A Strip-down Database for Modern Information Systems

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Abstract: *In-depth study of mobile computing forms basis for mobile database design suited for advance enterprise systems. Paper investigates issues that need to be addressed in mobile database development suitable for mobile computing environment and then provide high-level adoptable object oriented mobile database management system model. Considering GSN based mobile network provided with data services to mobile clients accessing database server via small mobile phones. Limited bandwidth, instability of wireless environment and limited resourced mobile phones require light weight adoptable object oriented mobile database management system to manage mobile database. Keeping only frequently access objects at mobile phone to improve performance, reduce data transmission and provides high data availability for disconnected operations especially for advance enterprise Information Systems. Scheme is also proposed along with simulation study which identify most frequently accessed objects to ensure high data availability for small memory mobile phones*

Keywords: *Nomadic Database Management System, Mobile Database Computing, Object Oriented Mobile Database, Object Replacement and Cache Schemes*

1 INTRODUCTION

As a matter of fact, now a days growing use of wireless communication networks, advance mobile phones and PDAs, allows a new kind of computation called mobile database computing. Therefore it is highly expected that GSM networks will mostly correspond to data transmission which will require light-weight database system providing high data availability at mobile host (MH) to enhance data management services during disconnected operations under wireless medium, which is vulnerable to frequent disconnection and provides limited bandwidth.

Mostly, due to asymmetric communication of wireless medium, contacting the server for required data is expensive therefore broadcasting of most frequently accessed data items [1,2,3,4] is considered much supporting in reducing point-to-point communication for performance gain. Eventually it may be possible if MH is disconnected, as is often the case in wireless medium. This research paper introduce a new light-weight high-level object oriented mobile database model which requests objects from the server very rarely by keeping minimum set of mostly required objects at MH.

The proposed solution strictly based on such characteristics which are very well suited with mobile database computing requirement such as: it is based on object oriented database architecture (OODBMS) which is well suited for mobile environment [5], it is stripped-down database version of server counterpart; it is based on request based object access at smaller level of granularity to reduce transmission overhead and storage requirement, rather than receiving pages returned by server contain other unnecessary objects; and most important possesses transparent mechanism of keeping only the mostly required objects in point-to-point paradigm by adapting the hidden dynamics in object calling pattern by queries at individual MH.

This research paper introduces new mechanism of finding mostly required objects for a MH over rarely required objects for keeping them in limited storage to cater mobile database requirements. Optimal Dynamic Exponentially Weighted Moving Average of durations (DEWMA) technique is implemented for adapting hidden dynamics in object calling pattern by the queries at MH. It is required to cater light-weight mobile database requirements over conventional commonly employed principle of locality based techniques which has widely been adapted by most database systems [6,7,8]. Conventional techniques are less efficient in point-to-point paradigm and require more, storage, transmission overhead, cost and power. Though there are few solutions available for mobile databases/mobile database computing but they all are supporting and compliant to the characteristics exhibit by notebooks or palmtops, which are entirely different than the required mobile database solution subjected for small resourced mobile phones.

Purpose of this paper is twofold, first; highlight the performance related concerns of mobile computing environment for mobile database computing and then focus on proposed model and mechanism in compliance with mobile database computing concerns. The structure of this paper is as follows: Section 2, discusses the recommended mobile computing environment for mobile database computing, and identifies the performance related issues for replication requirement by analyzing characteristics of mobile computing environment. The other related research work is also explored. Section 3 presents the proposed light-weight high level object oriented mobile database system, presents proposed database model architecture, working of Optimal DEWMA technique, which is the optimal version from our many other techniques. Most important supported research work in the area is also presented. Section 4 demonstrates the feasibility of proposed techniques, followed by the conclusion in Section 5. Finally Section 6 investigates and discovers dramatic future research directions and emerging trends in the respected research discipline.

2. CHARACTERISTICS OF MOBILE COMPUTING ENVIRONMENT AND RELATED DATA

REPLICATION AT MOBILE UNIT:

2.1 Mobile Computing Environment:

Widely accepted architecture [9] for mobile distributed computing comprised of following components: Mobile Units (MU), Fixed Hosts (FH) without wireless interface and Base Stations (BS) or Mobile Support Station (MSS) which are fixed hosts with wireless interface to provide coverage, called cell, for communication to MU. Cells usually overlap to provide smooth hand-off (see figure 1.1). In order to increase throughput the indirect model is suggested in [10], where an intermediary element, called proxy, is placed between two radically different media (wire and wireless) who relieves limited extreme of the communication from some task in such way that its existence remain unnoticed for two computers. Moreover in [11], philosophy behind the indirect model extended with Gateway Support Node (GSN), situated between the circuit switching and packet switching rather than between wire and wireless (see figure 1.2). Every GSN manages one or more BSs where as services incorporated at GSN relieves MU from many tasks and increase their capabilities, respecting their natural limitations; therefore the following architecture is considered in our proposal.

