A Reputation Replica Propagation Strategy for Mobile Users in Mobile Distributed Database System

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Abstract

In this paper, it is to focus on two areas, primarily data inconsistency problems faced by the mobile database users when they are trying to accessing or updating the database data while mobility in work, in such environment demand for appropriate strategies arises, to overcome this problem. When users come in contact with other network node, updated data is not reflected or propagated at the other sites or nodes, which is previously updated or changed at previous visited site or at activity center. Secondly, require advance replication architecture and effective network protocol based algorithms follows effective replication strategy that securely supports databases changes activities anytime and anywhere in mobile computing network environment.

Keywords: *Mobile Network; Distributed Database; Data Inconsistency; Replica Management; Mobility; Propagation Dynamic Replication; Activity Center*

1. Introduction

Wireless network technology allows accessing and transferring of data to other nodes in the network easily. Here important concerned is to strictly focus on the data, that a mobile users wants or demands from any of the network location during working environment, showing a transparent system of the distributed network. It is a serious matter of concern that, data being approached or accessed by the database users in the mobile distributed networks is consistent or not. In distributed system data availability with high consistency is on highest priority. But as technological development is on swing different areas such as hardware, software and communication technology become better and open better scopes, allow users to efficiently perform their various database transactional activities during mobility, when users usually moves from one location to another. Wireless network enable users to interact with the database, physically located at different location in the network. Recently, there has been increasing interest in replica management system in mobile distributed database system. From business and technology perspectives, data management technology that can support easy data access from and to mobile devices is among the main concerns in mobile information systems. Mobile network, especially, has characteristics that make it difficult to employ the currently available database solutions as most of them were developed for the use on the fixed network environment.

Distributed system in co-ordination with mobile technology in mobile distributed environment wireless communication allows the user to access information anywhere at

anytime without direct physical link to the network. It is mainly composed of the following as depicted (See Figure1):

1. A number of network servers enhanced by wireless transceivers, called mobile support stations (MSS), scattered along a geographical area and
2. A varying number of mobile hosts (MHs) free to move at will.

Data is an asset, and is can be easily available to different users in distributed network whenever it is required by them. Data in centralized or in a fixed network can be easily managed and availability of data can be satisfied, but users in mobile network trying to access the database facing different problems and are looking it into in different perspectives:

1. Whether the availability, correctness of data can be maintained in vast distributed database environment or not.
2. Are Replication System adapt to the change of working environment or not.
3. Data can be secure in wireless network when propagate among different nodes in the network.

