ORDBMSs support all features of RDBMSs including scalability and transaction processing performance. Moreover, language support for the new features of ORDBMSs has been added to recent releases of SQL standard, namely SQL:99 and SQL:2003.

So far, little is known about the performance implications of using these features (Carey et al. 1997). BUCKY (Benchmark of Universal or Complex Kwery Ynterfaces) is a query-oriented benchmark that tests many of the key features offered by ORDBMSs and evaluates the maturity of O-R technology relative to relational technology in the same ORDBMSs (Carey et al., 1997). It presents an O-R schema and a relational equivalent thereof. The outcome of running BUCKY on an early O-R product shows that the performance of the O-R version of the examined ORDBMSs was almost twice as slow as the relational version.

One key factor to the success of ORDBMSs is its performance. The concept of ORDBMSs, as a hybrid of relational and object-oriented database management systems, is very appealing, preserving the wealth of knowledge and experience that has been acquired by RDBMSs (Stonebraker et al., 1999). Users expect short time responses for their database operations, even though the complexity of data and queries. Stonebraker claims that ORDBMSs will be the next great wave in evolution journey of DBMSs (Stonebraker & Moore, 1996).

Database migration is the process of converting a source database into a target database to be handled in its new environment. Comparing the performance of source and target databases may help the user to decide whether or not they should move into their chosen database if performance is a deciding factor (Maatuk, 2009).

The aim of this paper is to investigate the maturity of O-R technology relative to relational technology. This includes the evaluation of the performance of ORDBMSs relative to RDBMSs by applying an O-R query-oriented BUCKY benchmark on Oracle 10g database management system (DBMS). The results from this study and the original BUCKY results are compared and discussed.

The remainder of this paper is organized as follows. In Section 2, an overview of related work is given. The BUCKY benchmark is briefly described in Section 3. While Section 4 explains experimental set-up, the next section describes the first results obtained from applying the queries of the benchmark on Oracle 10g DBMS. In Section 6, we discuss the results as whole and presents lessons we have learned from this study. Section 7 concludes this paper.

RELATED WORK

A set of query-based benchmarks has been designed to test and measure different aspects of the functionality and performance of object-based systems. The Simple Database Operations benchmark (Rubenstein, et al., 1987), the Object Operations Version 1 (OO1) (Cattell & Skeen, 1992) and OO7 (Carey et al., 1993, Carey et al., 1994) benchmarks were created to evaluate the performance of OODBMSs. The OO7 represents a comprehensive test of the wide range of OO features of OODBMS performance (Carey et al., 1993). OO7 includes three sets of operations: traversals, queries and structural modifications. BUCKY (Carey et al., 1997) and BORD (Lee et al., 2000) benchmarks are query-oriented benchmarks for ORDBMSs. They emphasize...
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