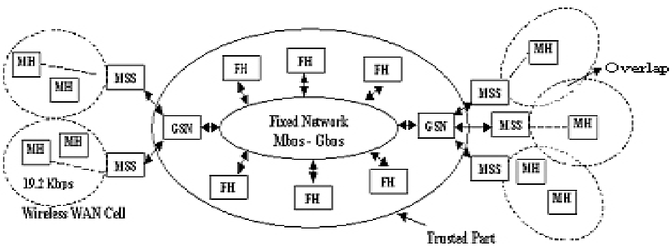

Figure 1.1: Mobile computing environment.[9]

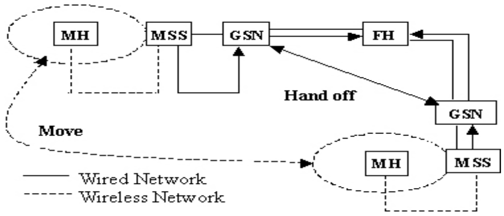

Figure1.2:Extended GSN based indirect interaction model[10]

2.2 Characteristics of Wireless Medium for Mobile Computing:

In wireless networks bandwidth, which is major concern for mobile database computing, is scarce resource (9 Kbps- 10 Mbps) in contrast with fixed network (10 Mbps- Gbps) see Table 1 [9,13,15]. Another important reason that makes bandwidth consumption a major concern for mobile database computing, is that data transmission over the air is monetarily expensive[12].Disconnection is much more frequent and various degrees of disconnections depending on available bandwidth and noise of communication channel [13,14,16,17]. Sometimes disconnections are considered *foreseeable* by detecting change in signal strength, predicting battery's life time, or making use of knowledge of the bandwidth distribution [14,15,16,17].

2.3 Characteristics of Mobile Units:

Mobile phones have limited resources as a result of their portability (see Table 2). MUs range from mobile phones, PDAs, or palmtops to tabletop computers with limited battery capacity [13], which is another important consideration for mobile database computing.

Table 1: Typical values of wireless networks.

Wireless Networks	Products	Cost of Comm.	Bandwidth	Cell's Range
Cellular	Ericson CE's Mobidem etc.	High	9-14 Kbps	1-2 Miles
Wireless WAN	GPRS, ARDIS, RAM etc.	Moderate	8-19.2 Kbps	Few Miles
Wireless LAN	NCR Wave LAN, Motorola's ALTAIR, Free Port, Telesystem's ARLAN etc.	Low in Wireless Medium	250 bps-2 Mbps, 10 Mbps	Few KMs
Satellites	Motorola's Iridium LEO, Qualcomm's Clobalstar MEO, TRW's Odyssey GEO etc	V. High	V. Low	400 Miles

Table 2: Typical values of mobile phones.

Products	Shared Memory	Talk Time hours.	Weight gram	Display mm
Nokia 6610i	4MB	1.5	87	2.5x3.5
Nokia 7610	8MB	3	118	2.5x3.5
KROME Intellekt iQ700	6 MB	2.5	130	3.5x4.5
Sony Ericsson K700i	6MB	6	93	3X4

2.4 Issues of Mobile Database Computing:

Mobile database computing is a distributed database computing where the use of wireless medium and resulting mobility of data consumers and producers affects database computing in various ways. Therefore Table 3 presents summarized characteristics or issues which impacts mobile database computing [18] together with wireless and MU's characteristics.

