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Mobile Database Technology and Main Memory Database Systems

Aburuotu, E. C.
School of Post Graduate Studies
Department of Computer Science
Faculty of Natural and Applied Sciences
Ignatius Ajuru University of Education
Rumuolumeni, Port Harcourt
Rivers State
Nigeria

&

Asagba P. O.
Department of Computer Science
Faculty of Science
University of Port Harcourt
Choba, Port Harcourt
Rivers State
Nigeria

ABSTRACT

Recent advances in digital device technology and connectivity have paved the way for next generation applications that are data-driven, whose data can reside anywhere securely, can be accessed at any time remotely and from any smart device. This work focuses on the integration of application interface that manages automatic updates in a developed mobile database and the advantages it have brought to the mobile users in this 21st century. The aim of this work is to integrate an application interface capable of carrying out application and data updates across the mobile database systems. The objective is to review the existing mobile database technologies, the advantage of the mobile database systems, main-memory databases and the integration of the application interface on the mobile database. These trends lead to applications that are mobile, embedded, and data-centric. Waterfall methodology was adopted as a software development design method. This methodology supports the process of development of the work and the application. The mobile database system in the context of this work was developed using SQLite. SQLite is relational database development application that contains a lighter version of SQL designed for mobile computing. At the end of the research, databases administrators and application developers can easily automate updates on the mobile databases to enable mobile users such as salespersons, reporters, doctors, administrators and others to update retrieve and review data on the move, anytime and anywhere.

Keywords: Main Database, Mobile Database, SQLite, Database Management System (DBMS), Mobile Computing.

Introduction

In this 21st century, there are high level demands on mobile computing for providing the types of support required by a growing number of mobile workers and its technology. Such individuals require working as if they are in the office, but in reality, they are working from remote corners of different locations of any particular area, including homes, clients' premises, or simply while routing to remote locations. The 'office' may come with a remote worker in the form of a laptop or desktop, PDA (Personal Digital Assistant), or other device accessing the Internet. With the rapid growth of cellular technology, wireless medium, and satellite communications, it will soon be achievable for mobile users to access any data from anywhere at any time. However, business etiquette, practicalities, security, and costs may still bound communication such that it is not achievable for establishing online connections for as long as users want, whenever they want. Mobile databases offer a solution to some of these restrictions or problems. Mobile Database is a database that is transportable, portable, and physically separate or detached from the corporate database server but has the capability to communicate with those servers from remote sites allowing the sharing of various kinds of data. With mobile databases, users have access to corporate data on their laptop, PDA, or other Internet access device that is required for applications at remote sites.

The development in memory technology have advanced so much that we now have Random Access Memory (RAM) and Flash Higher Memories (FHM) and their costs are also low. With the number of hand-held devices, smart phones and electronic gadgets, there is a greater need for databases that are mobile enabled and lite to drive faster transactions in a database. As more business are moving toward employee mobility, there is a great need for handheld devices that can access lite databases that supports organizational role, productivity and processes. A mobile database system (MDS) provides full database and mobile communication functionality. It allows a mobile user to initiate transactions from anywhere and anytime ad guarantees their consistency preserving execution. Multimedia libraries have enormous amount of information for communication in audio, video, text, graphics, animation form, Amreem and Ahiwah (2011). With these developments and advances in memory technology, people everywhere are expecting more from technology support service to enhance their work and productivity anytime and wherever they are. Although these developments and advancements enable people to connect and work anytime and anywhere, there are still issues to discuss and look out for solutions on the use of mobile database technologies.

Overview of Mobile Database Systems

The rapid advancements of wireless communication technology and computer miniaturizing technology have enabled users to utilize computing resources anywhere in the computer network. For example, you can even connect to your Intranet from an aeroplane while travelling on the air. Mobile database are the database that allows the development and deployment of database applications for handheld devices, thus, enabling relational database based applications in the hands of mobile workers. The database technology allows employees using handheld to link to their corporate networks, download data, work offline, and then connect to the network again to synchronize with the corporate database. For example, with a mobile database embedded in a handheld device, a package delivery worker can collect signatures after each delivery and send the information to a corporate database at the end of the business day. Most of us use our mobile phones as solution to mini-computers that travel alongside us and these devices keep us connected 24 hours of the day and anywhere, and we know that the quest for mobile solution will continue to grow. Mobiles phones and the data that these devices will access are now an integral part of our business world and the importance of mobile database cannot be underestimated.

