

A Distributed Database Architecture For Location Independent Scheme In Mobile Networks

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ABSTRACT

Mobile phone users who travel from one country or continent to the other are required to pay roaming charges to the telecommunication operator. Also, since the data resides in the home country of the user, this makes for delay in the call procedures. This paper discusses the need to design efficient database architecture to support location independent scheme which will reduce the roaming cost by making the telecommunication number as a local number where ever the user travels. Therefore to implement such a global mobile system, a location independent scheme is needed. The need to design efficient database architecture to support location independent scheme with acceptable loads in future is an important issue in the cellular mobile systems. The system generates a unique telecommunication number after registration, in which this generated number can then be adopted wherever possible.

Keywords- Global Roaming, Architecture, Personal telecommunication number, Service Provider, Location Independent.

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1. INTRODUCTION

In today's mobile network system, if a user moves from one country to another or to other continent, user needs to pay roam charges to the operator. Since the data (profile) resides in the home country it makes delays in the call procedures. Location management is one of the important functions to support global roaming. Location management allows the network to determine the current location of mobile terminal. One of the most essential functions for global roaming is managing the location of the users. It has various operations in different databases, which should record the information by all the users who are moving from one location to another. Hence this paper shows how a distributed database can maintain each user registration, service profiles, call setup and location update.

2. PROBLEM STATEMENT

In recent years, whenever the mobile user moves from one place to another place the service providers and service profile will be changed. The mobile user would register his location in the new area, maintaining the service profile when the mobile users move frequently. This provides more overhead to the database which increases the load as well as changing the user's personal telecommunication number.

2.1 Research Objectives

The objectives of this paper are:

- To propose the large centralized database architecture for global roaming in mobile networks.
- To ensure that a mobile subscriber can retain its lifelong personal telecommunication number regardless of its location and service provider.
- Discuss the location registration setup and roaming in mobile communication system.
- Review and understand the database architecture of the current cellular communication system.

3. REVIEW OF RELATED WORKS

3.1 Two-level database architecture

Per-User caching: This strategy which is based on two-level database architecture was introduced by Kazi et al [6]. This strategy which is also known as the Caching Strategy was propounded for locating the mobile users who would want to change the registration area in cellular mobile communication service. The caching strategy deals on the basic idea of reducing the loads in the database, and reducing the signal in the networking, memory costs as well as CPU processing. Since the strategy could reduce cost, it then became increasingly attractive. This strategy is more efficient for a user who receives calls frequently with respect to the rate at which the user changes its registration location.

For each entry in cache the location information of mobile terminals is created in signal transfer point. If any other call is arrived for the same mobile terminal, it obtains the information which is cached already. Then it forwards the call to the VLR (Visitor’s location register) which is mentioned in the cache. A hit occurs if the mobile user is not moved from that VLR otherwise a miss occurs [6]. If then a miss occurs, then the call delivery procedure of two-level database architecture has to be traced to find the mobile user, which increases the call setup delay. This implies that the strategy is inefficient if the mobile user changes the location more often.

The Replication Strategy: This strategy based on two-level database architecture was introduced by Ravi et al [8], in order to reduce the call delivery delay. The mobile user’s location information is replicated in some selected databases in this strategy. Hence, without querying the HLR (Home location register), the replicated database can be routed or searched for

the calls to the mobile users who originates from the previous service areas. All the databases that are replicated would have to be updated, when the mobile terminal changes its location. This method increases the signaling traffic and database load most especially for highly mobile users [8].

The Local Anchoring: This strategy which is based on two-level database architecture was introduced by GuoHui [2]. This method which is also known as ‘Anchoring Strategy’ scheme is used for tracking the location in personal communications network (PCN). The idea behind this scheme is to reduce signal costing in comparison with the location management strategy that is in IS-41 and GSM standards. The number of messages for location registration between the HLR and the VLR is minimized by reporting the change in the location to a nearby VLR which is in other words called LA (Local Anchor) done on behalf of the HLR.