Table 3: Summary of characteristics

Wireless Medium's Characteristics	Mobile Unit's Characteristics	Mobile Database Computing Issues
High bandwidth variability	Limited computing power	Access heterogeneous data sources
Frequent disconnections	Small screen	Location dependency
Low bandwidth	Limited battery life	Data relocation
Predictable disconnections	Limited memory & cache	Intelligent caching requirement
Monetarily expensive	Small size	Error prone
Asymmetry in communication	Intermittently connected	Few Long lived sessions
Broadcast is physically supported in cell	Susceptible to theft, and accident	Weak consistency
High power consumption for startup communication.	Limited storage	Distributed query processing

2.5 Characteristics of Data Replication required at MU:

Impact analysis of mobile computing environment in the area of data management demands required optimal implementation of mobile databases at MUs which are supposed to be stripped-down version of their server-based counterparts, provided mostly with task specific data for

offline data availability and accessibility with consistent database operations support, taking into account the limitations of wireless medium and limited resources at mobile unit. Provision of such replicated data at MU with high data availability and minimum required level of management functionalities, will surely be a solution. Following section of our paper will present high-level database architecture for high data availability appropriate for mobile computing environment.
Various ways and means for overcoming mobile computing data management issues are presented in [19].

2.6 Related Research Work:

As a matter of fact there isn't any true solution regarding light weight mobile phone database therefore any research is neither directly related nor directly complementary. Therefore researches related to data replication, cache consistency, distributed transaction management and predictive data compression etc., for mobile environment, are the related participant in our research problem.

Concerning transaction management in [25] mobile transaction processing system: PRO-MOTION stands for Pro-active Management of Mobile Transactions, is presented, which supports disconnected transaction processing in mobile client/server environment. It employs *Compacts*. A Study [26], in which revising methodology with model based approach is applied and semantic-based transaction management mechanism is comprehensively investigated and analyzed to illustrate the proposed global semantic-based transaction management model for mobile database. Mobile environment exhibits all the characteristics of a distributed database plus the features of whimsical connectivity. Two-tier replication model [27], generalized to the multi-tier model has become popular because it allows mobiles nodes to read and updates replicated objects during disconnections while it avoids concurrency anomalies. Consequently many times transactions respecting data consistency suffer unpredictable and unbounded delays caused by integrity constrained. Therefore in [28], the constraints are localized and model's applicability is extended to more transaction classes than the ones considered in the original model

If caching is done, without taking advantage of the semantics of cached data it will be difficult to determine whether queries could be answered entirely based on locally cached data? Therefore a semantic caching mechanism [29] is proposed, which allows data to be cached based on semantics, as a collection of possibly related blocks, where each of which is the result of a previously evaluated query. Cache replacement technique based on semantics of cached data is also proposed.

As compression and prediction are interrelated therefore compression is done by a predictive scheme [30], for improving cache memory tasks. Two highly predictable properties of program references: inter reference gaps and cache misses are used to improve cache replacement and cache prefetching, respectively.

Mobile Agents are commonly used in variety of mobile database computing solutions for different purposes [3, 34].

3. MOBILE DATABASE STSTEM:

Because of the limited bandwidth and instability of wireless medium for mobile computing, simplified and lightweight management system for replication of minimum set of frequently accessed data items into mobile unit's limited local storage is extremely important, for providing high data availability during disconnected operation and improving the performance of data access operations. In this section we will propose such high-level database system for MUs.

3.1 Mobile Database Model Motivation:

To provide understanding of our database model functionality, we first consider a simplified context for our mobile database computing environment like GSM network using GSN (see figure 1.1) for providing data services to their customers and similarly to our junior project managers, equipped with advance technology mobile phones or PDAs for accessing Integrated Project Management System's Database (IPMS) to monitor the project status and present status report to their project directors at different locations, even in disconnected or partially disconnected mode[5]. Here we consider an Object oriented database system providing IPMS database (see figure 2.1) available at remote server, which is the counter-part of striped-down version of corresponding object oriented database (see figure 2.2) at MH and accessed via mobile network.

