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Concurrency Control issues in Mobile Database

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Abstract— **Mobile computing is a revolutionary technology, born as a result of remarkable advances in computer hardware and wireless communication. Mobile applications have become increasingly popular in recent years. Today, it is not uncommon to see people playing games or reading mails on handphones. With the rapid advances in mobile computing technology, there is an increasing demand for processing realtime transactions in a mobile environment. Hence there is a strong need for efficient transaction management, data access modes and data management, consistency control and other mobile data management issues.**

This survey paper will cover issues related to concurrency control in mobile database. This paper studies concurrency control problem in mobile database systems, we analyze the features of mobile database and concurrency control techniques. With the increasing number of mobile hosts there are many new solutions and algorithms for concurrency control being proposed and implemented. We wish that our paper has served as a survey of the important solutions in the fields of concurrency control in mobile database.

Keywords-component; Distributed Real-time Databases, Mobile Real-time Databases, Concurrency Control, Data Similarity, and Transaction Scheduling.

I. Introduction

Today advances in wireless communication technology have made mobile information services a Reality. Mobile computing is today's computing and communication area. It is a revolutionary technology, born as a result of remarkable advances in computer hardware and wireless communication. Traditional transaction management in multidatabase systems cannot be applied to mobile environment. Effective Data management in mobile networks is the key to the success of Mobile Computing.

Compared to wired networks, mobile networks are much slow, unreliable, and unpredictable. The mobility of clients affects the distribution of workload in the network and the system. Disconnection between mobile clients and base stations is common. It can seriously affect the probability of data conflicts and the deadline missing probability. The poor quality of services provided by a mobile network can also seriously increase the overheads and affect the effectiveness of a concurrency control protocol in resolving data conflicts as the transactions now require a longer time for completion.

Concurrency control (CC) is an integral part of a database system, and is the activity of coordinating the actions of transactions that operate in parallel, access shared data, and potentially interfere with one another. Concurrency control has been actively investigated for the past several years, and the problem for no distributed DBMSs is well understood. A broad mathematical theory has been developed to analyze the problem, and one approach called Two- phase locking (2PL), has been accepted as a standard solution. Dynamic two-phase locking (2PL) is the CC technique that current databases use almost exclusively. A dynamic 2PL system thrashes at high data contention levels, restricting performance to levels inconsistent with available resources.

This paper studies concurrency control problem in mobile database systems, we analyze the features of mobile database and concurrency control techniques. We will discuss data management issues in mobile environments. We describe the model of mobile environment and its important characteristics that need to be considered when using database in a mobile environment.

II. Mobile Database:

Mobile computing is widely used in many applications such as mobile banking, traffic status, weather

forecasting, etc. In order to provide these services, required information is retrieved from database server via a wireless channel and is passed on to the mobile hosts.

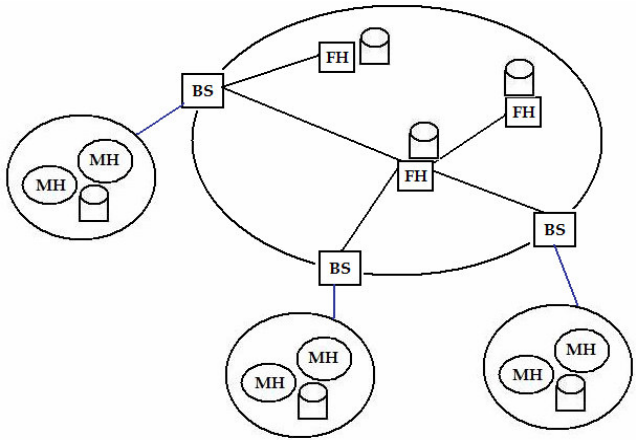
Mobile database has become a popular terminology, attributed to the data management technology that enables the use of databases on the mobile computing environment. This database is more advanced and challenging than the fixed distributed databases as it offers the following features:

- *Data are available anywhere independent of the availability of the fixed network* connection: With mobile-ready devices, users can store a part of database and use it while being mobile. When a mobile user needs data which is not available locally, she can activate the wireless communication of her mobile device and initiate connection to the network via the closest mobile support station (MSS). Once connected, she can access the publicly available data by using applications such as internet browsers, or her system can take part in a distributed database environment where she can access specific data granted for her. In this way, mobile users can virtually access any data, anywhere and anytime, even in the absence of fixed network connection.

- *Databases on both mobile and fixed hosts are sharable in seamless way:* In mobile information systems, databases proliferated on both mobile and fixed hosts naturally form a distributed database system. In general, techniques to support data sharing in distributed databases are more complex than those in centralized databases. Mechanisms such as distributed transaction processing and commit protocol, for example, are known to be dependent on reliable and many network connections. In a mobile environment, however, we involve also the use of wireless network which is known to be prone of frequent disconnections and the period of disconnection is also unpredictable. In order to support seamless data sharing among mobile and fixed hosts, we need to employ distributed computing technologies that should also work properly even in the disconnection-prone environments.

III. Mobile Database Architecture

The mobile computing environment generally consists of three entities Fixed Host (FH), Mobile Hosts (MH) and Base Stations (BS) respectively. Terminals, desktop, servers are the fixed host, which are interconnected by means of a fixed network.



