Chapter 2
Architecture for Integrated Mobile Calendar Systems

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ABSTRACT

In central databases the consistency of data is normally implemented by using the ACID (Atomicity, Consistency, Isolation, and Durability) properties of a DBMS (Data Base Management System). This is not possible if distributed and/or mobile databases are involved, and the availability of data also has to be optimized. The objective of this chapter is to describe an architecture for mobile integrated calendar systems where performance, local autonomy, and availability are optimized by using relaxed ACID properties and different asynchronous replication methods. By using relaxed ACID properties across different database locations it is possible for the users to trust the data they use even if the distributed database temporarily is inconsistent. It is also important that disconnected locations can operate in a meaningful way in so-called disconnected mode.

INTRODUCTION

When using DBMS to manage the database an important aspect involves transactions which are any logical operation on data and per definition database transactions must be atomic, consistent, isolated, and durable in order for the transaction to be reliable and coherent. The ACID properties of a database are delivered by a DBMS to make database recovery easier and make it possible in a multi user environment to give concurrent transactions a consistent chronological view of the data in the database. The ACID properties are consequently important for users that need a consistent view of the data in a database. However, the implementation of ACID properties may influence performance and slow down the availability of a system in order to guarantee that all
users have a consistent view of data even in case of failures. In several situations, the availability and the response time will be unacceptable if the ACID properties of a DBMS are used without reflection. This is especially the case in distributed and/or mobile databases where a failure in the connections of a system should not prevent the system from operating in a meaningful way in disconnected mode.

Information systems that operate in different locations can be integrated by using more or less common data and/or by exchanging information between the systems involved. In both situations, the union of the databases of the different systems may be implemented as a database with so-called relaxed ACID properties where temporary inconsistencies may occur in a controlled manner. However, when implementing relaxed ACID properties it is important that from a user’s point of view it must still seem as if traditional ACID properties were implemented, which therefore will keep the local databases trustworthy for decision making. In the following part of the introduction, author gives an overview of how relaxed ACID properties may be implemented and used in central and mobile databases integrated by using relaxed ACID properties.

The Atomicity property of a DBMS guarantees that either all the updates of a transaction are committed/executed or no updates are committed/executed. This property makes it possible to re-execute a transaction that has failed after execution of some of its updates. In distributed databases, this property is especially important if data are replicated as inconsistency will occur if only a subset of data is replicated. The Atomicity property of a DBMS is implemented by using a DBMS log file with all the database changes made by the transactions. The global Atomicity property of databases with relaxed ACID properties is implemented by using compensatable, pivot and retriable subtransactions sequentially. By applying these subtransactions it is allowed to commit/execute only part of the transaction and still consider the transaction to be atomic as the data converge towards a consistent state.

The global Consistency property is not defined in databases with relaxed ACID properties because normally such databases are inconsistent and this inconsistency may be managed in the same way as the relaxed Isolation property.

The Isolation property of a DBMS guarantees that the updates of a transaction cannot be seen by other concurrent transactions until the transaction is committed/executed. That is the inconsistencies caused by a transaction that has not executed all its updates cannot be seen by other transactions. The Isolation property of a DBMS may be implemented by locking all records used by a transaction. That is the locked records cannot be used by other transactions before the locks are released when the transaction is committed. The global Isolation property of databases with relaxed ACID properties is implemented by using countermeasures against the inconsistencies/anomalies that may occur. The Durability property of a DBMS guarantees that the updates of a transaction cannot be lost if the transaction is committed. The Durability property of a DBMS is implemented by using a DBMS log file with all the database changes made by the transactions. By restoring the updates of the committed transactions it is possible to recover a database even in case it is destroyed. The global Durability property of databases with relaxed ACID properties is implemented by using the local Durability property of the local databases involved.

Data replication is normally used to decrease local response time and increase local performance by substituting remote data accesses with local data accesses (Frank, 2005). At the same time, the availability of data will normally also be increased as data may be stored in all the locations where they are vital for disconnected operation. These properties are especially important in mobile applications where the mobile user often may be disconnected from data that are vital for the normal operation of the application. The major
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