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# MANAGEMENT ISSUES AND CHALLENGES IN MOBILE DATABASE SYSTEM

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***ABSTRACT***

*The popularity of the mobile database is increasing day by day as people need information even on the move in the fast changing world. This database technology permits employees using mobile devices to connect to their corporate networks, hoard the needed data, work in the disconnected mode and reconnect to the network to synchronize with the corporate database. With the advent of mobile databases, users can load up their smart phones and Personal Digital Assistant (PDA) with mobile databases to exchange mission-critical data remotely without worrying about time or distance. In this scenario, the data is being moved closer to the applications in order to improve performance and autonomy. This paper focuses on the management issues and challenges faced with mobile database.*

***KEYWORDS:*** *Mobile database system, Wireless technologies, Mobile devices, MSS, Mobility and portability.*

## I. INTRODUCTION

A mobile database is a database which can be connected to by a mobile computing device over a mobile network. The client and server have wireless connections. A cache is maintained to hold frequent data and transactions so that they are not lost due to connection failure. A database is a structured way to organize information. With the advances in mobile technology and portable mobile devices, which include handheld mobile phones, their larger counterpart, personal device assistance and the laptop, are becoming increasingly useful tools for mobile users. Modern technologies have provided portable computers with wire-less interfaces that allow networked communication even while a user is mobile. Wireless networking greatly enhances the utility of a portable computing device. The mobile users can access information independent of their physical location through wireless connections.[1]

## II. LITERATURE REVIEW

Wi-Fi is the most popular wireless communication protocol for local area networks. Private home and business networks, and public *hotspots* use Wi-Fi to network computers and other wireless devices to each other and the Internet. *Bluetooth* is another wireless protocol commonly used in cellular phones and computer peripherals for short range network communication. Today, competitive pressures, changing market conditions, and the availability of mobile and wireless services for the first time are forcing businesses to shift automated business processes into the mobile workforce. Managing the complexities of the mobile workforce and their need for mobile applications requires a platform specifically designed for the task.[8]

Information retrieval by users with mobile devices such as cell phones, PDA and MP3 music players have become a common everyday activity. Traditionally, database is processes by immobile processing units, servers or clients. The inherent immobility of processing units of legacy systems was a serious impediment in achieving the desired objective. The introduction of mobility actually happened through remote control units. The first remote control unit to activate remote machines was used in Germany.[2]

In 1952, Zenith developed a remote control called Lazy Bones, but it was not a mobile device. It was rather connected to the TV set with a long cable. In 1955, a unit called Flash-o-Matic was introduced which activated units by throwing light on light sensitive cells connected to TV sets. In 1957, Zenith introduced a wireless remote controller called Space command which used ultrasonic as an activation medium. In 1964, the Bell System introduced an improved mobile telephone service which consisted of a broadcast system equipped with a higher power transmitter. In 1970, the Federal Communication Commission allocated spectrum space for cellular systems and by 1977 AT & T Bell Laboratories together developed and began the testing of a prototype cellular system. Then, all systems were based on analog communication.[7]

Today's mobile systems are mainly based on digital technology but analog systems are in use too. Users desire that a mobile unit should have transaction management capability which will allow a user to perform everyday activities. These demands and creative thinking laid down the foundation of Mobile Database System which is a distributed client/ server database system where the entire processing environment is mobile.

Mobile relational Database systems are: IBM's DB2 Everywhere, Oracle Lite, Microsoft SQL Server and Sybase's SQL.

*i) SQL Anywhere Technologies:* SQL Anywhere Server is a high performing and embeddable relational database-management system (RDBMS) that scales from thousands of users in server environments down to desktop and mobile applications used in widely deployed, zero-administration environments.

*Ultralite* - is a database-management system designed for small-footprint mobile devices such as PDAs and smart phones. *Mobilink*- MobiLink is a highly-scalable, session-based synchronization technology for exchanging data among relational databases and other non-relational data sources. *QAnywhere*- QAnywhere facilitates the development of robust and secure store-and-forward mobile messaging applications. *SQL Remote*- SQL Remote technology is based on a store and forward architecture that allows occasionally connected users to synchronize data between SQL Anywhere databases using a file or message transfer mechanism.

*ii) IBM DB2 Everyplace (DB2e):* DB2e stores, retrieves, organizes and manages data on a handheld device. The data on the handheld device is synchronized to a server-based relational database management system (RDMS). DB2e is currently available for Palm OS, EPOC, Neutrino, Windows CE and Embedded Linux DB2e on the handheld device includes: IBM DB2 Database Engine, IBM Sync, Query by Example (QBE). DB2e includes a component called Synchronization Server, which allows synchronization between DB2e and server database.

*iii) Microsoft SQL Server Compact (formerly SQL Server 2005 Mobile Edition):* Microsoft SQL Server Compact (SSC) is a small footprint embedded database designed for developers who target Microsoft Windows mobile-based devices or desktops. It provides synchronization with Microsoft SQL Server, programming APIs, integrated development experience through Visual Studio and a Management Studio.

