# Fitting Database Transactions into mobile environment

ملائمة تحديثات قواعد البيانات في بيئة الهاتف النقال

Dr. Fouad A. Aref
College of engineering
Al-Iraqia University
Fouad.Aref@aliraqia.edu.iq

د. فؤاد عبدالرزاق عارف
كلية الهندسة
الجامعة العراقية

## الخلاصة

اجريت الكثير من البحوث في مجال ادارة الاستفسارات لقواعد البيانات في بداية ظهور الاتصالات اللاسلكية والحوسبة النقالة . هذا البحث يعرض مقترح جديد يستند في عمله على معمارية النماذج النقالة المعمول به حاليا، مع الاضافة المقترحة المتمثلة بـ(منظم التحديثات النقالة) والذي يعمل كمنسق لعمل الاجهزة النقالة المرتبطة بالشبكة والتي بدورها مرتبطة بمحطة دعم النقال ، مع المحافظة على خصائص قواعد البيانات المتمثلة بـ(كل شيء او لا شيء "Atomicity" و التناسق "Consistency" والعزل "Isolation" والمتانة "Durability"، "ACID"). يرتبط الضيف النقال مع محطة الدعم من خلال الشبكة اللاسلكية الافتراضية، وترتبط بدورها محطة الدعم مع منظومة الشبكة. يتم اجراء وصف لمتابعة تحديث في المعمارية المقترحة.

## Abstract

Much work has been done to mobile computing and database querying and transaction management with the dawn of portable computers, mobile computing and wireless communication system. This paper proposes a novel architecture based on current mobile models, but with addition of MTO (Mobile Transaction Organizer), which serves as coordinator for the mobile host's transactions, besides maintaining database ACID (Atomicity, Consistency, Isolation, Durability) properties. Mobile Hosts (MHs) and Mobile Support Station (MSS) are connected over a wireless virtual subnet, and the MSSs are in turn connected to a network. The mobile network and supporting hardware are assembled, and an example demonstrates a database transaction traced through the proposed architecture.

## 1- Introduction

In the early 90s work started on mobile database. The key research issues that the research community has tried to tackle are how to cope with mobility, frequent disconnection and energy limitation of the client in a number of DBMS (Database Management System) issues, such as transaction management data caching, data replication and location aware query processing.[1]

In a database environment, a transaction is defined as a unit of process which changes the database from one consistent state to another consistent state. If the state change is successful, the transaction is committed, otherwise rolled back. In the context of mobile computing, there are several interpretations of mobile transactions.[2]

There are four attributes that define the characteristics of a transaction: atomicity, consistency, isolation, and durability, which are also known as ACID attributes of a transaction. Mobile devices may not be connected to the central database server all the time. It is critical that ACID attributes of mobile transactions are maintained. [2]

## 2- Theoretical background

Remote access to various types of data is not a new concept. Traditional distributed database and multidatabases relying on fixed network connectivity have addressed many of the issues involved in accessing remote data. However, the concept of mobility, where a user accesses data through a remote connection with a portable device, has introduced several disadvantages for traditional database management systems. These include:[3]

- Reduced network connectivity,
- Processing and resource restriction, and
- Effectively locating and accessing information from a multitude of sources.