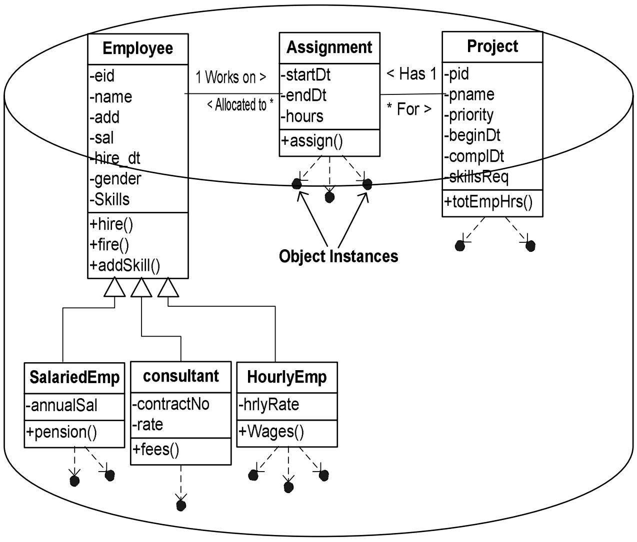

Figure 2.1: Portion of OODB Model of IPMS Database at Server

3.2 Mobile Database Model Considerations:

Our proposed mobile database model is presented on the data model level and utilizing OODB modeling constructs, presented in ODMG standard [20], therefore we consider that every mobile client will be able to process ODL and OQL queries to request objects from OODB at MH.

3.3 Architecture:

Consider partial OODB model of IPMS database (figure 2.1) maintained at server, containing objects instantiated from their related classes like; different project associated with many assignments, where each assignment could be assigned either to salaried employee, hourly employee or consultant. On the other hand mobile clients, like project managers, who are interested in accessing/maintaining project details, are supposed to have only related set of class hierarchy from the server database into their MH. Related class hierarchy at MH, will be imported with a little variation, such as every class hierarchy will be routed from Reference class (see figure 2.2), which is meant for maintaining object reference of each corresponding server object at MH. It is achieved by placing two attributes at parent level class Reference (figure 2.2), like R_oid: containing OID of corresponding server object and R_host: containing the address of the corresponding server containing referenced object, these attributes will then be inherited by every object created at MH by client's OODBMS, and every object available at MH, will have the original OID used at corresponding server with its server address , which will be used by mobile database to communicate with corresponding sever database regarding object transfer.

Containing related class hierarchy schema for those objects which will be minimally required for mobile database computing is compulsorily required; such as our project managers who are only interested in project details will require related schema of employees and assignments in addition to project schema (figure 2.2); in the case where mobile database does not have any object stored and client executes the query then the schema will be used for validating requested objects within the query and valid request will then create an empty object by the local database system followed by the remote request to the server database for object values to be stored in newly created local database object, and finally clients request will be fulfilled; therefore locally available schema will be used twice; one for request validation like attributes and object requested are correct, and second for creating new local object for holding requested object values returned from the server.

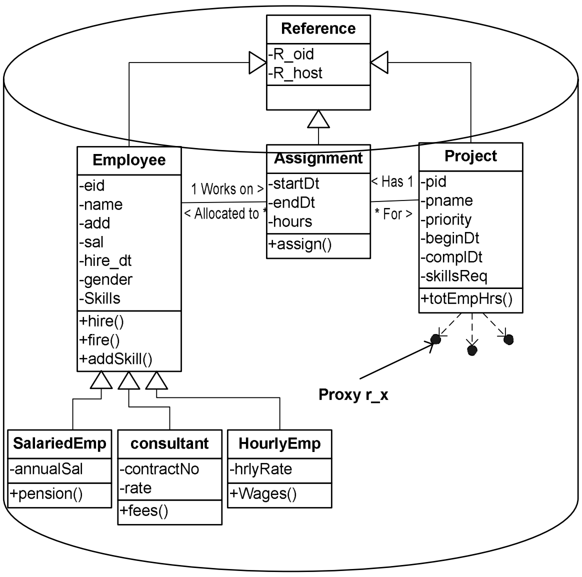

Figure 2.2: Corresponding Object Oriented Mobile Database Model at Mobile Host.

In addition to the metadata of local data objects, MDB will also maintain Object Count List (OCL); a list of total count available at corresponding server, for all those objects which are also available at MDB, which provides clear picture about the portion of replicated objects not available at MDB, and reduce those unnecessary attempts which were made when MDB has total set of objects.

3.4 Functionality:

Referring to our example (section 3.1), if project managers are interested in accessing their certain instances of project class at server to their MH for mobile database computing, then they need to be replicated from server database to their mobile database on the basis of their query specified criteria and following courses of actions will be required for complete functionally.

First of all every mobile user will import corresponding subset of main database schema which will fully satisfy its expected query domain, then request will be made using query as "(1)", for required objects to be filled in mobile database. Query will be validated against database schema and encoded query text will be sent to the server by empty MDB, then server database will return result sets in form of (OID and attribute values) of all those objects which fulfill the criteria. Upon receiving request MDB creates local proxy object, identified by local identifier called proxy ID, and additional attributes R_oid and R_host referring to the object at server. Finally those values are filled in proxy objects (see figure 2.3), and made available for client.