Problem Statement

There is a growing number of mobile workers worldwide and the demand for mobile technology is rapidly growing. Recently, it has been discovered that more businesses are moving toward employees' mobility. In most of the industry, there are salespersons, reporters, administrators even doctors that needs to update record and generate report on the move. However, the delay in the update of our mobile database has made it a struggle for this mobile workers to carry out their functions on the move and remotely. Therefore, an automation of the update and synchronization is required to meet up the demand from mobile workers without human intervention. The integration of an application interface (API) can enhance this solution. The current database systems do not provide special facilities for specific update operations in a mobile computing environment. Some of the commercially available Mobile relational Database systems are:

- IBM's DB2 Everywhere 1.0
- Oracle Lite
- Sybase's SQL

These databases work on Palm-tops 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. Mobile computing has proved useful in many applications. Many business travelers are using laptop computers to enable them to work and to access data while traveling. Delivery services may use/ are using mobile computers to assist in tracking of delivery of goods. Emergency response services may use/ are using mobile computers at the disasters sites, medical emergencies, etc. to access information and to provide data pertaining to the situation. Newer applications of mobile computers are also emerging.

One of the issue relating to wireless computing is that creates a situation where machines no longer have fixed locations and network addresses. This may complicate query processing for the cases where location plays a key role, since it becomes difficult to determine the optimal location at which to materialize the result of a query. This may happen only for the cases where the location of the user is a parameter of the query. For example, if a traveler information system provides data on hotels, roadside services, etc. to motorists; queries about services that are ahead on the current route must be processed based on knowledge of the user's location, direction of motion, and speed. Another issue relating to mobile computing is the energy (battery power). It is a scarce resource for mobile computers. This limitation influences many aspects of system design. Can we reduce the requirements of data transfer for the sake of energy efficiency? Yes, by doing scheduled data broadcasts, we may reduce the need for mobile systems to transmit queries. But on the other side it will increase the amount of data residing on machines administered by users, rather than by database administrators. In addition, these machines may, at times, be disconnected from the network; thus, raising the question about the consistency of data.

Related Literature

Many researchers have come up with various solutions to improve mobile database technologies However, the process of updating the mobile databases remains a serious concern over the years.

Augustine, et al (2005), discussed the emergence of mobile computing as development that provides the ability to access information at any time and place. However, as mobile computing environments have inherent factors like power, storage, asymmetric communication cost, and bandwidth limitations, efficient query processing and minimum query response time are definitely of great interest. They presented a survey that contains a variety of query optimization and processing mechanisms in mobile databases into two main categories, namely: (i) query processing strategy, and (ii) caching management strategy. Query processing includes both pull and push operations (broadcast mechanisms). They further classify push operation into on-demand broadcast and periodic broadcast. Push operation (on-demand broadcast) relates to designing techniques that enable the server to accommodate multiple requests so that the request can be processed efficiently. Push operation (periodic broadcast) corresponds to data dissemination strategies. In this scheme, several techniques to improve the query performance by broadcasting data to a population of mobile users are described. A caching management strategy defines a number of methods for maintaining cached data items in clients' local storage. This strategy considers critical caching issues such as caching granularity, caching coherence strategy and caching replacement policy. Finally, this survey concludes with several open issues relating to mobile query optimization and processing strategy.

