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Current State of the Art in Mobile Transaction Models: A survey

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Abstract - Mobile Database popularity is on the increasing by the secend as people need information while they are on the move in today fast changing world. This new technology allows users of mobile devices to connect to their corporate networks, collect the needed data, carry out theirr jobs while in disconnected mode and reconnect back to the network to synchronize with the corporate database. But the critical issue in mobile data management is to respond to real – time data access requirements of the supported application. However, it is difficult to handle real-time constraints in today mobile computing environment due to the physical constrains imposed by the mobile computer hardware and wireless network technology in use. The availability of the World Wide Web on mobile computing systems is expected to open up a new class of applications which provide location sensitive applications. The data is being moved closer to the applications in order to improve the performance and autonomy. These activities has lead to many problems in mobile Transactions. This paper surveys the current state of the art in Mobile Transactions Models. The survey focuses on recent types of Transaction Models proposed by some scholars.

KEYWORDS - Architecture, Transaction Models, Mobile Transaction, (ACID - Atomicity, onsistency, Isolation, Durability).

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I. INTRODUCTION

Wireless communication technology, personal digital assistances (PDA), handhelds and portable computers are the bases for today mobile computing. Mobile devices are gradually more used for database driven applications like Sales Order Entry, Product Inventory Tracking, Airline Booking, Academics and Customer Relationship Management. The manner in which Mobile applications access the data and manage them has greatly changed completely due to these applications. In these applications data are moved closer to them to improve the efficiency and autonomy instead of storing them in a central database. A transaction is nothing but a legitimate implementation of database operation [1]. Several efforts are devoted to improve data management in mobile environments and solutions have been proposed in distinct areas [2].

These Models has been proposed by scholars in attempt to improve support for different types of applications that can be personal or professional ones. To manage data correctly, support for traditional properties of transactions – atomicity, consistency, isolation and durability (ACID) – is needed with respect to the these mobile applications. For that several models have been proposed so far by so many scholars. This paper surveys different mobile transaction models and in a tabular form compares them to show their distinction. This topic is considered very important given the complex aspects of Mobile transactions in today technology environment.

Many researchers have been working in this area, but there has not been a deep comparison of existing proposed models. This paper then attempts to survey the current state of the art in Mobile Transactions Models and compare the current models as proposed by scholars.

II. MOBILE TRANSACTION MODELS

Collection of operations that form a single logical unit of work is called a transaction [4]. If the transaction takes place in the mobile environment, it is teamed a Mobile Transaction. In [5], the characteristics of a Mobile Transactions is provided as follows:

- The Mobile transactions are long-lived transactions due to the mobility of both data andusers and due to the frequent disconnection.
- The mobile transactions might have to split their computations into sets of operations,some of which execute on MH and others on MSS. A mobile transaction shares theirstates and partial results with other transactions due to disconnection and mobility.
- The mobile transactions require computations and communications to be supported byMobile Service Stations (MSS).
- As the MHs move from one cell to another, the states of transaction, states of accesseddata objects, and the location information also moves.
- The mobile transactions should support and handle concurrency, recovery,disconnections and mutual consistency of the replicated data objects.

III. Types of Transaction Models

In [1] a model called Report and Co-transaction model was prposed. This model grounded as a context of specific multi database system (MDBS). Nested transaction is a parent transaction that makes child transaction supports more of the qualities of being adaptable than atomic transaction. According to [6] this model arranges the mobile transaction into following four types:

- Atomic transactions: It is related with substantial events like Begin, Commit, and Abort having the normal aborts & commit properties.
- Non-compensatable transactions: It is not linked with compensating transaction. It can execute at any time and the parents of these transactions have the responsibility to commit and abort [7].
- Reporting transactions: A report can be regarded as a delegation of state between transactions.
- Co-transactions: These transactions executed like coprocedures executed. When one transaction is executed then control passes from current transaction to another transaction during sharing the results.

Kangaroo transaction model. This type of model was proposed by [8] and was made to perform to represent the movement behaviour and data behaviour of transaction when a mobile host changing the position from one mobile cell to another in static network. It is named so because in mobile environment hop transaction move one base station to another [9]. The execution of a Kangaroo subtransaction in each mobile cell is supported by a Joey transaction that control in the scope of the mobile support station [10] The Joey transaction performs to require of a proxy transaction to approve of the execution of the sub transaction of the Kangaroo transaction in the mobile cell. A Kangaroo transaction has a unique identification number composed of the base station number and unique sequence number within that base station [11].

Clustering model was proposed by Pitoura, this model accepts a fully distributed system and is considered as an open nested transaction model. It is grounded on collection of related data together to form a cluster. Each cluster is composed of reciprocally consistent data. The level of consistency changes according to the calculation of the accessibility of network bdwidth among clusters [11].

Isolation – only model: This type of model was proposed by Satyanarayan and is used in Coda file system. Coda is a distributed file system that uses file hoarding and concurrency control for mobile clients which provides disconnected operations [11].

Isolation only transaction covers read/write conflicts only within the service but it can only take value or importance in write/write conflicts.

Two-Tier transaction model is also called refered to as Base Tentative model and is grounded on a data replication scheme. For each object, there is a master data copy and various replicated copy. In this model transactions are arranged in two categories: Base and Tentative. Base transaction function on the master copy while Tentative transaction retrieves the replicated copy. When the mobile host is abrupt, Tentative transactions modify the replicated data copy [12]. When the mobile host reconnects, Tentative transactions are converted to Base transactions that are re-executed on the master copy. [6].