Select * from projects p where "CRM" in p.pname. (1)

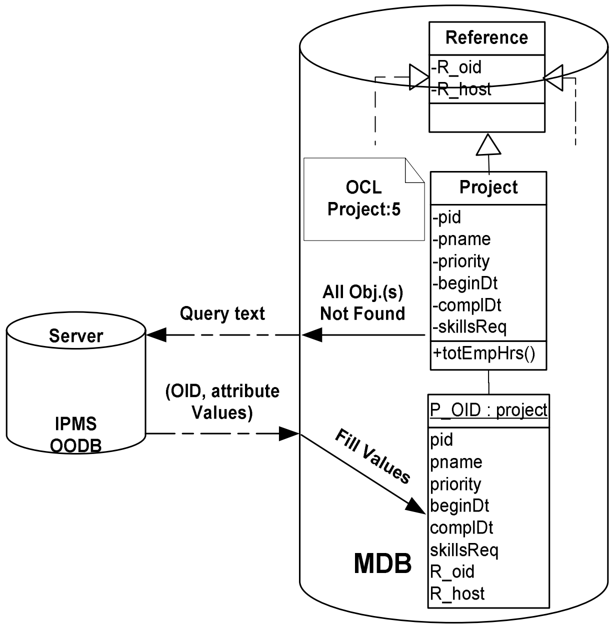

Figure 2.3: Model functionality, when none of the requested object(s) found at MH

After some time when client's request contains some new objects which are not found in MDB (referring OCL), then MDB requests server with encoded query text and OID's of found objects at MDB, request will be evaluated against criteria and result sets (OID, attribute values) of all qualified objects, except objects found at mobile client, sent to requested MDB where they are stored into newly created local proxy objects with corresponding global OIDs and host (see figure 2.4).

In case when MDB contains total set of objects which are referred in client's query (by referring OCL) then no communication will be made between the server database and MDB.

Granularity of our system is supported at object level, to reduce many future requests for the attributes of same objects, and also provides simple system implementation.

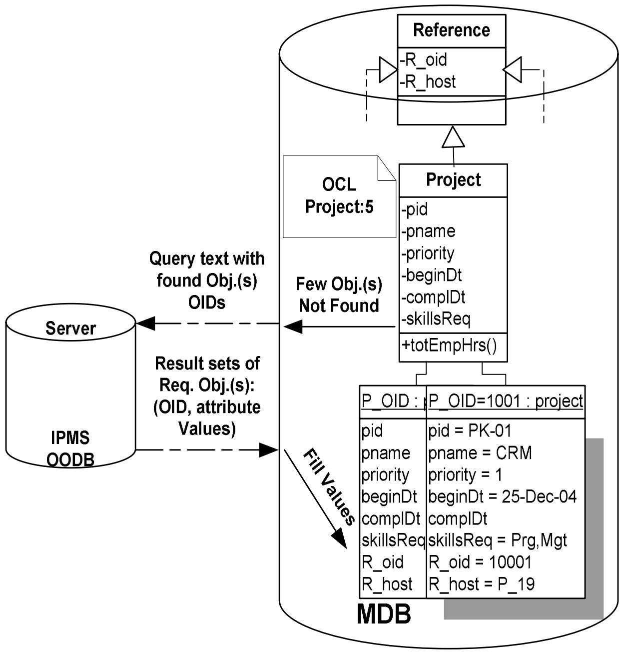

Figure 2.4: Model functionality, when some of the requested object(s) found at MH

3.5 Identification of Frequently Required Objects:

Referring to our model context where mobile phones are provided with small memory, low battery and scare bandwidth of expensive wireless computing environment, we provide high data availability at low memory MH by incorporating the mechanism of identifying mostly required objects for mobile client, which will always be made available through replacement.

Employing any conventional technique based on locality of reference per-page basis is not suitable for mobile database computing because in point-to-point paradigm every mobile client exhibit certain directed object calling pattern in different queries of specific intervals, therefore our proposed scheme adapts the hidden dynamics of object calling pattern in different queries and kernel level implementation of the scheme will provide required level of transparency.