Weiqi, et al (2010) presented that the trend of recent technological in flash media have made it an attractive choice for non-volatile data storage in a wide spectrum of computing devices, such as PDA' s, mobile phones, MP3 players, embedded sensors, etc. Compared with the disk drivers, the success of flash media for those devices is mainly due to its superior merits for smaller size, lighter weight, better shock resistance, lower electric consumption, less noise, and faster read performance. At present, one of the most popular embedded databases is SQLITE, which has been widely applied in mobile phones. In its paper, it was able to optimize for commit strategy and parameters configuration for SQLITE on a real application in mobile phone, which utilizes SQLITE as its embedded database library. We focused on providing different suitable parameter configurations and commit strategy for SQLITE to generate the different Portable flash packages (such as secure digital (SD) cards, mini SD cards, and micro SD cards) according to the special requirement of the middleware applications. Through this way, make such flash memory management database perform more suitable and efficiency to the middleware application in the embedded device which it is exactly implemented on.

Mobile users demand accuracy and speed in data that is being accessed over the cloud. Amreen and Ahiwar, (2011), proposed that the use of strong infrastructures over the cloud can help in in minimizing the errors that can be encountered when accessing information over the mobile database. They discussed various issues including current problems and the problems that may arise in future. Author has discussed challenges that may encounter in implementation of multimedia mobile database system. They recommended that they use of Software as a Service in the cloud computing environment for mobile databases users can enhance security of the data in the mobile database. Concept of green cloud is to perform all cloud computing function in an energy efficient environment. Although many architecture are proposed for this but still it requires improvement.

The time it takes for a data to be retrieved in a mobile database system became another challenge for mobile workers around the globe. Ersan and Ulusoy (1999), evaluated the real-time access data access requirements. This is a critical issues to mobile users because quick response is required on most query parsed to the mobile database. They recommended the optimization of the user interface and data-driven applications that are connected to the mobile database. However, it is difficult to handle real-time constraints in a mobile computing environment due to the physical constraints imposed by the mobile computer hardware and the wireless network technology. The publishers presented a mobile database system model that takes into account the timing requirements of applications supported by mobile computing systems. They also provided a transaction execution model with two alternative execution strategies for mobile transactions and evaluated the performance of the system considering various mobile system characteristics, such as the number of mobile hosts in the system, the handoff process, disconnection, coordinator site relocation and wireless link failure. Performance results are provided in terms of the fraction of real-time requirements that were satisfied.

The need for update in the main components of the mobile database remains a constraints for mobile database users. The database administrators are not readily available to handle the regular updates on the data and the main components of the mobile database. Updating the mobile database will ensure that mobile users are able to access same content as it is available in the main database. The database management system manages the data and collection of records in the main database, which is not usually available for mobile users except update is carried out. This work ensured that an application interface is developed to handle regular updates in the mobile database system.

The Components of a Mobile Database Environment

The components of a mobile database environment include:

- Corporate database server and DBMS that deals with and stores the corporate data and provides corporate applications
- Remote database and DBMS usually manages and stores the mobile data and provides mobile applications
- mobile database platform that includes a laptop, PDA, or other Internet access devices
- Two-way communication links between corporate and mobile DBMS.

Based on the particular necessities of mobile applications, in many of the cases, the user might use a mobile device may and log on to any corporate database server and work with data there. In contrast, in others, the user may download data and work with it on a mobile device or upload data captured at the remote site to the corporate database. The communication between the corporate and mobile databases is usually discontinuous and is typically established or gets its connection for a short duration of time at irregular intervals. Although unusual, some applications require direct communication between mobile databases. The two main issues associated with mobile databases are the management of the mobile database and the communication between the mobile and corporate databases. In the following section, we identify the requirements of mobile DBMSs

Functionality Required For Mobile DBMSS

The functionality required by a mobile databases includes a capability to:

- communicate with the centralized or primary database server through modes
- repeat those data on the centralized database server and mobile device
- coordinate data on the centralized database server and mobile device
- capture data from a range of sources such as the Internet
- deal with those data on the mobile device
- analyze those data on a mobile device
- create customized and personalized mobile applications

A Model of Mobile Computing

Indira Gandhi National Open University (IGNOU, 2019) explained that the mobile-computing environment consists of mobile computers, which are referred to as mobile hosts, and a wired network of computers. The communication between the Mobile hosts and the wired network takes place through the computers referred to as mobile support stations. A mobile support station manages the mobile hosts within its cell. But what is a cell? A cell is defined as the geographical area covered by a mobile support station. Mobile hosts may move between cells, thus, necessitating a transfer of control from one mobile support station to another. Since mobile hosts may, at times, be powered down, a host may leave one cell and re-materialize later at some distant cell. Therefore, moves between cells are not necessarily between adjacent cells. Within a small area, such as a building, Mobile hosts may be connected by a wireless local-area network within a small area, which may provide lower-cost connectivity than a wide-area cellular network. This will also reduce the overhead of transfer of control.