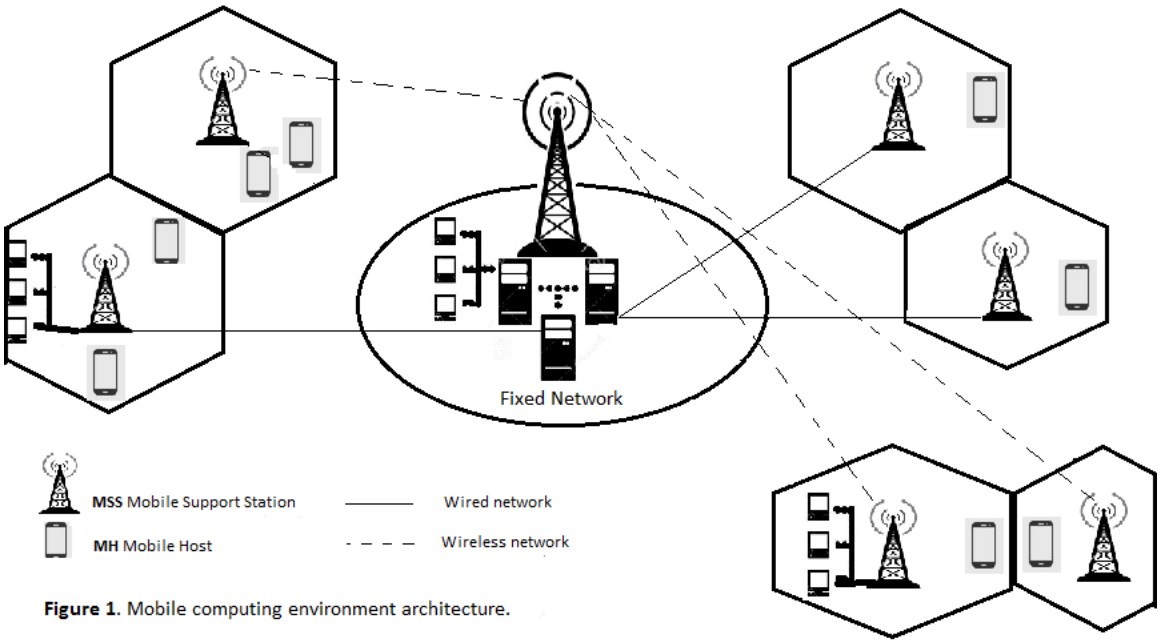


**Figure 1.** Mobile computing environment architecture.

The mobile computing environment is based on wireless communication that allows the user to access information anywhere at anytime without direct physical link to the network. The wireless network (**figure 1**.) is mainly composed of the following:

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

The MSS provides a link between the wireless network and the wired network. The link between a MSS and the wired network could be either wireless (showed as dashed line) or wire based. The area covered by the individual transceiver is referred to as a cell. The size of the area covered by each cell varies widely, depending on the technology being used. The MH is relatively small, light weight, and portable. It is designed to preserve space and energy, and it usually has limited amount of resources (memory, processing power, etc). Most of the time, the MH relies on temporary power sources such as batteries as its main power source. To save energy, the MH is design to operate in different operational modes (i.e. active doze, sleep, nap) that consume different amount of power.[4]

**3- Mobile issues**

With the rapid growth of wireless networking technology and mobile computing devices, a highly increasing demand arises for processing mobile transactions. This allows mobile users to access and manipulate data anytime and anywhere. However, to guarantee timely access and correct results for

concurrent mobile transactions, concurrency control techniques become critical. Furthermore, there are some issues to be reviewed, when designing mobile database. [5]

**3-1- Mobility**

The ability to change nodes locations while retaining network connections is the key motivation of mobile computing. However, a nod's network and physical location change dynamically, and at the same time, the states of transactions and accessed data items have to move along with the node. Mobility can lead to multi-hop communication, high communication latency and frequent disconnections. [6]

**3-2- Low (limited) bandwidth**

Wireless network bandwidth is much lower than its wired counterpart. Thus, within the cell of one node, inside neighbors have to share and compare for the same channel. If someone fails, it may keep sending requests until timeout. This limitation can cause a communication delays and a high risk of disconnections.[6]

**3-3- Multi-hop communication**

In traditional mobile networks, mobile nodes that communicate with each other must go through a fixed infrastructure. When communication does more hops, results a more power and bandwidth consumption, and more execution time are needed to complete transactions.[5]

**3-4- Limited battery power**

Because of the mobility and portability, database applications have severe resource constraints in terms of capacity of battery and sizes of memory and hard drive. In addition, the battery technology is not developed as rapidly as the mobile devices and wireless technologies. Once a mobile unit runs out of power or has insufficient power to function, communication fails, disconnections happen, execution of transactions is prolonged, and some transactions may have to be aborted.[5]

**3-5- Limited storage**

Due to mobility and portability, the sizes of memory and hard drive are smaller than the ones in the wired network. The consequences of this are less stored/cached/replicated data, fewer installed applications, and more communication.[6]

**3-6- Frequent disconnections**

A MH (node) is disconnected when it moves freely from one cell to another, when battery runs out. It's normal for a node to become disconnected. When disconnected, the node should still be able to process already started transactions. However, when disconnections happen frequently, more transactions may be delayed or blocked, and even aborted.[6]

### 3-7- Prolonged transactions

Due to mobility, wireless communication delay, poor processing power, frequent disconnections and unbound disconnection time, transactions in mobile-database tend to be long-lived. When execution is prolonged, the probability of conflicts with other transactions become higher and , consequently, transactions are likely blocked.[5]

## 4- The proposed work

This paper proposes architecture uses mobile environment with some crucial additions. The architecture subdivides MHs into two categories: roaming mobile host (RMH) and home mobile host (HMH). Each MH will be joined with a particular cell, and this cell will be traced (governed) by the MHs home MSS. Whenever a MH wishes to connect within this cell, it will be recognized as a HMH by the MSS. During a transaction, if the MH moves out this cell, the MSS for the next cell will identify the MH as roaming mobile host (RMH).