*iv)Oracle9i Lite:* This is a complete solution for mobile or wireless applications that require the use of a relational database on the mobile client. It includes support for Win32, Windows CE, Palm OS, and EPOC database clients, integration with Oracle's Advanced Queuing (AQ) mechanism, and data and application synchronization software (to enterprise Oracle databases. The Oracle9i Lite relational database is surprisingly powerful. The database supports 100% Java development (through JDBC drivers and the database's native support for embedded SQLJ and Java Stored procedures) as well as programming from any development tool that supports ODBC (Visual Basic, C++, Delphi). These databases work on Palm top and hand held devices (Windows CE devices) providing a local data store for the relational data acquired from enterprise SQL databases. The main constraints for such databases are relating to the size of the Program as the handheld devices have RAM oriented constraints. The commercially available mobile database systems allow wide variety of platforms and data sources. They also allows users with handheld to synchronize with Open Database Connectivity (ODBC) database content, and personal information management data and email from Lotus Development's Notes or Microsoft's Exchange. These database technologies support either query-by-example (QBE) or SQL statements.[9]

# III. MOBILE DATABASE SYSTEM

Mobile databases typically involve three parties: fixed hosts, mobile units, and base stations. *Fixed hosts* perform the transaction and data management functions with the help of database servers. *Mobile units* are portable computers that move around a geographical region that includes the cellular network (or "cells") that these units use to communicate to base stations. Base stations are two-way radios, installations in fixed locations that pass communications with the mobile units to and from the fixed hosts. They are typically low-power devices such as mobile phones, portable phones, or wireless routers. A cellular mobile network is similar to that of Mobile Network Architecture. It consists of Mobile Client (MC) containing data centric applications roaming between wireless cells and accesses a centralized database (fixed host). Some of the fixed hosts called Mobile Support Stations (MSSs), are augmented with wireless interfaces. The wireless channel is separated into two sub-channels: an uplink channel and a downlink channel. The uplink channel is used by MCs to submit queries, while the downlink channel is used by MSSs to answers from the server to target mobile client.[4]

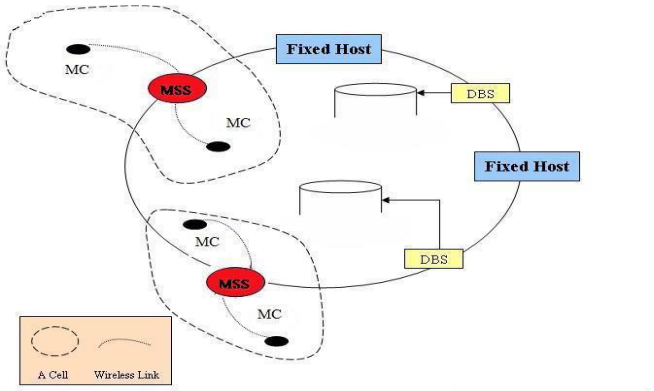


**Figure 1**: Mobile Network Architecture

## 3.1 Benefits of Mobile Database System

When a mobile unit leaves a cell serviced by a particular base station, that station transparently transfers the responsibility of the mobile unit's transaction and data support to which ever base station that covers the mobile unit's new location. A common goal in mobile database systems is to minimize the amount of data transmitted over the wireless link between the servers to the mobile client. Mobile Database System (MDS) provides full database and mobile communication functionalities. It allows mobile user to initiate transaction from anywhere and at anytime, and guarantees their consistency preserving execution. In any kind of failure (transaction, system and media), MDS guarantees database recovery. Mobile Database System is a distributed multi-database client/server system based on PCS and Global System for Mobile Communication (GSM).[10]

## 3.2 Confront in Mobile Databases

Data management for mobile wireless networks is really a challenge task. A user would always need connection transparency with the server so as to complete the intended application. The challenges of data management system include the followings: first, how to ensure data availability in spite of disconnections; second, how to manage weekly connected mobile wireless links between clients and server; and thirdly, how to support constant resource availability to complete the applications.

# IV. MANAGEMENT ISSUES IN MOBILE DATABASE SYSTEM

Building an integrated platform to manage complexities demands a scalable, robust environment providing the following fundamental services: data management, connection management, integration management, mobility management, handoff management.

## 4.1 Data Management:

Today's mobile applications require more than simple data synchronization. They require a complete set of data management services, including strong data modeling, mobile and server-side support for schema deployment and versioning, rules-based data distribution, bi-directional data transfers that are fast and secure, mobile device-based database services, and tight transaction-level integration with multiple enterprise information sources. The asymmetric nature of the wireless communication link is another challenge for data management in wireless links to ensure low consumption and data access latency.