It is possible for mobile hosts to communicate directly without the intervention of a mobile support station. However, such communication can occur only between the nearby hosts. The size and power limitations of many mobile computers have led to alterative memory hierarchies. Flash memories may be used in such systems to save power. If the mobile host includes a hard disk, the disk may be allowed to spin down when it is not in use, to save energy.

Routing and Query Processing

The mobile computing poses typical problems from the point of view of routing and query processing. For example, as per the mobile-computing model, the route between a pair of hosts may change over time, if one of the two hosts is mobile. This simple fact may have a dramatic effect at the network level, since location-based network addresses are no longer constants within the system. However, these networking issues are beyond the scope of this course. The mobile-computing model also directly affects database query processing. In the case of distributed query processing, the communication costs play important role in query optimization process while selecting the best method of query evaluation strategy. Mobility results in dynamically changing communication costs, therefore, complicates the optimization process.

Some of the anomalous factors, which need to be considered for mobile computing, are:

i. User time is a highly valuable commodity in most of the business applications

ii. Connection time is the unit of monetary charges is assigned in most cellular systems, therefore, should be minimum.

iii. Number of bytes, or packets, transferred is the unit of charges is computed in digital cellular systems

iv. Time-of-day based charges may vary based on whether communication occurs during peak or off-peak periods

v. Energy is limited. Often, battery power is a scarce resource and should be optimized.

One of the basic principles of radio communication is that it requires less energy to receive than to transmit radio signals. Thus, transmission and reception of data impose different power demands on the mobile host.

Broadcast Data

It is often desirable for frequently requested data to be broadcast in a continuous cycle by mobile support stations, rather than transmitted to mobile hosts on demand. A typical application of broadcast data is stock-market price information. There are two reasons for using broadcast data:

- The mobile host does not have to invest on the energy cost for transmitting data requests.
- The broadcast data can be received by a large number of mobile hosts in a single transmission, at no extra cost, thus, ensures effective utilization of the available transmission bandwidth.

Thus, the mobile hosts need to only receive data as and when those data are transmitted, rather than consuming energy by transmitting a request. The mobile host may also have the local nonvolatile storage for storing (cache) the broadcast data as and when received, for possible later use. The mobile host may optimize energy costs by determining whether a given query may be processed using only cached data. In case, the cached data is not found to be appropriate for the query, then the mobile host may either may wait for the data to be broadcast, or transmit a request for data. However, in order to make this decision, the mobile host must know when the relevant data will be broadcast. The broadcasting of data may be made according to a fixed schedule or a changeable schedule. If the schedule of data transmission is fixed then the mobile host uses the known fixed schedule to determine when the relevant data will be transmitted. In the data transmission schedule is changeable then even the broadcast schedule may itself be broadcast at a well-known frequency and time intervals.

In effect, the broadcast medium can be thought of as a disk with a high latency Requests for data can be thought of as being serviced when the requested data are broadcast. The transmission schedules behave like indices on the disk. This area is still evolving and research is still being conducted on broadcast data issues.

Existing Mobile Database System

The existing mobile database system with its full functionality handles data and application updates inconsistently. The locally cached data may become inconsistent, but the mobile host can discover this fact only when it is reconnected. Similarly, the updates occurring in the mobile host cannot be propagated until reconnection occurs. However, such updates must be propagated as and when the mobile host reconnects. However, if the mobile host caches read-only copies of data, which is being updated by other computers, the cached data may become inconsistent once a different machine updates the value. In such cases on reconnection, the mobile host may be sent with invalidation reports that may inform it about inconsistent cache entries. In case updates can occur at both the mobile host and elsewhere, detecting conflicting updates become even more difficult. Details on these issues are beyond the scope of this text. Figure 1 illustrates the local process data and application is updated by the database host. The process causes inconsistency in the mobile database.