In addition, this paper introducing the idea of mobile transaction organizer (MTO) traces transactions for each MH. The MTO will be the organizer of all transactions from the network. The following, is a description of different components of the proposed architecture, as shown in (**figure 2**).

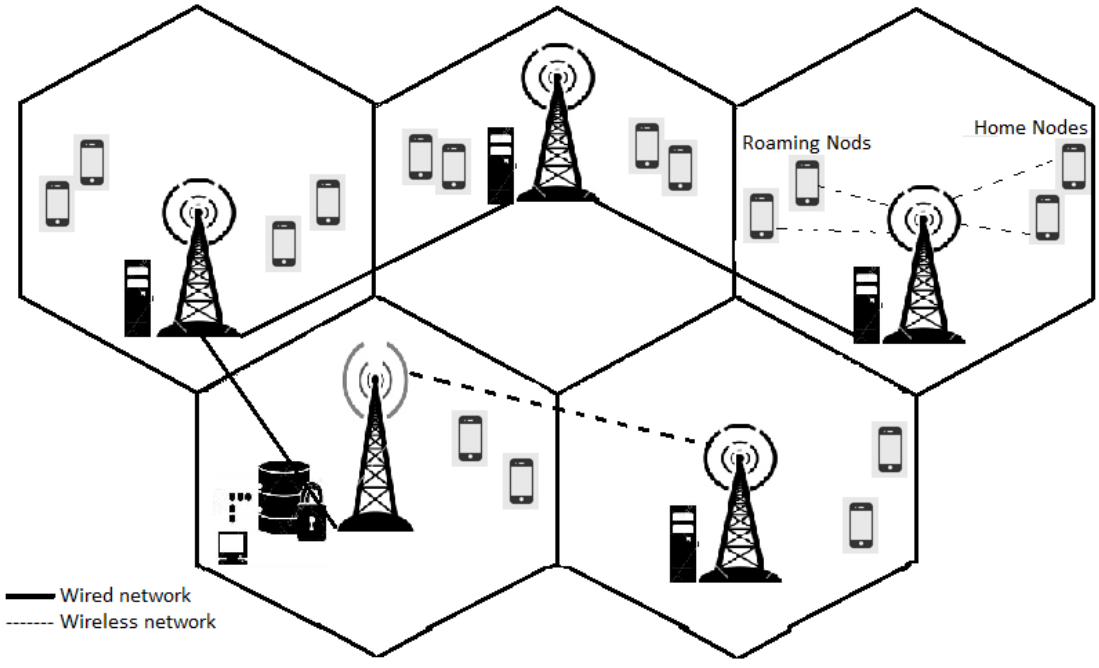


**Figure 2.** The proposed Architecture

### 4-1- MSS role in the proposed architecture

**The** mobile support station MSS is the physical and software component required to support a wireless connection from MH to the static network. These components include the Mobile Support Router (MSR), the mobile transaction organizer (MTO), and the network router. The MSR is the unit which communicates with the mobile hosts by passing packets to and from the MTO.

The network router communicates with the static network, and also returns query results from the static network back to the MTO.

**4-2- Mobile Transaction Organizer (MTO)**

The key to successful implementation of the proposed architecture is to have an easily accessible transaction organizer available at all times. Mobile Transaction Organizer (MTO) provide a central repository for all of the MH`s transaction responses and logs, since they must be available at all times and easily locatable, the users primary cellular provider will maintain track for each subscriber.

Each MH will have access to the MTO that is created by the local cellular provider. The MTO will contain transaction information, such as completed transactions and logs. The MH will be able to access the MTO by utilizing the current MSS, either local or remote, to connect with the home cellular provider. This MTO could be the key to mobile transaction recovery, because all messages destined for the MH will be sent to the MTO.

**5- Simulation and discussion**

In this section a trace of query is presented. At any given time or place, the MH initiate a connection with the network, using the TCP/IP, a wireless connection will be established between the MH and the MSR via acknowledge packet, a rout is now established between MH and HMH, in which its designated MTO is located, as shown in (**figure 3**).

