EFFICIENT ACCESS OF REPLICATED DATA IN DISTRIBUTED DATABASE SYSTEMS

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By

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Thesis Submitted in Fulfillment of the Requirement for the Doctor of Philosophy in the Faculty of Computer Science and Information Technology University Putra Malaysia

September 2001

Dedicated to my beloved mother Chik Bt Omar and father Mat Deris bin Muda

"Thank you for your support"

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philisophy

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September 2001

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Replication is a useful technique for distributed database systems where a data object will be accessed (i.e., read and written) from multiple locations such as from a local area network environment or geographically distributed world wide. This technique is used to provide high availability, fault tolerance, and enhanced performance.

This research addresses the performance of data replication protocol in terms of data availability and communication costs. Specifically, this thesis present a new protocol called Three Dimensional Grid Structure (TDGS) protocol, to manage data replication in distributed database systems (DDS). The TDGS protocol is based on the logical structure of sites/servers in order to form a read or a write

quorum in the DDS. The protocol provide high availability for read and write operations with limited fault-tolerance at low communication cost. With TDGS protocol, a read operation is limited to two data copies, while a write operation is required with minimal number of copies. In comparison to other protocols, TDGS requires lower communication cost for an operation, while providing higher data availability.

A system for building reliable computing over TDGS Remote Procedure (TDGS-RP) system has also been described in this research. The system combines the replication and transaction techniques and embeds these techniques into the TDGS-RP system. The model describes the models for replicas, TDGS-RP, transactions, and the algorithms for managing transactions, and replicas.

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CAPAIAN BERKESAN BAGI DATA REPLIKA DI DALAM SISTEM PANGKALAN DATA TERAGIH

Oleh

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Replikasi merupakan teknik yang penting bagi system pangkalan data teragih di mana data objek dicapai (iaitu baca atau tulis) dari beberapa lokasi seperti dari rangkaian setempat atau mana-mana tempat diseluruh dunia. Teknik ini digunakan untuk menyediakan ketersediaan yang tinggi, toleransi-kesalahan, dan peningkatan prestasi.

Tesis ini memaparkan prestasi protocol replikasi data dalam bentuk ketersediaan data dan kos komunikasi. Tesis ini mempersembahkan protokol baru dipanggil protokol Struktur Grid Berdimensi Tiga (TDGS) untuk mengurus replikasi data di dalam system pangkalan data teragih (DDS). Protokol ini berdasarkan kepada struktur logical pelanggan/tempat untuk membentuk korum baca atau tulis dalam DDS. Protokol ini menyediakan ketersediaan yang tinggi dengan kos komunikasi rendah. Dengan protokol TDGS, operasi baca memerlukan hanya dua salinan data, sementara bagi operasi tulis memerlukan jumlah salinan yang minima.

Dibandingkan dengan protokol-protokol lain, protokol TDGS memerlukan kos komunikasi rendah, dan menyediakan ketersediaan data yang tinggi.

Satu system untuk membangunkan pengkomputeraan yang dipercayai ke atas system TDGS-RP juga dijelaskan. Sistem ini menggabungkan teknik replikasi dan transaksi, dan menggunakan teknik ini ke dalam system TDGS-RP. Ia menjelaskan model bagi replica, TDGS-RP, transaksi, dan algorithma untuk mengurus transaksi dan replica.