### 4.2 Connection Management:

Today, mobile connection management is technically complex and esoteric, and it varies widely as travelling across the globe. Newcomers to mobile computing must wrestle with the plethora of emerging communication protocols, standards, and low-level operational aspects of wireless connectivity. However, a mobile platform should provide the ability to seamlessly service multiple connection methods, wireless connectivity service options, and handheld device types at the same time. Load balancing and scalability options should be provided to handle volume and frequency spikes as they occur, connections between mobile devices and the enterprise should be secure, efficient and extremely reliable.[9]

### 4.3 Integration Management:

In a mobile platform approach, integration management services provide flexible and robust methods for tying into multiple back-end information sources. The requirement for data transformation and business data processing before entry into the back-end source is a key issue. Perhaps the most important aspect of integration management from the mobile platform perspective is the ability to extend the investment made in large corporate information systems to the mobile workforce in an efficient, transparent and meaningful way. To the mobile worker, their mobile interface into the corporate computing world is simply an automation of previously revered pencil and paper-based procedures.[9]

### 4.4 Mobility management:

Location management on mobile devices will become increasingly important in the new future, considering the increasing number of location-enabled mobile devices and location-based services. On the technical side, location-enabled devices and location-based services have been deployed and used for a number of years already. However, there are two issues, one is, how to make location information openly available on the Web, and the second is, how to provide users with privacy control in such an environment. Location management is a two-stage process that enables the network to discover the current attachment point of the mobile user for call delivery. The first stage is location registration (or location update). In this stage, the mobile terminal periodically notifies the network of its new access point, allowing the network to authenticate the user and revise the user's location file. The second stage is call delivery. Here, the network is queried for the user location profile and the current position of the mobile host is found[6].

### 4.5 Handoff Management:

Handover management enables the network to maintain a user's connection as the mobile terminal continues. Mobility Management in Next-Generation wireless systems moves and changes its access point to the network. The three-stage process for handoff first involves initiation- where the user, a network agent, or changing network conditions identify the need for handoff. The second stage is new connection generation- where the network must find new resources for handoff connection and perform any additional routing operations. Under network-controlled handoff, or mobile-assisted handoff, the network generates a new connection, finding new resources for the handoff and performing any additional routing operations. For mobile-controlled handoff, the mobile terminal finds the new resources and the network approves. The final stage is data-flow control- where the delivery of the data from the old connection path to the new connection path is maintained according to agreed upon service, mobile terminal finds the new resources and the network approves. The final stage is data-flow control- where the delivery of the data from the old connection path to the new connection path is maintained according to agreed-upon service guarantees. Handoff management includes two conditions: intra-cell handoff and inter-cell handoff. Intra-cell handoff occurs when the

user moves within a service area (or cell) and experiences signal strength deterioration below a certain threshold that results in the transfer of the user's calls to new radio channels of appropriate strength at the same Base Station (BS). Intercell handoff occurs when the user moves into an adjacent cell and all of the terminal's connections must be transferred to a new BS. While performing handoff, the terminal may connect to multiple BS's simultaneously and use some form of signaling diversity to combine the multiple signals. This is called soft handoff. On the other hand, if the terminal stays connected to only one BS at a time, clearing the connection with the former BS immediately before or after establishing a connection with the target BS, then the process is referred to as hard handoff.[9]

# V. CHALLENGES OF MOBILE DATABASE SYSTEM

## 5.1 Limited Resources:

The CPU power and storage of mobile devices is continuously increasing. However, they are far behind non-mobile systems such as servers on the Internet. Due to the size of the database, limited CPU power, storage capacity mobile device need to perform simple operations on local data available in cache. Limited storage capacity also makes it difficult to cache entire databases to a mobile device. Resource availability refers to battery power at the mobile node. The problems of limited power a mobile node have had to be addressed carefully.[9]

## 5.2 Power consumption:

The most prominent limitation of mobile device is power. These devices rely entirely on battery power. Combined with the compact size of many mobile devices, this often means unusually expensive batteries must be used to obtain the necessary battery life.[10]

## 5.3 Disconnection:

Weather, terrain, and the range from the nearest signal point can all interfere with signal reception. Reception in tunnels, some buildings, and rural areas is still poor. Interaction between a mobile device and a database is directly affected by the device's network connectivity. The two solutions approach to this disconnection challenges are: (1) Prevent disconnections (2) Cope with disconnections. For mobile computers, allowing disconnections to happen and recovering from them is the better solution for asynchronous operation caching and reconciliation.[3]

## 5.4 Insufficient bandwidth:

Mobile access is generally slower than direct cable connections. Using technologies such as GPRS and EDGE, and more recently 3G networks, bandwidth has been increased but still less compared to the wired network. Asymmetry problem is faced when bandwidth in the downstream direction (1805–1880 MHz) is often much greater than bandwidth in the upstream direction (1710–1785 MHz).

## 5.5 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[10].

## 5.6 Limited battery power:

Because of the mobility and portability, clients and servers 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. For instance, a fully-charged Dell Latitude C600 laptop can run about 3.5 hours, which is estimated by well-known industry battery life benchmarks. When processing power is limited, it compromises the ability of each mobile node to support services and applications. Once a node 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]

# VI. RESULT AND DISCUSSION

This paper covers the historical trends, the rationale for the management issues and challenges that need to be addressed in mobile database. There is a need to develop mobile database systems which can cope with millions (or billions) of such mobile clients and which will cope with mobility in road networks, 2D, 2.5D, 3D settings, and with uncertain data. The mobility of both vehicles (persons) and

the environment (weather, ocean currents, fire) should be considered in future research. Also, there is need to extend the systems to accommodate sensing applications where data streams characteristics are taken into account.

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