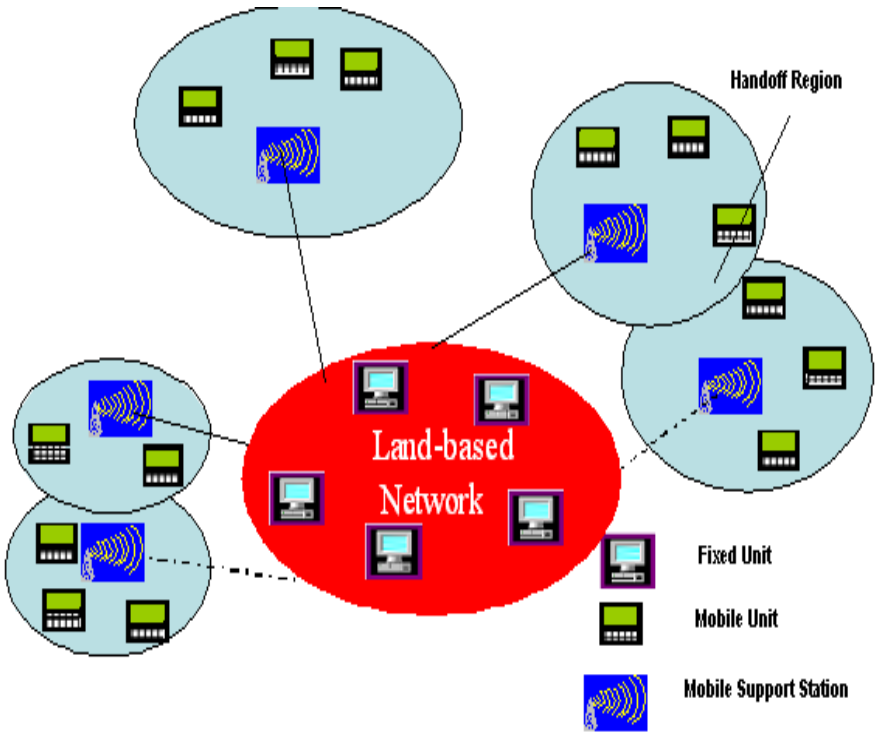

Figure 1. Mobile Computing Environment

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:

Firstly, Data is 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 users 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.

Secondly, 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.

In a concurrent environment execution of update requests at replicas may result in inconsistency among replicated data. Serial update request, a type of request ordering is used in distributed system to maintain consistent data copies and handle replicas at different sites or locations. Request handling at replicas is achieved by following ways:

1. Every request is held-back until ordering constraints can be met
2. Request is defined to be stable at a replica once no request from a client and bearing a lower unique identifier can be subsequently delivered to replica; that is, al prior requests have been processed.

Ordering can be categorized into different types:

1. Total ordering: Requests are processed in the same order at all replicas.
2. Casual Ordering: Causally related requests are only ordered at all replicas.
3. Sync Ordering: Requests are ordered in sync before or after a certain request at all replicas.

2. Terms and Concepts

We define some terms and concepts used throughout this paper.

2.1. Replica

A replica is an exact copy of a file that is linked to the original file through some well-defined mechanisms. Replicas of a given file may be synchronized to different levels of consistency, they may be catalogued, and their lifetime may be managed. We refer to these mechanisms as replica management functionalities.

2.2. Consistency

Replicas usually adhere to a certain consistency scheme. If there is no consistency mechanism between a replica and master copy, then the replication of files is equivalent to normal file copying, with the possible subsequent modification of the replicas enforced consistency schemes are:

- Consistent read-only replicas

  Once a file is under the control of a replica manager it becomes read-only. Modifications to a file result in the generation of a new file and, possibly, a new replica. Consequently, all replicas are consistent.

- Consistent read/write replicas

  Replicas may be modified. This scheme is equivalent to a readers/writers synchronization on a set of files; hence it requires appropriate locking mechanisms. Modifications need to be propagated to all the replicas of a file before the write lock can be released. This is true for a synchronous replication model where all replicas have the same values and updates need to lock all existing replicas. More relaxed replication schemes that use asynchronous update mechanisms allow certain replicas to be out of synchronization for a certain amount of time. In the asynchronous replication model, write locks only need to be applied to certain replicas but has the consequence that not all replicas are always up-to-date. For more details on synchronous versus asynchronous replication refer to [2].

3. Literature Survey

Much work has been done in the field of data management issues in mobile and P2P network [1]. It allows us to uses of wireless communication, makes the data availability, so it focuses on the problem of data availability and provides detailed discussion about replicating mobile databases.

Survey on replication algorithms of different distributed storage and content management systems, ranging from distributed Database Management Systems, Service-oriented Data Grids, Peer-to-Peer (P2P) Systems, and Storage Area Networks [3].

To deal with the frequent, foreseeable and variable disconnections that occur in a mobile environment, two-level consistency model was introduced. Semantically related or closely located data are grouped together to form a cluster. While all data inside a cluster are mutually consistent, degrees of inconsistency are allowed among data at different clusters. To take advantage of the predictability of disconnections, and to accommodate mobility, the cluster configuration is dynamic. It allows transactions to exhibit certain degrees of tolerance for inconsistencies by introducing strict and weak operations. Weak operations are operations that can be executed under weaker consistency requirements. It defines correctness criteria for schedules that involve weak operations and compare them with traditional serializability criteria [4].