Multi database transaction model is grounded on a framework to be adopted as a belief on transaction submission from mobile hosts in a multi database environment. Call for messages from a mobile host to its coordinating site is dealt asynchronously allowing for the mobile host to unplug it [13].

Pro-motion transaction model. This model was proposed by [14], [1] and grounded on nested transaction model [15]. Here Mobile transactions are conceived as long and nested transactions where top level transaction is executed at fixed hosts, and sub transactions are accomplished at mobile hosts [**16**]. The accomplished task of subtransactions at mobile host is confirmed by the concept of compact objects. Compacts are brought in as the introductory unit caching and control.

In [17] a **Toggle transaction model was proposed**. In this model a Mobile Multi database system is determined as an assembling of set and mobile databases [17]. Mobile Multi database management system is the software which occupies on a determined network and operates several database systems. As mobile users change location to a new location of another Mobile Support Station (MSS), operations of a global transaction may be presented from different MSSs. Such transactions are referred to as migrating transactions.

Twin-Transaction Model was proposed by [18]. It defines a transaction execution mechanism which satisfies the need of both connected and disconnected modes of operation. A defined resynchronization mechanism that achieves a consistent state on reconnection of the mobile host.

Zhengwei et al., in [19], proposed a novel theoretical mobile web transaction model called **PMTM** (P system-based Mobile Transaction Model) to formalize the behavior of mobile transactions. This model has two transition rules namely Membrane rules and Object rules. The Object rule describes the transitions in membranes whereas the Membrane rule defines the structural modification of membranes.

In [20] an **Adaptable Mobile Transaction Model was proposed** which permits defining transactions with several execution alternatives associated to a particular context. The aim of this model is to adapt transaction execution to context variations. In this model Atomicity and Isolation properties are relaxed but conflict serializability is preserved. The advantage of this model is that it improves the commit possibilities and permits to select the way transactions will be executed according to their costs.

In [12] a new enhanced **shadow paging technique** called a **Mobile-Shadow** technique for handling mobile transaction processing and disconnection was discussed. M-Shadow uses a notation of actionability, which differentiates the actions to be taken during the transaction's validation phase according to the types of affected attributes.

A new transaction scheme called **Surrogate Object Based Mobile Transaction Model** (an Improved Kangaroo Transaction Model) is presented by [7]. The main focus is to support data caching at surrogate object for faster data access and database operations among mobile transactions at different mobile hosts in mobile environment. The

experimental results prove that there is a significant reduction in wireless access and abort probability can be obtained with the proposed model.

Also, in [21] a **Connection Fault- Tolerant Model was proposed** for mobile environment which reduces the blocking time of resources at the fixed devices provides fast recovery from connection failures owing to mobility of mobile devices and increases the number of committed mobile transactions.

IV. Comparison of different models

Type of Modell	Atomicity	Consistency	Isolation	Durability	Execution takes place in	Transaction Type	Operation mode	Scalability	Database system Model
Report & Cotransaction Model	Yes	yes	yes	Yes	Mobile unit or fixed unit	Global and sub transactions	Connected	Require high bandwidth	Multi Database
Kangaroo transaction model	Not quite	No	No	No	Fixed network	Coordination and transaction execution	Movement in connected mode	Splitting with frequent commits might load the database	Heterogeneous Multi Database
Clustering model	No	No	No	No	Mobile unit or fixed network	Strict & Weak Transaction	Connected, weak connected, disconnected	Large number of clusters	Fully Distributed Database
Isolation only transaction model	No	No	No	Yes	Mobile unit or fixed network	Validation and resolution of second class transactions	Connected, Disconnected	-	Fully Distributed Database
Two-tier transaction Model	No	No	No	No	Mobile Unit or fixed network	Base transaction	Connected, disconnected	-	Fully Distributed Database
Multi database transaction model	No	No	No	No	Mobile Unit or fixed network	Coordination and execution of multitransactions	Movement in connected, disconnected mode	-	Fully Distributed Database
Promotion model	Yes	Yes	Yes	Yes	Mobile Unit or fixed network	compact construction, commit of locally committed transactions	Connected, Disconnected	-	Distributed
Toggle transaction model	Yes	Yes	Yes	Yes	Mobile unit or fixed network	site-transaction, migrating transaction	Connected	-	Distributed

V. Conclusion and Future Research

In recent past, Industry and Academia has shown a lot of interest in improving data and transaction management in Mobile environment. Data and Transaction management in mobile database is very difficult compare to traditional databases as the mobile environment needs to be highly versatile and have to satisfy several resource constraints. Mobile transaction originates and ends at same site. The implication of the movement of such transaction is that atomicity, concurrency and recovery solutions must be revisited to capture the whole behavior. As an effort in this direction variety of different types of transaction models (proposed by scholars) was surveyed and they were compared in order to reveal the similarities and dissimilarities. It can be seen from comparison that many of these proposed models does not satisfy ACID property. Hence, in choosing a type of model one has to realy decide which of these models and also because of the continous change in transaction research will continue in this area in other to meet with the increasing demand in mobile transaction.

In recent time there has been relatively little research so far on mobile database transaction systems. Mobile environments are highly versatile and face several resource constraintsand and also mobile transaction executions are not predictable and require adapted approaches. These are some of the reasons that lead to the development of various new Mobile Transaction Models. The use of database systems is on the increase by the second and most of the existing database transaction models works with the certainty. But today mobile transaction needs systems which can cope with uncertain data e. g. connectivity, location and direction of weather systems and many more. Hence, more research work on mobile transaction should be directed in this direction.

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