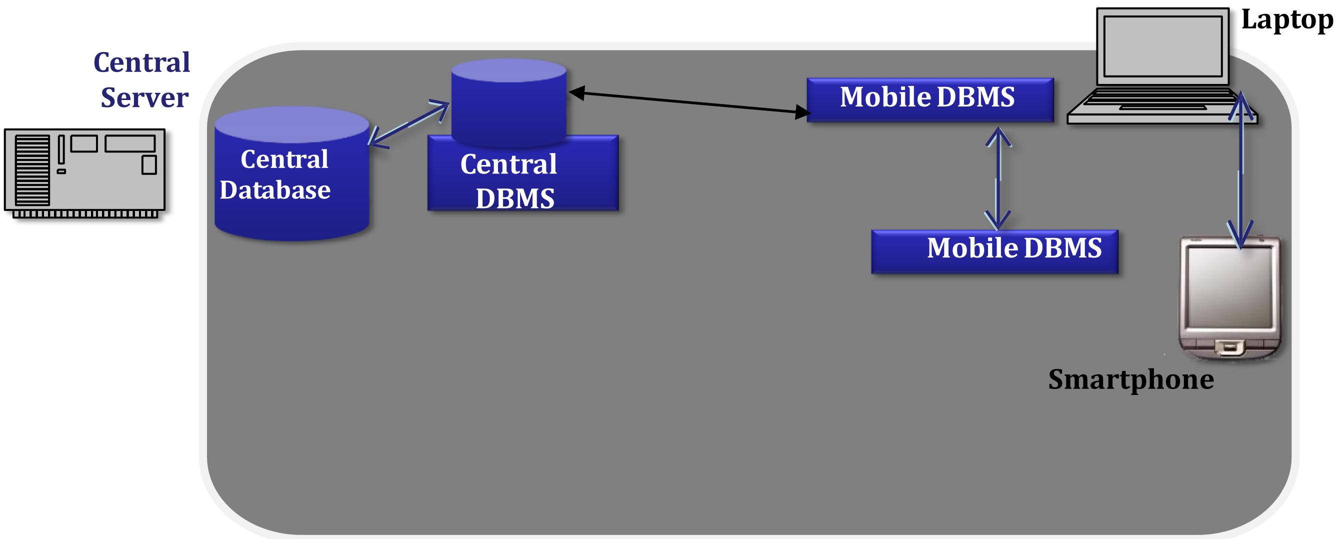

Figure 1: Mobile database system without an integrated Application Interface (API) Amreen Khan and Kamal Kant Ahirwar (2011).

As shown on figure 1, contents of the database and the application are managed and supported by the database host or the administrator. In this case if the host is not readily available for update, mobile users will not have access to the updated contents in the main database.

Advantages of the Existing System

1. Low maintenance cost
2. Low transmission bandwidth
3. Low storage capability

Disadvantages of the Existing System

1. Unavailability of data and application updates in the mobile database
2. Main database components not readily available which causes security issues
3. Storage constraints are

The Proposed System

The proposed system is the integration of an application interface in the mobile database to handle routine updates on a regularly basis. Figure 1 demonstrates the relationship between the central database and mobile database as well the API integration.