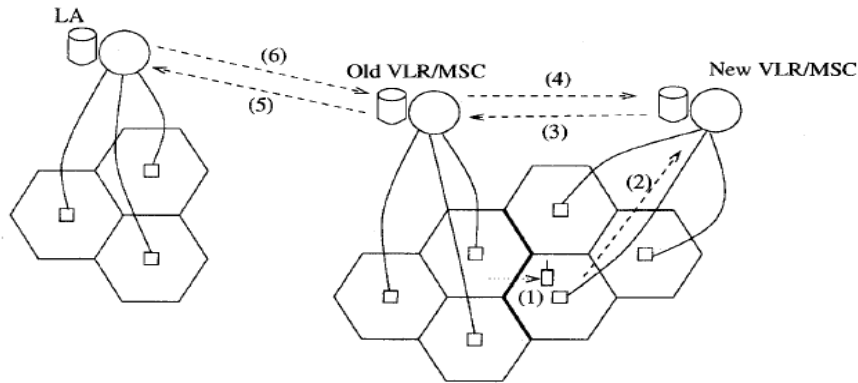


Fig.1: Reporting Location changes to the LA.

3.2 Distributed database architecture

Hierarchical Database Architecture: The need to reduce the access loads on a distributed database architecture was designed by Akyildiz [3], which distributes the loads into the lower level database. An extra level database called directory registers (DS) is being added in between the HLR and VLR cellular system. The rate of access to the HLR is executed by the DR, because it distributes the location information frequently to the associated mobile terminal using the distribution strategy.

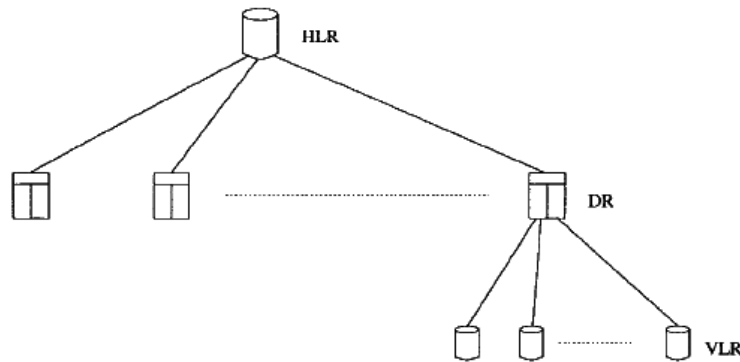


Fig.2: Hierarchical Database Architecture.

This strategy reduces the chances of inter-Directory Area movement which results in additional reduction in database access and the signaling cost. This method about location management depends on the newly added directory registers (DR) to distribute the Mobile Terminals (MT) location information. Hence all further jobs, such as finding the location information distribution strategies, are carried out by the Directory registers (DR). The distribution method for each mobile terminal (MT) can be obtained independently at the local directory register (DR) by using the information existing at the serving Visitor Location Register (VLR). This makes centralized control not necessary.

Distributed Database Architecture On Metropolitan Area Network : This was introduced by Andrew [1]. Multi-levels of database mobile architecture network have been introduced based on the location numbering independent plan. The previously designed databases has some common drawbacks, which has only one root centralized database to maintain all the service profiles of the mobile users. It is inoperable to store & maintain a database globally due to expected large number of users. Entire system will be affected if the root database crashes. A system is used to estimate MAN coverage in metropolitan areas, and is used to reveal coverage of around 50 city blocks per MAN. Distributed mobile user database architecture is used to assist call setup, tracking of handoffs and detecting mobile terminals that roam. It is only acceptable in wide mobile systems like MAN. A multi-level database system is proposed, which increases the database system more sophisticated, by the use of additional nodes in it. Extra nodes in the global mobile system are necessary to deploy in different countries.

4. METHODOLOGY

This work is basically an efficient location database architecture based on the location-independent personal telecommunication number scheme. Thus, the proposed multi-tree database architecture consisting of a number of database subsystems, works on the spiral model in software methodology. Hence, the discipline of change and the extent of taking change requests are important to develop and deploy the product successfully. This means that change request regarding locations can be effective using spiral model.

