

MANAGING REPLICATION AND TRANSACTIONS  
USING NEIGHBOUR REPLICATION ON DATA GRID

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DOCTOR OF PHILOSOPHY  
UNIVERSITI MALAYSIA TERENGGANU

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**MANAGING REPLICATION AND TRANSACTIONS  
USING NEIGHBOUR REPLICATION ON DATA GRID**

**NORAZIAH BINTI AHMAD**

**Thesis Submitted in Fulfillment of the Requirement for the  
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Thesis submitted to the Senate of Universiti Malaysia Terengganu (UMT)  
in fulfillment of the requirements for the degree of Doctor of Philosophy

## MANAGING REPLICATION AND TRANSACTIONS

Dedicated to my beloved father Ahmad Zakaria and in memory of my  
mother Esah Ibrahim. Also, to my husband Zakaria Mamat and my family.

July 2007

Supervisor: "Thank you for your patience, understanding and support".

Member: Associate Professor Muhammad Ismail Hassan, Ph.D.  
Professor Maszida Mat Dera, Ph.D.

Faculty: Science and Technology

Replication is a useful technique for distributed database systems. Through this technique, a data object will be accessed (i.e., read and update) from multiple locations. Thus, it ensures the data availability and accessibility to users despite site and communication failures. The all-site-or-all-site replication schemes such as Round Robin Mirroring (RRM) and Time Partitioning (TP) are the popular techniques being used for replication and management of data in this domain. However, these techniques have to work within the limits of data storage capacity and also data access time due to some number of sites must agree to complete or abort certain transactions. In this study, the all-site-or-all-site scheme called Neighbourhood Replication on Grid (NRG) technique is proposed by considering only neighbours that have the replicated data. It is based on the logical structure of supercomputers in order to form a grid of a wide domain in distributed database systems. The proposed scheme ensures only neighbours obtain a data copy. That is, only the neighbours are assigned with your one and zero otherwise. The assignment provides a minimum communication cost with high system availability, due to the consistent

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USING NEIGHBOUR REPLICATION ON DATA GRID**

**NORAZIAH BINTI AHMAD**

**July 2007**

**Chairperson : Professor Md. Yazid Mohd. Saman, Ph.D**

**Member : Associate Professor Muhammad Suzuri Hitam, Ph.D  
Professor Mustafa Mat Deris, Ph.D**

**Faculty : Science and Technology**

Replication is a useful technique for distributed database systems. Through this technique, a data object will be accessed (i.e., read and written) from multiple locations. Thus, it increases the data availability and accessibility to users despite site and communication failures. The all-data-to-all sites replication schemes such as Read-One-Write-All (ROWA) and Tree Quorum (TQ) are the popular techniques being used for replication and management of data in this domain. However, these techniques have its weaknesses in terms of data storage capacity and also data access times due to some number of sites must agree in common to execute certain transactions. In this study, the all-data-to-some sites scheme called Neighbour Replication on Grid (NRG) technique is proposed by considering only neighbours that have the replicated data. It is based on the logical structure of sites/servers in order to form a read or a write quorum in distributed database systems. The proposed technique considers only neighbours obtain a data copy. For simplicity, the neighbours are assigned with vote one and zero otherwise. The assignment provides a minimum communication cost with high system availability, due to the minimum

number of quorum size required. In addition, it minimizes the storage capacity as well as data access time.

A series of experiment was carried out by using three servers. Neighbour Replication on Grid (NRG) daemon is developed under Linux platform in the local area network (LAN) environment. It was carried out in Shell and Perl programming integrated with File Transfer Protocol (FTP) for the communications agent. The experimental results showed that the proposed model work successfully in managing replication and transaction when no failures occurred. Besides, the reconciliation and resolving conflict during system recovery are also supported when primary and neighbour replicas have failure.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu  
(UMT) sebagai memenuhi keperluan ijazah Doktor Falsafah

**MENGURUSKAN REPLIKASI DAN TRANSAKSI  
MENGUNAKAN REPLIKASI KEJIRANAN GRID DATA**

**NORAZIAH BT AHMAD**

**Julai 2007**

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Replikasi merupakan suatu teknik yang berguna bagi sistem pangkalan data teragih. Melalui teknik ini, objek data boleh dicapai (iaitu baca dan tulis) dari beberapa lokasi. Oleh itu, ia meningkatkan ketersediaan dan pengaksesan data kepada pengguna walaupun berlaku kegagalan nod dan komunikasi. Skema replikasi semua-data-kepada-semua-nod seperti Baca-Satu-Tulis-Semua (ROWA) dan Korum Pokok (TQ) merupakan teknik-teknik popular yang telah digunakan untuk replikasi dan pengurusan data dalam bidang ini. Walaubagaimana pun, teknik-teknik ini mempunyai kelemahan dalam istilah kapasiti storan data dan juga masa capaian data disebabkan sebahagian bilangan nod lazimnya mesti bersetuju untuk melaksanakan transaksi-transaksi tertentu. Dalam kajian ini, dicadangkan skema semua-data-kepada-sebahagian-nod yang dikenali sebagai teknik Replikasi Kejiranan Grid (NRG) dengan mempertimbangkan hanya jiran-jiran yang mempunyai data replikasi. Ianya berasaskan kepada susunan logikal nod-nod untuk membentuk suatu korum baca atau tulis dalam sistem pangkalan data teragih. Teknik yang dicadangkan ini mempertimbangkan hanya jiran-jiran memperolehi salinan data. Jiran-jiran ditetapkan

dengan undi satu dan selainnya adalah sifar. Ketetapan ini telah menyediakan kos komunikasi minima dengan ketersediaan sistem yang tinggi disebabkan jumlah saiz korum yang diperlukan adalah minima. Sebagai tambahan, ia turut meminimakan kapasiti storan dan juga masa capaian data.

Suatu siri eksperimen telah dijalankan dengan menggunakan tiga pelayan. Demon Replikasi Kejiranan Grid telah dibangunkan di bawah platform Linux dalam persekitaran rangkaian setempat (LAN). Ia telah dibina dengan bahasa pengaturcaraan Shell dan Perl serta berintegrasikan Protokol Pemindahan File (FTP) untuk komunikasi-komunikasi agen. Keputusan eksperimen menunjukkan bahawa model yang dicadangkan telah berjaya dalam menguruskan replikasi dan transaksi apabila tiada kegagalan berlaku. Di samping itu, pemulihan dan penyelesaian konflik ketika sistem pulih turut disokong apabila replika primer dan jiran mengalami kegagalan.