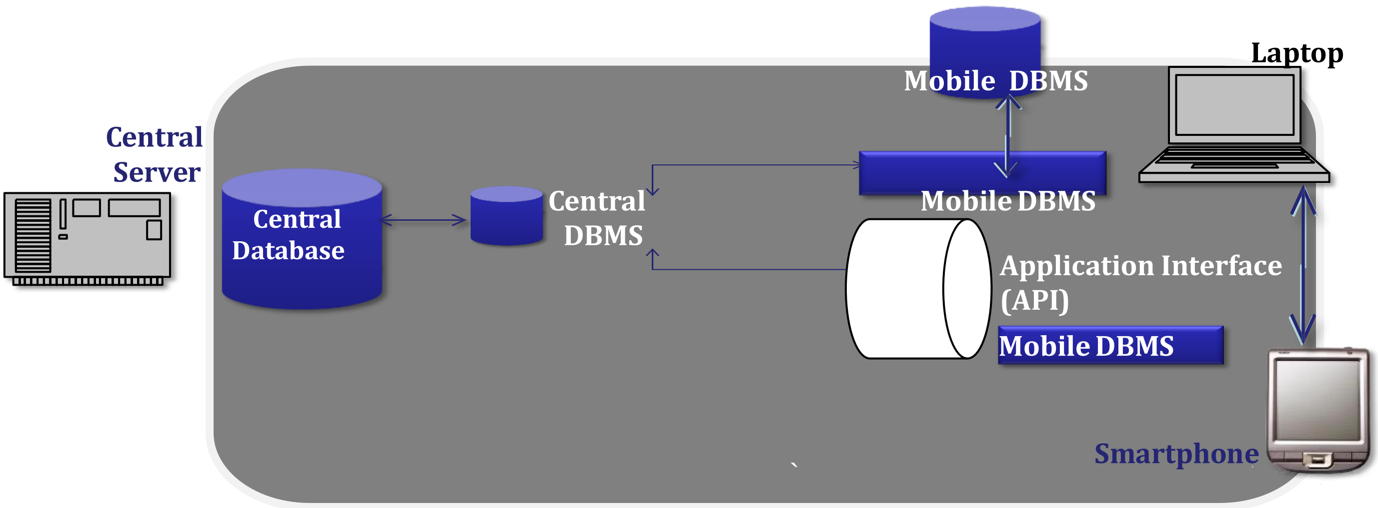

Figure 2: Mobile Database System with Application Interface Integrated (API)

From figure 2, the central server manages the main database where the data is stored and updated. The database is managed through the central database management system. There a relationship existing between the central database management system and the mobile database management system. The database administrator does not initiate an update between the central database system and the mobile database system. Instead an application program interface (API) is introduced that serves as the operation handler to regularly and automatically handle updates in the databases system. When there is new update in the central database, the application interface automatically updates the mobile database to enable the mobile user access same content that central database holds for the users.

Advantages of the Proposed System

1. Database is regularly updated
2. Content is always available
3. It enhances security of database content
4. Reduces programing error and application independency
5. Consistency of data
6. Recoverability of the system in the case of failure

Disadvantages of the Proposed System

1. Cost of implementation of the Application Interface
2. Security of Deployed Infrastructures
3. Requirement for IT specialist to manage the mobile database

Waterfall Methodology of System Design

This work adopted a waterfall model for the design and implementation of the proposed system. The mobile database system in the context of this work was developed using SQLite. SQLite is relational database development application that contains a lighter version of SQL designed for mobile computing and the user interface (UI) is enabled to run on Hypertext Markup Language (HTML). The Waterfall methodology is a software development life cycle (SDLC) that consists of several consecutive design Phases that follow different sub-processes which flows downwards from the problem definition, analysis, design, coding, testing, implementation and then maintenance. And these phases need to be completed one after the other before moving to the next phase only when it is the preceding phase is completely done. And so, waterfall methodology is recursive in nature, because each phase depends on the other and can endlessly be repeated until it is perfected. Sometimes moving back to the previous stage is necessary due to failure in the current phase. This prevailing model is a principal industry-proven methodology that has resulted in an effective design. This methodology is followed closely in the development of this efficient and improved application interface for the mobile database systems. This model possesses some advantages over other methodologies. These advantages include;

1. The waterfall model is the easiest methodology used in system development since it follows a defined number of steps
2. Using the waterfall model, risk management is reduced unlike the spiral model, risk management with software development.
3. Unlike the spiral model, the waterfall model does not need to reuse any of the phases many times and nit based on the continuous requirement of key components for software development.
4. The development of a prototype is necessary when using a waterfall model.