4.1 Proposed Architecture

Each database subsystems consists of three different databases namely DB0, DB1, and DB2, in which without any much registration the mobile users can roam freely because the DB2 holds the information of the registration areas. The DB2 is also concerned with mobile switching which is used to perform the process of call orientation and termination. A group of DB2s make up one DB1 and a group of DB1s make up a single DB0. In order to exchange messages between various location databases a switch is used, called STP. DB0 currently holds the mobile user's service profile information in its corresponding service area. DB2 holds the service mobile users who are currently roaming in that particular area.

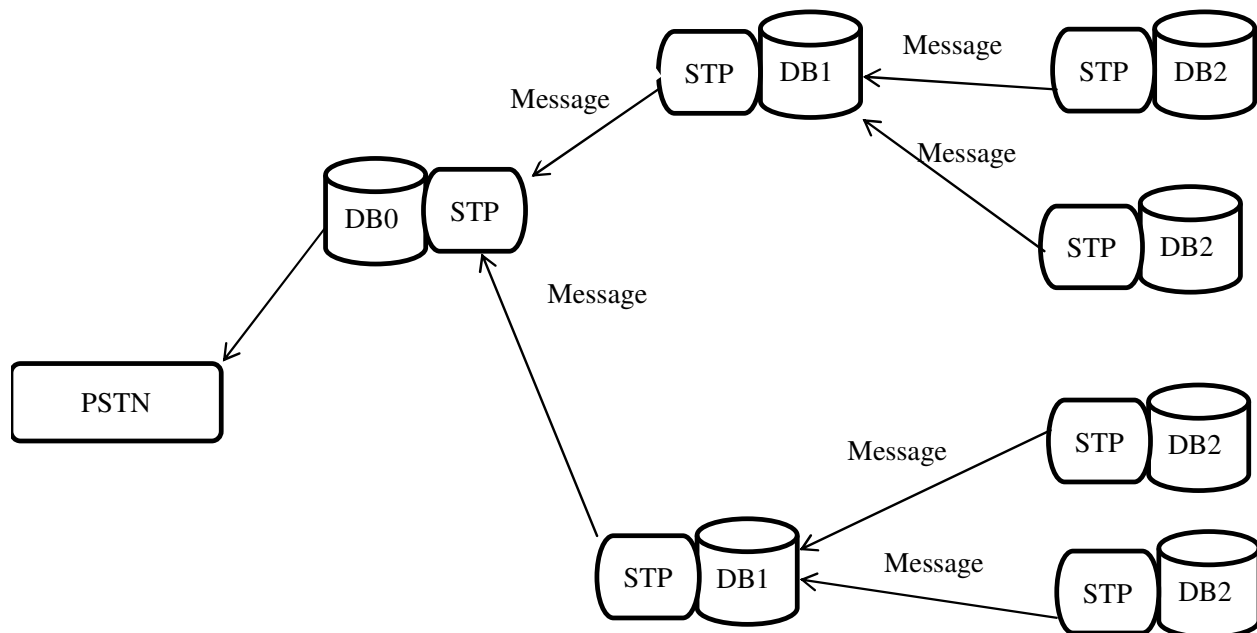


Fig.3: Proposed Multi-tier Architecture.

5. RESULT

All the mobile terminals in the database subsystems are communicated through their root databases. Thus, these various databases represent various network operations possibly by different service providers. Public switched telephone network (PSTN) is essential in order to interconnect all the database subsystems in the architecture. This system is being built using JAVA in which an application interface is developed that enhances the effective communication of the various database subsystems. The system generates a unique telecommunication number after registration, in which this generated number can then be adopted wherever possible.



Fig.4: Home View

A new user gets registered by filling the necessary information needed which will prompt a personal telecommunication number to be generated.