Large databases can run on servers that guarantee efficient processing and reliable storage of database. Fixed hosts perform the transaction and data management functions with the help of data base servers (DBS). Mobile units are the portable computers which can retain the network connections through the support of the Base Stations (BS).

Transactions are initiated at a mobile host may be executed at fixed host or mobile host. A Mobile unit connects to a fixed host through a wireless link A Base station connects to a mobile unit and is equipped with a wireless interface. It is also known as a Mobile Support Station. Mobile Hosts (MH) may not always be connected to the fixed network. They may be disconnected for different reasons. Mobile host may differ with respect to the computing power and storage space; however MH can run a DBMS module.

IV. Transaction Process of mobile Database

Transactions are a convenient mechanism for building reliable distributed systems in the presence of concurrent access and failures. They allow operations on objects to be grouped together and provide the atomicity guarantee, i.e., either all or none of these operations are performed on the database state. The characteristics of mobile transactions are described as follows:

- *Mobility of transactions.* The execution of transactions in mobile environments is tightly coupled with the behavior of the mobile hosts. A mobile host can initiate mobile transactions or participate in the transaction execution processes. When a mobile host moves from one location to another, all the transactions that are being carried out at that mobile host will also move. Consequently, many computing activities associated with these transactions are moved or changed, for example handling hand-over processes, establishing new communication channels, or updating the routing tables. In other words, the mobility of transactions

causes the movement of related transaction resources, controls, and services.

Long-lived transactions. Transactions in mobile environments have longer life (i.e., long-lived) than traditional ACID transactions.

- *Adaptive transaction processing.* Due to the real-time movement of the mobile hosts, the limitations of the wireless networks, and the variation of the mobile resources, the execution plan of a transaction in mobile environments may not be as scheduled. Therefore, the mobile transaction processing system must have the ability to support adaptive transaction processing that includes: distributed and disconnected transaction processing.

- *Temporary data inconsistency.* Due to long disconnection periods, shared data among different mobile hosts may not be fully consistent all the time. For example, a transaction at a disconnected mobile host can modify a shared data item that is currently being read-only cached in a local storage of another disconnected mobile host. Data synchronization processes will be carried out when the disconnected mobile hosts reconnect to the database systems so that the data consistency of the database systems will be achieved.

V. Concurrency control

The goal of concurrency control is to prevent interference among users who are simultaneously accessing the same database. Concurrency Control is one of the important components of transaction management. Several valuable attempts were made to efficiently implement the concurrency control strategies in mobile environment.

Concurrency control is the activity of coordinating concurrent accesses to a data base in a multi-user database management system (DBMS). Concurrency control permits users to access a database in a multiprogrammed fashion while preserving the illusion that each user is executing alone on a dedicated system. The main technical difficulty in attending this goal is to prevent database updates performed by one user from interfering with database retrievals and updates performed by another. The concurrency control problem is exacerbated in a distributed DBMS (DDBMS) because

1. User may access data stored in many different computers in a distributed system
2. A concurrency control mechanism at one computer cannot instantaneously know about interactions at other computers.

Concurrency control in a Mobile database refers to mechanism which permits multiple transactions to operate on the database simultaneously while ensuring that the database appears consistent to each transaction. Problems, which need to be addressed, include avoiding or recovering from deadlock transactions and making transactions operate on a consistent database atomically.

Traditionally, Concurrency Control techniques have been classified into four categories.

1. Two Phase Locking
2. Timestamp- ordering
3. Optimistic
4. Hybrid

VI. Concurrency Control Strategy in Mobile Database

Most of concurrency control strategies are based on three mechanisms viz., locking, timestamps and optimistic concurrency control. Though these schemes are well suited for traditional database applications, they don't work efficiently in mobile environments. Due to various constraints in the mobile environment and nature of different online applications, traditional concurrency control mechanism may not work effectively.

Concurrency control deals with the issues involved in allowing Simultaneous accesses to shared data items. Atomicity, consistency, and isolation of transactions are achieved in the database through concurrency control mechanisms. In particular, mobile applications have to face disconnections. It is expected that the transaction continues when the mobile host is disconnected. Hence there is a need of optimistic replication techniques.

In optimistic replication, shared data is replicated on mobile hosts and users are allowed to continue their work while disconnected. After successful completion of local operations at mobile host, the results are later propagated to fixed hosts. In the earlier approaches whenever a concurrency violation occurs i.e. data items are updated at fixed host the conflicting transaction using the similar data items was aborted. In this approach the conflicting transaction is not aborted but it is restated with new state of the data items.

Conclusion

Concurrency control in Mobile Databases has the same behaviors with those in multidatabase systems in many aspects. Many approaches in multidatabase systems can be extended to mobile multidatabase environment. The differences in Mobile Databases are that transactions in Mobile Databases have mobility and long-lived nature.

In this paper we have developed a mobile transaction model, which captures data and movement nature of mobile transactions.

We are in the process of investigating schemes by which the performance of high security level transactions can be improved without compromising with the security. Further we are looking to secure mobile database systems by which the performance of high security level transactions can be improved without compromising the security.

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