Simulations of the implementation of primary copy two-phase locking in distributed database systems

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Abstract

This paper considers algorithms for concurrency control in Distributed database (DDB) systems. Below are the simulating models of the implementation of two-phase locking (2PL) in DDB. From four types 2PL in DDB (Centralized 2PL, Primary copy 2PL, Distributed 2PL and Voting 2PL) is viewed Primary copy 2PL, as this protocol is a “transitional” protocol of Centralized 2PL to the Distributed 2PL. The paper describes specifically the simulations of two-version 2PL and 2PL with integrated timestamp ordering mechanism. In concurrency control method 2PL may take place deadlocks of the transactions. Therefore, in the modelling algorithms described here are integrated algorithms for deadlock avoiding: two-version architecture of database and timestamp ordering strategy “wait-die”. There are also presented, the results of the simulations of these two variants of the 2PL method at different scales of the networks for the transmission of data and at different intensities of inflow transactions. Modelling algorithms are developed by means of the system for simulation modelling GPSS World Personal Version.

Keywords: Simulation models, concurrency control, distributed transactions, 2PL, distributed database

1 Introduction

Concurrency control techniques are generally divided into: Locking, Timestamp ordering and Optimistic strategies – Validation check up. [1] In the last two methods were obtained a better retention of transactions in the system when it is saturated with conflicts (due to frequent rollbacks of transactions). Therefore, it is desirable to use the method of Two-phase locking (2PL). But emerging problems in its application require testing. One effective and inexpensive method for testing the operation of the various systems is the method of simulation. The basis of design are used presented and examined in [2] and [3] simulation algorithms, primary copy two-version 2PL and primary copy 2PL with built mechanism of Timestamping (TS) strategy “wait-die”. The models were developed by means of the “classical” system modeling - GPSS World.

Since pessimistic protocols can arise deadlocks transactions, the problems arise to detect and resolve deadlocks. One way to avoid deadlocks is the use of a data architecture with many versions in Distributed Database Management Systems (DDBMS). In [4] are presented and discussed algorithms with many versions for concurrency control in database management systems (DBMS), and in particular: Multi-version 2PL and Two-version 2PL. Since in the Multi-version 2PL there are problems with the management and conservation of the versions, to benefit of its advantages is desirable to limit the number of versions. So look Two-version Two-phase locking (2V2PL). Besides algorithms with versions, were developed and protocols for concurrency control, which combine advantages of 2PL and Timestamping method. In the paper, we consider the model of such an algorithm - Model of Primary copy 2PL with integrated mechanism of Timestamping (TS) - strategy “wait-die” (This method is described in [5] and some others).

2 Primary Copy 2V2PL Model

A protocol with two versions for 2PL is first proposed by Bayer in [6]. In 2V2PL protocol are only two versions of elements: 1 current version of the item and not more than one incomplete version. We use 3 types of locks, each lock is released at the end of the transaction: rl - (read lock) - established on the current version of the data item shortly before reading it; wl - (write lock) - sets before creating the new (incomplete) version of the item; cl - (commit lock) - established before the implementation of the last transaction of the transaction (usually before surgery commit) on each data item that it has recorded.

Advantages of the protocol: limit the number of older versions leads to reduction of volume of database (DB); does not require special storage structure versions; simple enough to implement a protocol. The structural scheme of a modelling algorithm for Primary copy 2V2PL of distributed transactions is shown in fig. 1.
number of the incoming streams - 6 and number of the data elements in the global database - 50. The results are received in 6 streams of concurrent transactions with different intensity. The copies of the data elements are distributed evenly and random by 6 sites in the system. The results of Primary copy 2V2PL model and Primary copy 2PL with TS model simulations for equal intensity of 6 input flows for 2 element copies are summarized and presented graphically in figure 2. (The results for Primary copy 2PL with TS are similar to those for 2V2PL, but in lower values). This approach may be useful in developing an information system for mobile learning [7].

3 Model of Primary copy 2PL with TS “wait-die”

The method uses the so called timestamps of the transactions. The TS strategy “wait-die” algorithm when transaction Ti wants to acquire a lock of an element [5]: If Ti is older (with smaller value of timestamp) than Tj, which has blocked the element then Ti waits for the release of the element in order to put the lock. If Ti has a greater timestamp than Tj, then Ti restarts. In the TS „wait-die” method the number of “superfluous” rollbacks is much smaller. And the method is not very difficult to be realized.

4 Simulation Results

Our researches has been made for 2 replicas of the element.

References