

Lock management algorithms in distributed databases

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Abstract: This thesis investigates lock management algorithms for distributed databases, focusing on the trade-offs between concurrency, consistency, and fault tolerance. As distributed systems scale, traditional centralized locking mechanisms become bottlenecks, while naive distributed approaches risk deadlock or data inconsistency. The study systematically analyzes primary lock management paradigms, including centralized, primary copy, and distributed voting-based algorithms. A comparative evaluation is conducted using simulation models that measure throughput, response time, and overhead under varying workloads and network latencies. The research proposes an adaptive hybrid algorithm that dynamically selects between optimistic and pessimistic locking strategies based on real-time contention levels and transaction characteristics. Experimental results demonstrate that the proposed algorithm reduces deadlock frequency by up to 30% compared to static approaches while maintaining comparable throughput. The findings provide practical guidelines for designing scalable concurrency control in geo-distributed database environments, contributing to the broader field of distributed transaction processing.

Keywords: Key management, distributed database, locking algorithms, concurrency control