The scheme, Dynamic Exponentially Weighted Moving Average of durations DEWMA is finally proposed after the development and testing of our own versions of techniques, and best suited with object calling pattern of small size memory mobile phones provided for mobile database computing. DEWMA focuses on such features which are necessary to adapt the hidden dynamics of small memory client's object calling pattern within the period of time. In DEWMA, δ represents priority weight such as with δ=0.1 show higher priority weight for recent duration and δ=0.9 for lower priority weight to duration become aged. Considering r=1means when object i is first time accessed in mobile database, then the metric can be computed as "(2)", where d is duration from clock.

$$\overline{d}_i^{\delta_i} = (1-\delta_i)d_{i,1} \qquad \text{for r = 1} \qquad (2)$$

On the other hand, r>1 means object i is accessed more than once in mobile database, then the changing metric will be calculated as "(3)", such as d is inter object access duration.

$$\overline{d}_i^{\delta_i} = \delta_i \overline{d}_{i,r-1}^{(\delta_i)} + (1-\delta_i)d_{i,r} \qquad \text{for r > 1} \qquad (3)$$

By taking d: duration from current clock, in our scheme DEWMA, enables the feature to adapt quickly to changes in access pattern of specially those objects that are not being accessed for so long. When mobile database is filled, and new request is encountered, then mobile database checks the availability of new object within the database; incase, when miss is reported with no space for new object then, object having maximum calling duration rate, calculated by DEWMA, among all other object will be replaced with new object, requested by mobile client, otherwise when the object is hit then only changing metric is calculated.

3.6 DEWMA Scheme Dynamics:

DEWMA exhibits all those features like: systematically maintain object calling rate, earlier rates must be minor additive, dynamically update the rate to reflect the change by some intelligent means when they are not called for long period of time, provide priority to recently called objects.

3.7 Object Replacement Policy:

When mobile database is filled, and new request is encountered, then mobile database checks the availability of new object within the database; incase, when miss is reported with no space for new object then, object having maximum calling duration rate, calculated by DEWMA, among all other object will be replaced with new object, requested by mobile client, otherwise when the object is hit then only changing metric is calculated.

3.8 Schema Translation:

Changes in database objects schema will only be made at server part of the database rather in footprint or mobile database, to assure consistency and integrity. Once schema is updated the server part will provide the updated schema to relevant mobile databases. Most of the changes to object classes do not affect the database. This includes adding, removing and changing constructors, methods and derived fields. Schema changes to attributes, however, do affect the database. The new objects are stored using the new schema, and old stored objects, which were stored using the old schema, have to be converted to the new schema.

Our propose database model implements an automatic schema evolution mechanism, which enables transparent use of old schema instances. When an old instance is loaded into the memory it is automatically converted into an instance of the new up-to-date Object class.

The conversion is straightforward. New attributes that are missing in the old schema are initialized with default values

ISSN: 1792-4251

ISBN: 978-960-474-201-1

(0 , false or null). Old attributes that are missing in the new class are just ignored. When a type of an attribute is changed, if casting of the old value to the new type is valid then the old value is converted automatically to the new type. If casting is illegal (e.g.: int to Date) the field is initialized with a default value as a new field.

When an upgraded object is stored again in the database, it is stored using the new schema. Until then, the conversion is done only in memory each time the object is loaded, and the content of the object in the database remains in its old schema without any change. The transparent schema evolution functionality will also be implemented in mobile database.

3.9 Object Transportation:

As object transportation is the most critical issue in object oriented databases regarding compatibility. Separate approaches are used for the objects and object classes transportation. CORBA standard code will be used to export object class code and XML will be used to generate data for object instances in our OODB.

3.10 Supporting Research Work:

Whenever mobile client makes updates in replicated object by making transactions the consistency will be maintained with weak transactions [21] and therefore every object will be ready for replacement once transaction get completed. On the other hand side if some data will be changed on server the Certification Report [22] will be broadcasted. Database summarization is best way to maximize the available storage at MH [30]. Transaction proxies or dual transaction are the best way to control inherent vulnerability found in mobile phones. Transaction relocation provides reduce communication cost, increased response time, load balancing, level of security and availability [31].

4 FEASIBILITY OF SCHEME BY SIMULATION:

In this section we will explain simulation strategy for our scheme followed by typical results to demonstrate the feasibility of our scheme.

4.1 Simulation Study of DEWMA:

In this simulation study we included our three schemes Hybrid, Clock Difference Exponentially Weighted Moving Average of durations (CDEWMA) and optimal DEWMA for effectiveness comparison with other related, MA, EWMA [23, 24], and conventional LRU, schemes.