Work related to proposing new strategy for maintaining the eventual consistency in large-scale mobile distributed database systems is also performed. The proposed strategy consists of three components in order to support the characteristics of such systems. These components are: replication architecture, updates propagation protocol, and replication method. The purpose of the replication architecture is to provide a comprehensive infrastructure for distributing replicas among wide areas [5].

Above [1, 3, 4, 5] survey has the capability to deals with how to maintaining eventual consistency problems, work with storage and content management system, replicas architecture and disconnection problems, but less focus on mobile users who faces problems

in the form of inconsistency. A new algorithm is proposed to propagate the required changes takes place by the mobile user at any of the site in the wise distributed network.

3. System Analysis

3.1. Objectives

Our main focus is to improve the matchless copies of data found in distributed system. It enables distributed users to use or depend on outdated or incorrect data available from nodes used wireless network. It is achieved by focusing on the following points:

1. Maintaining consistency of data.
2. Eliminate or avoid propagation delay
3. Distributed system with effective protocol and strategy
4. Propagation of data at every level in case of updation takes place at any level in the architecture chosen.

3.2. Existing System

The Wireless network is used to access the network nodes in the distributed database environment eventual by several users at the same time. Users when perform transaction activity at any activity center during mobility, it faces the problem of getting updated information, due to the problem of propagation delay during routing of changed data.

4. Highlights

a) Replication strategies introduce to improve the replica propagation in distributed environment.

b) New proposed architecture follows the replication activities perfectly without creating inconsistency in the database in mobile environment.

c) Focus on types of data to be replicated when any modification takes place at any of the site.

d) How replication of data is possible at different levels when changes takes place.

e) A new protocol Nearest Neighbor propagation distribution protocol is proposed to strengthen the replica propagation process in a dynamic sense.

5. Replication Strategies

To achieve performance in system with replication, it is important to work for high level replication. It is because replica enables the database users to work efficiently in mobile distributed system. In a mobile environment, however, mobile hosts or users are dynamic. They could move to anywhere and for unpredictable length of time. Furthermore, the users of replicas may need to work at several ‘‘well-known’’ sites. In such cases, it may be more advantageous to deploy multi-replication, i.e., placing a replica on each ‘‘activity center’’ of its users. Based on usage replica two types of schemes follow: Static and Dynamic replication. In general static replication has so many problems in the form of:

a) Calculation of location and number of replica before it is deploy among different network node in distributed database system to reflect new changes patterns

b) Wrong assumption of fixed locations cause changes patterns are no more exists or hold.

On the contrary, dynamic replication holds following:

a) It continuously or regularly maintained statistics of changed patterns and updated into related locations synchronously, so that changes can be adapted to fulfill the requirement of the mobile user transactions.

In the centralized approach, where data is shared or controlled from one single site while in distributed approach where data is control or shared among different sites in the network. So, dynamic replication is the only strategy which follows synchronous replication system control.

6. Proposed Architecture

This hierarchical replication architecture contains mobile users, scheduler work on the side of local server (LS), fixed host and mobile host. Hierarchical architecture is divided into fixed network and mobile network. The fixed network consists of Fixed Hosts (FH) and wired local area network to connect the fixed hosts. Considers as total geographic area called the Root level, divided into a set C = {c1, …, cn} of childs. Each child consists of a set A = {A1,…, Am} of smaller areas called abstraction level. Abstraction level is all about showing how fixed hosts are connected with local server or MSS used scheduler for proper ordering of updates to avoid inconsistency problem. Each Abstraction level represents an area where mobile users can perform their database transaction before moving towards another cell. In this architecture, the network is divided into fixed network and mobile network. The fixed network consists of Fixed Hosts (FH) and wired local area network to connect the fixed hosts in the master level, and also include wide area network to connect fixed hosts in the root and child levels, and the servers of the cell called Local Server (LS). The abstraction level local server is augmented with a wireless interface and acts as a mobile support station (MSS) for connecting mobile hosts to the fixed network. Here scheduler works on behalf of LS, responsible to update the data into Local Server in ordered way, performed by several database users during mobility. It is also responsible to control the traffic coming from different database users to avoid inconsistency problems occur. Because same information or data is propagated further to other levels. On the other hand, the mobile network consists of wireless network and Mobile Hosts (MH) in the abstraction level. To provide more flexibility and application areas for this architecture, replicas are divided into three levels (See Figure 2).