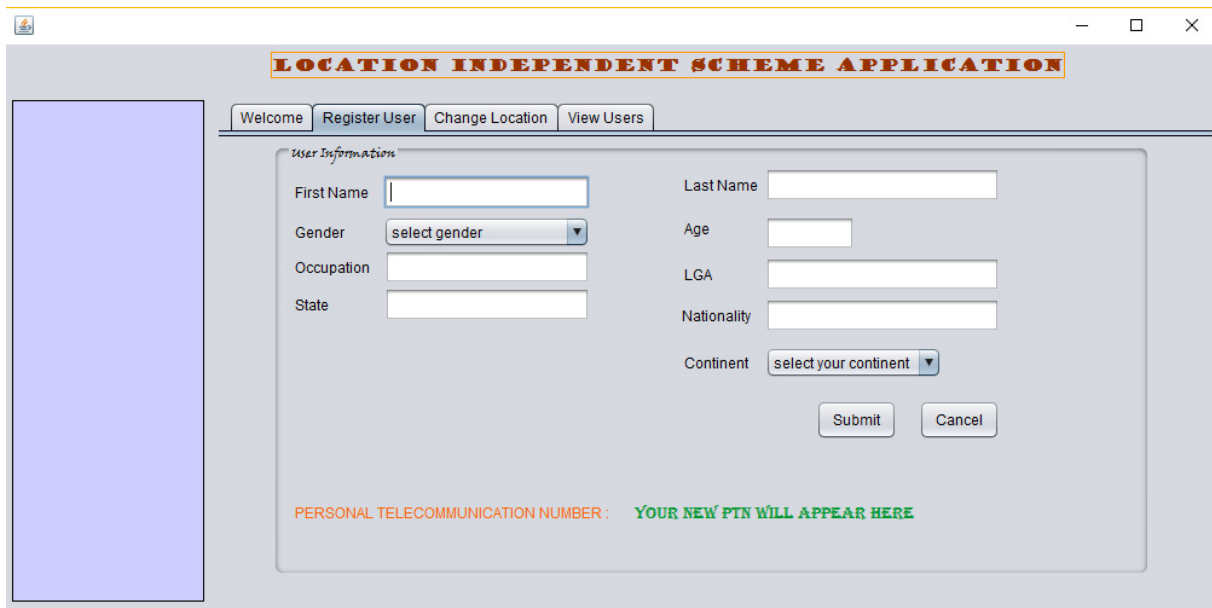


Fig.5: Location registration

Here an already registered user can now change the user's new location by using the registered personal telecommunication number which has been generated.

