TRANSPARENT REPLICATION FOR EFFICIENT DISTRIBUTED TRANSACTIONS

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Certificate

This is to certify that the thesis titled "Transparent Replication for Efficient Distributed Transactions" being submitted by Rekha Singhal to the Indian Institute of Technology, Delhi, for the award of the Degree of Doctor of Philosophy, is a record of bonafide research carried out by her under my supervision. The results obtained in this thesis have not been submitted to any other University or Institute for the award of any other degree or diploma.

Gautam Shroff

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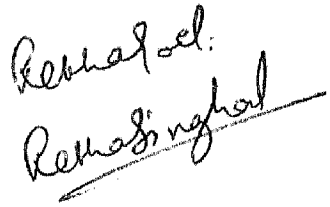

Abstract

This thesis proposes the parallel replication system (PRS), a transaction processing middleware designed specifically for object oriented applications. The goal is to enable an object oriented transaction processing application to be deployed in parallel at multiple physical locations, each potentially supporting different sets of data objects, and yet having transparent access to all application data objects. PRS can work with standard OLTP monitors; alternatively it can provide some of these services independently. PRS can support transaction processing in world wide web as well as in mobile computing environments.

PRS exploits replication as well as weak consistency to provide efficient transaction processing while preserving transaction transparency, distribution transparency and object storage transparency; PRS utilizes only application specific object level interfaces to access the persistent store. PRS is an object aware system which exploits application semantics to efficiently achieve any required level of data transparency in a wide area distributed scenario.

PRS uses application semantics to classify *modify* operations into *write*, *update* and *commutative update* operations, and read operations into *browse_read* and *critical_reads*. This categorization helps in defining an intermediate level of transaction isolation, Consistent Committed Read (degree 2.5), between Repeatable Read (degree 3) and Read Committed (degree 2). PRS uses this classification to provide transaction transparency by guaranteeing at least degree 2 isolation (i.e., degree 2, degree 2.5 or degree 3 as required) to users while ensuring correctness.

PRS employs a selective mix of eager and lazy propagation of data modifications to ensure mutual consistency: Efficient message ordering protocols are used to ensure mutually exclusive access to all replicas of an object whenever required. Due to lazy propagation, concurrent access to replicas of the same object may introduce conflicts potentially violating transaction transparency; PRS uses time vectors to correctly resolve such conflicts.

PRS supports all possible distribution of data objects including full distribution, full replication, partial replication and large objects. To summarize, PRS is a generic approach for efficient and transparent access to any distribution of data objects accessed by application replicated across wide area network.

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