Main Memory Database Systems

In-memory databases also known as main-memory database work faster than databases with disk storage.” This is because they use “internal” optimization algorithms, which are simpler and faster, and this type of system requires fewer CPU instructions than a disk storage system. Additionally, accessing data that has been stored “in-memory” eliminates the need for seek time while searching for data. As a consequence, several data warehouse vendors are switching to in-memory technology to speed up the processing of data. The cloud also presents an opportunity for using in-memory databases. Traditionally, data has been stored on disk drives, with RAM used for short-term memory while the computer is in use. In-memory database architecture uses a database management system that relies primarily on a computer’s main memory (RAM), and is organized by an In-Memory Database Management System (IMDBMS). In-memory database (IMDB) architecture requires a management system designed to use the computer’s main memory as the primary location to store and access data, rather than a disk drive.

Though in-memory database systems do have broad uses, they are used primarily for real-time applications requiring high performance technology. The use cases for these systems include applications for real-time responses, such as with the finance, defense, telecom, and intelligence industries. Applications requiring real-time data access such as streaming apps, call center apps, reservations apps, and travel apps also work well with IMDBMS. The two primary reasons in-memory databases have not historically been popular have to do with costs and a lack of ACID (atomicity, consistency, isolation, and durability) compliance." The lack of "durability," refers to the IMBDs loss of memory, should the electricity be cut. "Also, RAM has, historically, been fairly expensive, and this has stunted the growth and evolution of in-memory databases. Recently, the cost of RAM has begun to drop, making IMBDs more affordable.

Technology of Memory and Storage

Storage is for data that is currently not being used, but has been recorded on a hard disk, can be saved indefinitely and be recalled as needed. Data stored on a disk is permanent unless erased. Hard drive storage is generally used for long-term storage purposes. Traditionally, hard drives were designed to save much larger amounts of data than RAM. That situation is changing. RAM is a physical component, not a software program. It uses computer chips (integrated circuits) that are soldered to the main logic board, or, as is true of many personal computers, uses a plug-in system for the easy upgrading of memory modules (also known as DRAM modules). Using an IMDB instead of a disk drive system provides the following benefits:

- RAM can be increased to improve performance with relative ease.
- Additional RAM allows a computer to do more at once (but does not actually make it faster).
- Additional RAM improves the switching between different applications and allows multiple applications to be open without causing the system to become sluggish.
- It uses less power than disk drives.
  There are two basic types of RAM: DRAM (Dynamic Random Access Memory) and SRAM (Static Random Access Memory). RAM has been used as a form of short-term memory for computer use." The word used to describe RAM's loss of memory when the electricity is cut off is "volatile."
- **DRAM:** The term "dynamic" indicates the memories must constantly be refreshed. DRAM is generally used as the main memory in computers. RAM must be refreshed thousands of times each second.
- **SRAM:** Typically used as a system cache. (A smaller, faster memory that is closer to a processor core). It stores copies of regularly used data from its main memory, and is described as "static" because it does not need to be refreshed. However, SRAM is also volatile, and loses its memories when the power is cut.

Scaling in a Main Memory System

Currently, IMDGs provide a simple, cost-effective way to provide scalability. An IMDG allows scaling simply by adding a new RAM. Adding memory is described as "vertical scaling" and involves increasing the capacity of a system, allowing it to handle more transactions. This is the simplest, fastest way of increasing capacity without significantly changing the system architecture. Also, databases that can scale out, while offering a view of the data, can make working with containers significantly easier.

NVRAM

RAM comes with a significant and obvious problem. It loses data during a power outage (or if it becomes unplugged), causing great frustration for its human users. Non-volatile random-access memory (NVRAM) describes a computer memory capable of holding data even after power to the memory has been cut. At present, the most popular form of NVRAM is called flash memory. Flash memory is non-volatile computer storage that can be deliberately erased and reprogrammed. It is a memory chip for storing and transferring data from one digital device to another. Flash memory can be electronically re-programmed or erased. It can be found in digital cameras, MP3 players, USB flash drives, and solid-state drives.