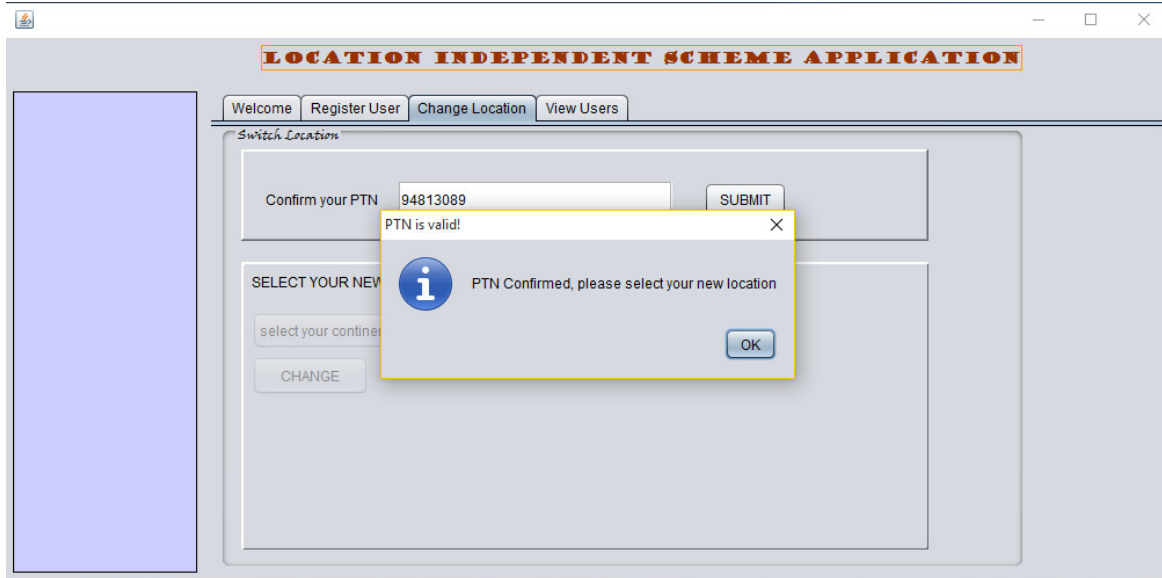


Fig.6: Changing Location

Location successfully changed, showing old location as well as new location.

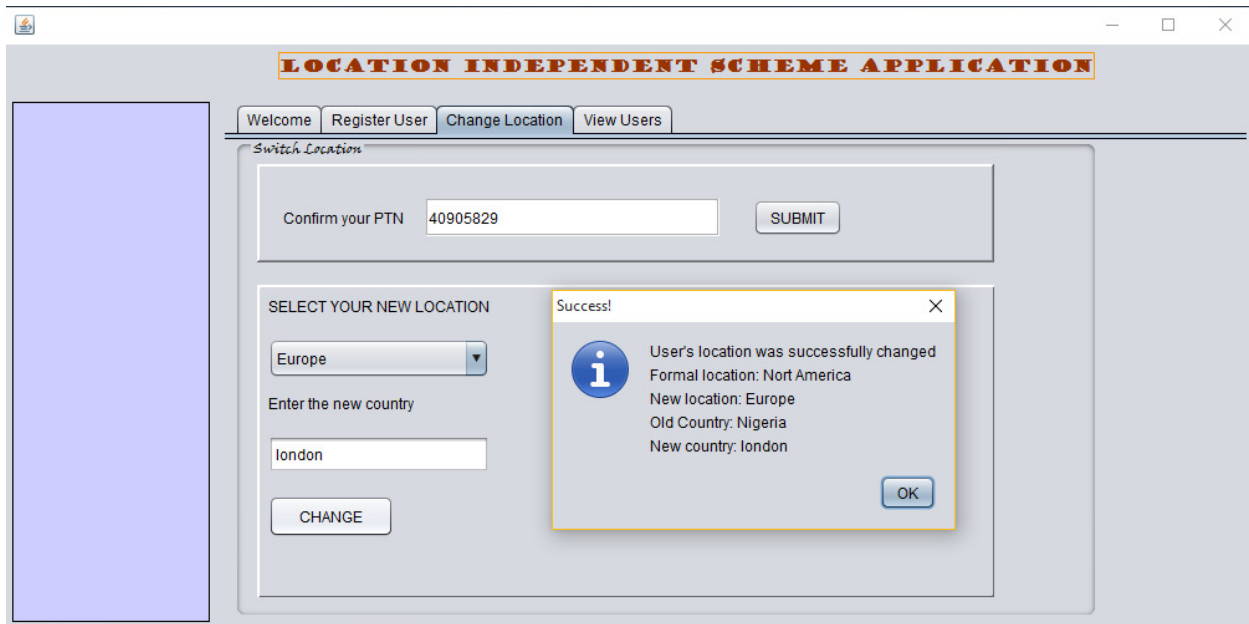
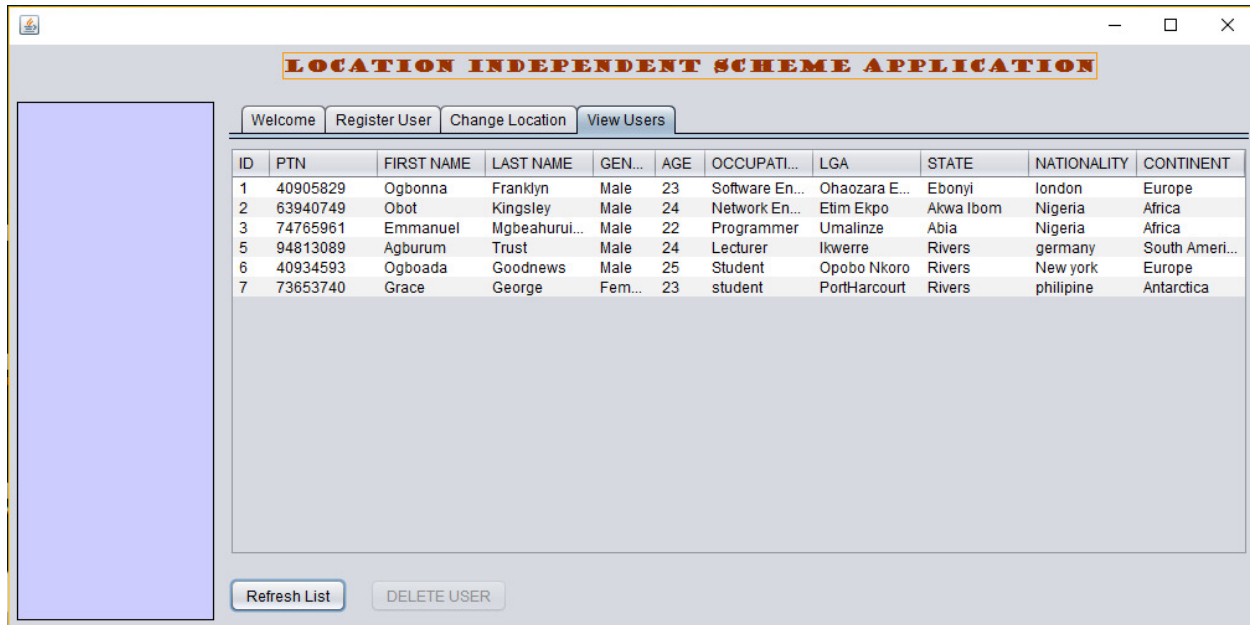


