Transaction Processing in Mobile Distributed Real-time Database Systems

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In a *real-time database system (RTDBS)*, transactions have to be completed before their deadlines and all the accessed temporal data objects have to be valid. Besides meeting these timing constraints, a RTDBS needs to observe data consistency constraints as well [4]. Different transactions scheduling algorithms and concurrency control protocols have been proposed to satisfy these constraints [4]. The problems become more complicated in a *distributed real-time database system (DRTDSB)* where a database is partitioned into a number of smaller local databases residing at different sites. The communication network, which is an essential component in a DRTDBS, is another important performance issue.

The rapid growth of mobile computing technology [1, 2] provides a new, alternative platform for distributed real-time database applications. With increasing uses of portable and mobile computers, mobile real-time database applications become more and more popular. We call the new systems as *mobile distributed real-time database systems (MDRTDBS)*. Processing time-constrained transactions in MDRTDBS is a very new area and a lot of design issues still remain unresolved.

The predictability of a MDRTDBS is affected by a number of factors such as concurrency control, priority scheduling, commitment and mobile wireless communication. In a mobile environment, the behavior of the underlying wireless network is highly unpredictable. Certain behavior of the mobile computing system creates an additional burden on the system performance and increases the unpredictability of the system. In particular, the narrow wireless bandwidth and the limitation of processing power in the mobile clients may be bottlenecks to the performance [3]. Mobile clients (MCs) face wide variance in network quality including unpredictable call setup probability. There are several factors which may affect a call to setup such as the availability of the receiver in the cell site and the utilization of the channel in the Main Terminal Switching Office (MTSO). Even when a call can be set up, the setup time is also fluctuating. Furthermore, MCs always prefer a light, compact, and power-saving units. Methods have to be designed to save power in the MCs. Also, the mobility of the MCs affects the distribution of workload on different cells and thus the system predictability.

Another source of problem is the cost in resolving data conflicts. In DRTDBS, different real-time concurrency control protocols have been proposed. One of the commonest methods to resolve data conflict between transactions with different priorities is by restarting transactions. However, this will be very expensive under a mobile environment. The restarted transaction will have a very probability of deadline missing. Methods have to be designed to reduce the cost in resolving the conflict. One of the possible solutions to reduce the number of restarts is to adopt a less restrictive correctness criteria for database consistency such as using the concept of similarity or epsilon serializability.

Similar problem will occur when a committing transaction has a data conflict with an executing transaction. Up to now, very little of work has been done on the design of real-time commitment protocol which is required to reduce the impact of transaction commitment on the system predictability. Some proposals are based on the optimistic method.

References

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