Hybrid scheme is functional coupling of EWMA and MA, that can be calculated as “(4)”, where w is maximum no of inter object access durations of object i.

$$\overline{d}_{i,r+1}^{(\delta,w_i)} = \delta_i \overline{d}_{i,r}^{(\delta_i,w_i)} + (1-\delta_i) d_{i,r+1} \quad (4)$$

CDEWMA can simply be defined as “(5)”, when r=1, means object *i* is first time requested in mobile database, where *d* is duration from clock to the time object first accessed, similarly the metric can be calculated as “(6)”

$$\overline{d}_i^{\delta_i} = d_{i,1} \qquad \text{for } r = 1 \quad (5)$$

when r>1, means object *i* is accessed more than once, where d is inter object access duration.

$$\overline{d}_i^{\delta_i} = \delta_i \overline{d}_{i,r-1}^{(\delta_i)} + (1-\delta_i)\, d_{i,r} \qquad \text{for } r > 1 \quad (6)$$

In accordance with the realistic situations for mobile database computing using mobile phones, we have simulated series of schemes for three different configurations, from which two of them based on inter operations arrival patterns and last one based on object access rate. First configuration resembles with situation when frequency of operations arrival start getting increased dramatically at peak working hours of mobile clients for certain time interval when most of the operations are clustered, that is represented as Poisson arrival. Second configuration poses situation when mobile client performs same no of operations on all objects in equal intervals of time, without giving any preference to any particular object, which is very rare case in mobile database computing that is represented as Uniform arrival in our simulation, and finally the most suitable and frequently occurring configuration for mobile database computing is represented as Hotspot which represents such situation when each specific mobile client access some of the database objects pertaining to his interest within many of his routine operations, that is the most realistic case for MDB.

Simulation assumes that there are total 10,000 operations generated by mobile client which are accessing total of 1000 object available at sever to be accessed by mobile client but mobile can store only very few of them locally. There are two versions of simulation, over which each scheme is measured, one for small size memory and other for large size memory, which are capable to store only 30 objects and 10 objects from 1000 objects respectively. Priority weight δ is taken 0.5 for simulation purpose, which could be 0.1 in real cases where priority is known to be given.

We have run many passes of simulation with different parameter values to evaluate different effects such as priority weight δ, maximum no of inter object access durations w, no of operations, and size of mobile database etc, and therefore only significant results are presented in figure 3.1 and table 4 for small memory and figure 3.2 and table 5 for large memory.

4.2 Resulted Effectiveness of Simulated Schemes:

Summarizing the simulation results every scheme has typical results for a specific situation such as Moving Average MA10 is fail to adapt quickly to changes in object calling pattern for all configurations, where as EWMA responses only to those objects who are continuously accessed in frequent manner with short interval and does not update their rate dynamically if they are no more accessed or those who were newly accessed, therefore new objects achieve similar access rate against old once are same. That’s why it is appreciated in hotspot with large database memory and in uniform arrival with small memory. Hybrid is almost following EWMA.

As per our simulation study, applying light weight conventional LRU scheme at object level instead of per-page level provides much better results which are significant in Poisson arrival with both small and large size memory.

Table 4: Hit Ratios for Small Size Memory.

	MA10	EWMA	Hybrid	LRU	CDEWMA	DEWMA
Hotspot	7.07	7.17	7.17	38.39	35.55	40
Uniform	10	10.50	10.50	9.89	9.79	9.79
Poisson	8.58	9.29	9.29	10.30	9.79	9.89

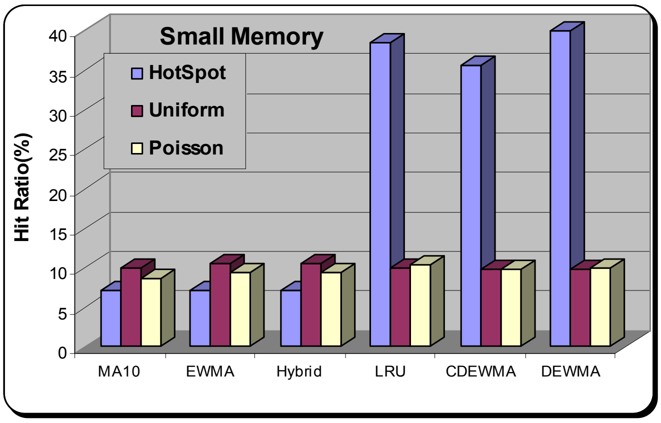

Figure 3.1: Graph Showing Simulation Results for Small Size Memory

Table 5: Hit Ratios for Large Size Memory

	MA10	EWMA	Hybrid	LRU	CDEWMA	DEWMA
Hotspot	58.39	83.29	81.66	69.24	69.25	69.33
Uniform	28.24	30.16	28.81	30.30	30.59	30.39
Poisson	26.08	30.25	27.72	30.82	30.12	30.77