a) First the Root Level, this level contains the master replica, which must be synchronized with the replicas from the child level. The server in this level is responsible for synchronizing all changes that have been performed on infrequently changed data with the lower level.

b) Second the Child Level, this level, each replica must be synchronized with replicas from the lower level. The child server is responsible for synchronizing all intra-level data with the root server.

c) Third, the Abstraction or hidden Level, where each replica in this level is updated frequently, and then synchronized with the cell server's or local server replica and in turn the local server synchronizes all intra-level data with the child server.

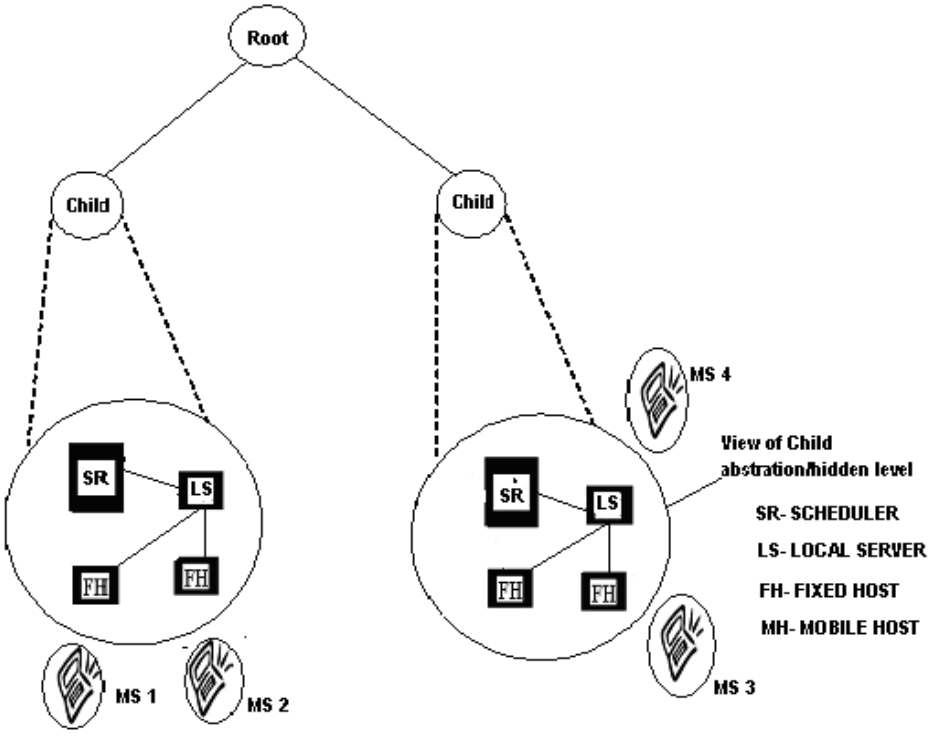

Figure 2. Hierarchical Architecture

7. Replication Structure

It is all about how different nodes in distributed system are physically accessed by different users during mobility. Nodes in the network contain identical data, but consistency of data with other network nodes is the prime issue of discussion that should be necessary, to maintain faith on distributed environment users. Data can be accessible from any node means availability of data can be approach from everywhere or anywhere within the wireless circle. Maintaining consistency of data at each site or node is the main concern, in which focus is given only to mobile users, because they regularly performs write or update operations time to time. It is important that data should be replicated equally among different nodes by propagating changing affects to other successive nodes in the network to maintain consistency. A Hypercube network structure is used to illustrate the process of replica management and is well suited in distributed environment. It shows a hierarchical architecture, each node has more than one child and further child have some sub child means, it depict a picture of parent child relationship structure.