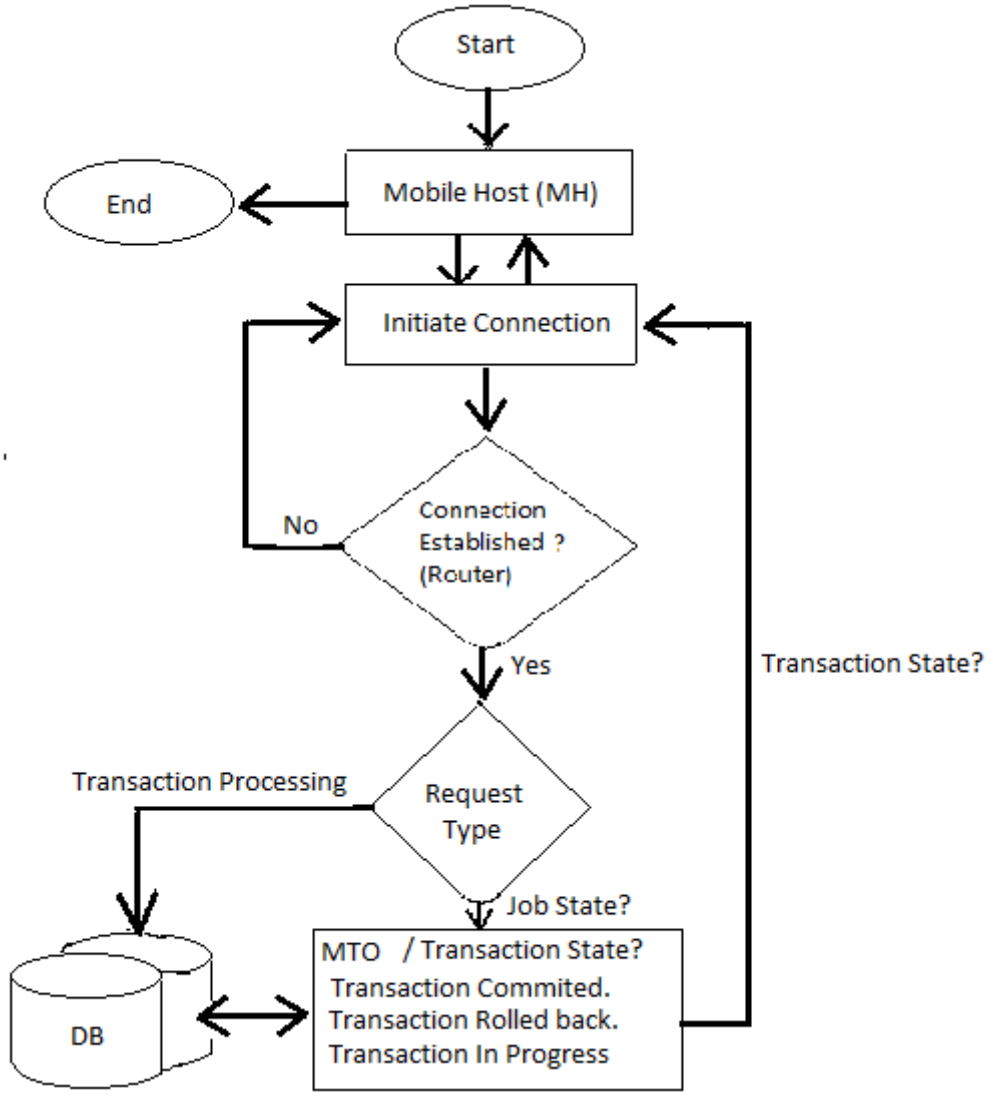


**Figure 3. System Flow Diagram**

After a hand shaking at all levels has been successfully completed, the MH is free to make query against any database to which the MTO is linked. Once the query has been submitted, the MH has several options: disconnection from service provider, submission of additional query, or retrieval of current or previous query results.

## 6- Conclusion

Mobile database suffer additional issues that are not usual in traditional database. The dependency of mobile computers on batteries causes poor network connectivity and loosing track of transactions. This paper proposed the MTO technique for a reliable database in the mobile environment. The technique shows that as long as the transaction is submitted, the MTO will keep track and trace transaction until commit is acknowledged. Meanwhile if the MH is connected it will be informed the result, otherwise the result will be kept in MTO and will be informed whenever the MH is connected.

**References**

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