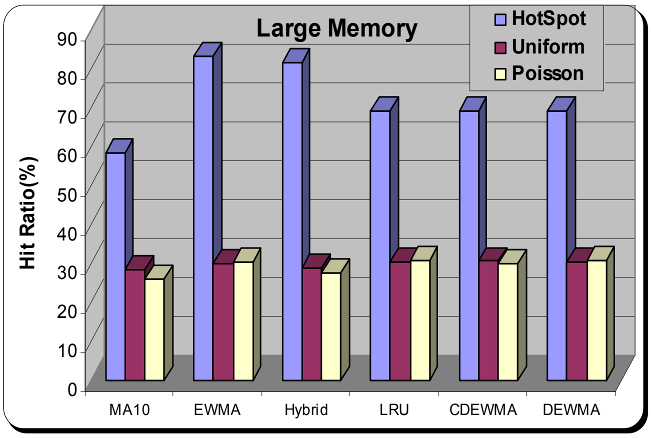

Figure 3.2: Graph Showing Simulation Results for Large Size Memory

CDEWMA is somewhere between LRU and DEWMA, well prominent in uniform arrival with large memory, and finally few configurations, which are very crucial to our proposed OOMDB, are sufficiently supported by DEWMA scheme providing outstanding results in hotspot and poison arrivals for small memory size, and also acceptable results in poisson and uniform arrivals for large memory size, therefore these results are enough to support our assumption that DEWMA adapt quickly and dynamically to changes in object calling pattern for small memory size mobile databases and resulted much suitable for our mobile database, especially where memory size is small, object access pattern is mostly similar to hotspot and some time to poisson which is most realistic configuration for MDB.

We recommend that if mobile database send object calling rate of every object with the request of new object from the server, before being replaced, then the sever can continue to calculate the weight of every object for each MDB, which will be transmitted with object itself, to make DEWMA more optimized.

4.3 Role of Server in Optimization of MDB:

We recommend that if mobile database send object calling rate of every object with the request of new object from the server, before being replaced, then the sever can continue to calculate the weight of every object for each MDB, which will be transmitted with object itself, to make DEWMA more optimized.

4.4 Object Broadcasting Paradigm:

High priority object within the server, with highest calling rate, evaluated by server with the cooperation of MDB must be selected for broadcast to reduce the transmission overhead for MU and easy availability without request. It provides better idea for more optimization [35]

5 CONCLUSIONS

Mobile computing offers exciting possibility of mobile database computing which introduces many features that has great influence on the performance of mobile database design considerations and similarly the inherent limitations of mobile computing systems present challenge to the development of effective mobile database system for small mobile client such as mobile phones. In this paper we first highlighted the performance related concerns of mobile computing environment for mobile database computing and therefore recommended the most suitable GSN based mobile computing network for better database computing, and then, for data replication we presented our light-weight object oriented mobile database model which ensures high data availability at mobile host during disconnected operations, under wireless medium, which is vulnerable to frequent disconnection and provides limited bandwidth. Data availability is considered extremely important that is ensured by our proposed object replacement scheme DEWMA, suitable for mobile database computing paradigm and limited memory mobile phones, which is making our database model suitable for performance related concerns. Finally presented simulation study proves the effectiveness of our scheme DEWMA against other related schemes.

6 FUTURE RESEARCH DIRECTIONS

The research work is not ended, rather more advance, adoptive, and light weight predictive model is expected by using fractals [32, 33], to efficiently promote mobile database computing even for small mobile phones.

On the other hand a complete Global Transaction Management System for Mobile Phones Databases will be developed. Necessary efforts and ground work is completed in aforementioned selected research work in related and supported research work sections of the report. This will serve as basis and provide guidance for completing our model to global system. System would embrace necessary functions to provide semantic database summarization, semantic-based transaction management support, constraints localization and completely heterogeneous distributed support etc.

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