A significant advance in NVRAM technology is the floating-gate transistor, providing erasable, programmable, read-only memory (EPROM). The floating-gate transistor consists of a gate terminal, protected by high-quality insulation (acting as a switch) for a grid of transistors. The EPROM could be erased and re-set by applying ultraviolet light. This technology was recently replaced with the EEPROM, which uses electricity to reset the memories. New concepts for NVRAM include:

- Ferroelectric RAM **(F-RAM):** A random-access memory, very similar to DRAM, but uses a thin ferroelectric film whose atoms change polarity, resulting in a switch. Memory is retained when the power is cut off.
- Magnetoresistive RAM **(MRAM):** Uses magnetic elements and operates similar to the core.
- Phase change RAM **(PRAM):** Uses the same tactics as writable CDs, but readings are based on changes in electrical resistance, instead of optical properties.
- Millipede memory**:** Basically a punched card created by nanotechnology.
- Nano RAM**:** Based on carbon nanotube technology.”

In-Memory Database Management System (IMDBMS)

A thorough understanding of an organization’s needs and priorities is crucial in determining the best choice of database architectures. IMDBMSs (sometimes abbreviated to “Main Memory Database Systems) use a variety of approaches and techniques to provide in-memory database processing. Modern IMDBMS not only store data in the memory, but also perform operations within the memory. All the data might be stored in memory, but may be in a compressed format, optimizing access and data storage. The DBMS can be designed to offer hybrid capabilities, such as combining the functions of a disk drive and in-memory technologies to maximize performance and minimize costs. To assure the durability of data within an IMDBMS, it must periodically be transferred from the volatile memory to a more persistent, long-term form of storage.” One method for this is called “transaction logging,” with timed snapshots of the in-memory data sent to some form of non-volatile storage. Should the system fail (and be rebooted), the database can be reset, with most of the current data still available.

The Cloud and Main Memory Database System

The cloud provides an excellent environment for getting the most out of in-memory computing. A cloud environment offers organizations the ability to access large amounts of RAM at will. This approach can help organizations avoid the expense of an on-premises in-memory computer. The cloud can also provide an environment that makes in-memory storage more reliable through the use of redundant hosts and virtual machines using automatic failover. With these measures, the disruption of RAM will not lead to a data loss. These protective measures are more difficult to develop in an on-premises computer system. Combining the cloud and in-memory computing provides an excellent way to maximize the benefits an in-memory system.

The Future of Main-Memory Database Architecture

Nima Negahban (2009) defined in-memory database as a memory that coordinates a lot of data for conservancy, having it constantly be updated, and then being able to look at all the data and generate it in real-time. It just makes things a whole lot easier, because it is faster. Wherever the data lives is where the rest of the solution stack will move toward because data is expensive and the need to be able to have fast access and do mutations of that data is what drives all computing. So as data continues to explode, and as in-memory databases get more creative, we are going to see databases take on a lot more roles where they become places where you house application containers, visualization engines, machine learning models, and more. The data gravity phenomenon is going to take effect.

Conclusion

In this research, we have discussed about the basic requirements of mobile databases. We have also dealt with the issues and problems faced in case of mobile databases as well as main memory database systems." We have discovered that In-memory databases work faster than databases with disk storage. This is because main-memory systems use "internal" optimization algorithms for storage, which are simpler and faster, and this type of system requires fewer CPU instructions than a disk storage system. Additionally, accessing data that has been stored "in-memory" eliminates the need for seek time while searching for data. As a consequence, several data warehouse vendors are switching to in-memory technology to speed up the processing of data. The cloud also presents an opportunity for using in-memory databases. Issues of disconnectivity and consistency were also discovered on the existing mobile database system. However, our proposed system will ensure updates initiated at the mobile host machine which is not connected may be saved and recovered a major failure. That means a copy of information are kept in the main database in case updates fail. But where there is no failure experienced, the API ensures that the mobile data the database contents are updated regularly.

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