

ABSTRACT

Recent years have witnessed tremendous growth of database applications in mobile computing environments. An important challenge to database researchers in such environments is to provide a data replication solution that maintains the consistency and improves the availability of replicated data.

This research addresses these problems for large scale distributed database systems that operate in mobile environments. The research called such systems as Large-Scale Mobile Distributed Database Systems (LMDDBSs). As a solution, the research provides a new comprehensive replication strategy that consists of four components in order to act in accord with the characteristics of LMDDBSs, and to better support the mobility and disconnections of mobile hosts. The components of the replication strategy are: replication architecture, updates propagation protocol, updates ordering mechanism, and replication method.

The effectiveness of the proposed strategy with respect to updates propagation is verified through a comparative study with Roam replication system. The results revealed that the proposed strategy achieves better propagation delay and lesser total number of messages than Roam. Moreover, the proposed strategy achieves load balance in both propagation and ordering processes. Also, the proposed updates propagation protocol is compared with N -ary tree based propagation protocol. The results showed that the horizontal extension provided by the proposed protocol is more suitable than the vertical extension for LMDDBSs.

The characteristic of updates ordering mechanism reveals that it is more suitable to meet the ordering requirements of LMDDBSs than the previous mechanisms that are based on version vectors.

To analyze the stochastic behavior of the replication system, the research developed a Stochastic Petri Net (SPN) model. The analysis proved that the mobile database state in which availability and consistency are satisfied is a recurrent state with a probability that depends on the number of the synchronizations of the mobile host with the fixed network.

Keywords: availability, consistency, optimistic replication, pessimistic replication, replication method, propagation protocol.