Fig.7: Location changed



The screenshot shows a web application window titled "LOCATION INDEPENDENT SCHEME APPLICATION". It features a navigation menu with buttons for "Welcome", "Register User", "Change Location", and "View Users". The "View Users" button is active, displaying a table of users. The table has columns for ID, PTN, FIRST NAME, LAST NAME, GEN... (Gender), AGE, OCCUPATI... (Occupation), LGA, STATE, NATIONALITY, and CONTINENT. Below the table are buttons for "Refresh List" and "DELETE USER".

ID	PTN	FIRST NAME	LAST NAME	GEN...	AGE	OCCUPATI...	LGA	STATE	NATIONALITY	CONTINENT
1	40905829	Ogbonna	Franklyn	Male	23	Software En...	Ohaozara E...	Ebonyi	london	Europe
2	63940749	Obot	Kingsley	Male	24	Network En...	Etim Ekpo	Akwa Ibom	Nigeria	Africa
3	74765961	Emmanuel	Mgbeahurui...	Male	22	Programmer	Umalinze	Abia	Nigeria	Africa
5	94813089	Agburum	Trust	Male	24	Lecturer	Ikwerre	Rivers	germany	South Ameri...
6	40934593	Ogboada	Goodnews	Male	25	Student	Opobo Nkoro	Rivers	New york	Europe
7	73653740	Grace	George	Fem...	23	student	PortHarcourt	Rivers	philipine	Antarctica

Fig.8: Database View

6. CONCLUSION

The system simulates the proposed multi-tree database architecture for location database management based on location independent PTNs scheme. The efficient database architecture is designed with three level tree structures to support large number of users. When compared to two-level database architecture the proposed multi-tree database is more robust, scalable and efficient because it supports higher user density and reduces the signaling load in location registration and call setup.

When compared to one-root database architecture it's more reliable because it's easy to expand and maintain multi-operator environment of a global mobile system. In one root database architecture, if the root is crashed the whole database will be affected. It's very difficult to retrieve back. In the proposed architecture it's easy to retrieve the crashed database and it will not affect the whole database systems. Eventually, the mobile users can move around the world without changing their PTN number as well as the service profile.

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