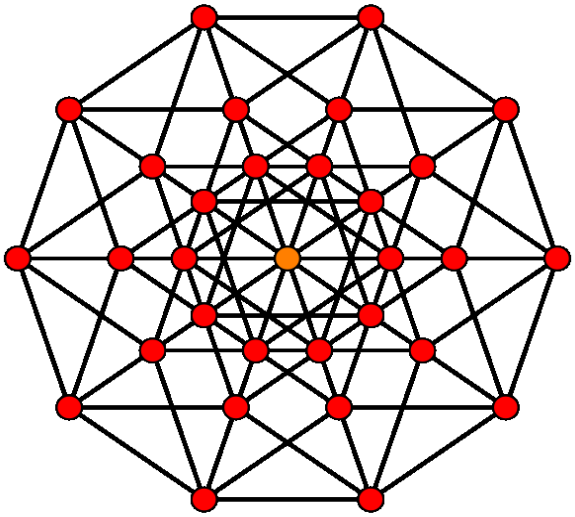

Figure 3. 5-Cube Structure

In 5-cube structure (See Figure 3), when any database updates or writes operation takes place at any of the node by the mobile users in distributed system. Most importantly, how the data is propagated among other nodes, so that availability or updated information is found by the users easily at every node? To propagate updates, different techniques can be applied. A distinction needs to be made concerning what is exactly propagated, to where updates are propagated, by whom propagation is initiated.

Based on the above replica structure, routing of updated data is propagated to each node by using protocols. Here nodes are uniquely identified by their unique identical addresses. Replication is performed initially from starting node, further it is replicate to its most nearest neighbor node by replication distribution protocol and at other levels by using Push Protocol or Server Based Protocol. Not every replica always needs to be updated immediately. Distribution protocol plays an important role which decides which replica is updated at which time. Push protocol is used here because further it propagated to other replicas without even asking for the updates. There are different issues to consider with respect to propagating updates, they are following as:

1. Propagate only a notification of an update.
2. Transfer data from one copy to another.
3. Propagate the update operation to other copies.

By follow the client-centric consistency model, suitable for distributed database for mobile users, it is ensure that whenever a client connects to a new replica, that replica is brought up-to-date with the data that had been manipulated by that client before.

8. Nearest-Neighbors Propagation Distribution Protocol

This section provides the details of the proposed protocol for updates propagation through the components of replication architecture. This protocol works as follows:-

When any mobile user reached at any location or node in the mobile access network and performs read-write operation, that node is treated as dirty, means there is a need to propagate the changed affects into its nearest neighbors nodes using replication distribution protocols.

Here replication process follows two cases:-

8.1. Case 1

When any change takes place at any node firstly it broadcast the changed effects to all it's nearest neighboring nodes. Here to perform the updating two issues are come in consideration:

1. Whether to propagate the whole changed file block: Here replica propagation is based on Coarse-Grain Granularity, in which whole block is accessed and write/update operations are propagated directly to others nodes.
2. Whether to propagate or reflect only changed data: Here replica propagation is based on Fine-Grain Granularity, in which only related data items that are manipulated only propagated to all its neighbor nodes.

8.2. Case 2

All the neighboring nodes further broadcast the changed effects to its corresponding nodes. This process of replication is repeated till last. Here two issues are in consideration:-

1. Whether to update the already updated node or not. Sometime adjoining node is already updated when broadcasting of updates takes places by other nodes.
2. To maintain or check the consistent data copies at each node, replicate data is compared with already existing updated information. If both the copies found identical than no propagation takes place otherwise old data is replaced by the new updated copy.

9. Conclusion

In this paper, focus is given on different issues and strategies to become replication process effective as well its importance in mobile distributed system are indicated. Mobile users face problems in the form of inconsistency, unreliable data and allow users to access the outdated data or information. A replication structure and new proposed replication protocol (NNPDP) is introduce in support to achieve better replication response in mobile distributed database system environment using dynamic replication.

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