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Efficient Backup methods for Location Register System in Cellular Network

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Abstract

A Location Register(LR) system manages each subscriber's location information, which continuously changes in mobile cellular network. For this purpose, the LR database system provides backup management facilities. The objectives of this paper are to identify the problems of the current LR system through rigorous analysis, to suggest solutions to them. I proposed efficient backup methods that takes into account the characteristics of LR database transactions. In the proposed backup method, I use two kinds of dirty flags in order to solve the performance degradation problem caused by frequent registration- location operations.

Keywords: *Mobile Cellular Network, Location Register, performance, backup*

1. Introduction

The management of location information is needed since the positions of subscribers are continuously changing in mobile network. LR(Location Register) system is playing important roles as call processing and supplementary services as well as managing the location of subscribers in main work. It is expected that the demands of diverse types for location-managing servers will be expanded. With the growth of semiconductor industry, the capacity of main memory with low prices is so big that the researches about main memory database system, to improve the performance of database system to take advantage of the main memory in database field, have actively been studied[1][2][3]. Main memory database system gives fast access to data since the whole database resides in main memory, which is different from disk resident database system[4][5]. The LR system for real time treatment of changing and accessing location information, and for management of a big amount of subscribers information, therefore, uses main memory database system. Main memory database system used in LR system, owing to the characteristics of mobile network, is different from general main memory database system as the following. First of all, it is possible to recover without the traditional recovery method even if the location information of subscribers is lost on account of system error. The traffic messages which location register, playing a main part to support these services, deals with, as such reason, keep increasing. Holding a dominant position will also depend on whether location register can flexibly accommodate how many subscribers with same equipment cost. The motivations as the above make me to design a new structure to improve the performances with the same equipment cost by analyzing the characteristics of location register as mobile network system.

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In this paper, We suggest the method of efficient backup for the performance of LR system and S/W structures applied practically to develop better system, which are based on the need of backup due to condition and the problems from the results of analyzing the current LR system.

The paper is organized as follow. I first describe the current LR system in section 2. Second, the proposed structures for more efficient LR system are represented in section 3. In section 4, I finally bring my research to conclusion.

2. LR system

The position and role of LR in mobile network will in this part be explained[6][7][8]. The process of call completion and the changing process of location information, giving the important functions in LR system, will also be represented. LR system connects MSC/VLR(Mobile Switching Center, Visitor Location Register). Its main function is to process it in real time to support call processing through location information management of subscribers, and manage or support supplementary service information for each subscriber, which is currently used in Cellular Network. LR system links with MSC/VLR by Common Channel Signalling No.7 (CCS7), from which it deals with the update of location information or the demand of inquiry, and reports the change of subscribers information to the MSC/VLR. In addition, it delivers messages between MSC/VLR and AuC(Authentication Center), sometimes makes a linkage with VMS/FMS, a supplementary service system, through MSC/VLR. As the software part of LR system to interwork MSC/VLR, there are MTP(Message Transfer Part) and SCCP(Signalling Connection Control Part)of the lower levels in protocol, TCAP(Transaction Capabilities Application Part) of the high level, and ASE(Application Service Entities) to deal with mobile communication application. The software structure consists of Database System to add, delete, search, and update, Operation and Maintenance Part to deal with failure, status, and statistics, and User Interface Part for the convenient use of LR system.

3. The proposed LR database backup system

In this section, We explain the proposed architecture of LR database system.

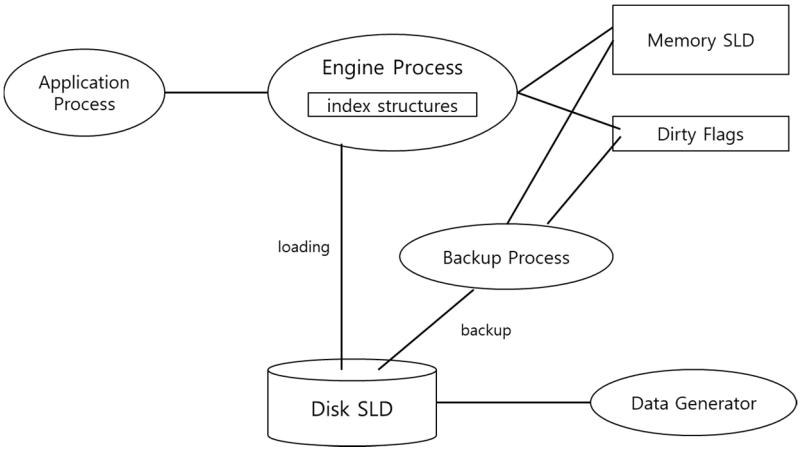

Figure 1. Location Register database system architecture

Main different points between the architecture of the proposed system and the existing database system are to add logging for consistency and change the function of backup process to use checkpoint. Tape backup processes are replaced by the existing backup instruction.

3.1 The proposed database system architecture

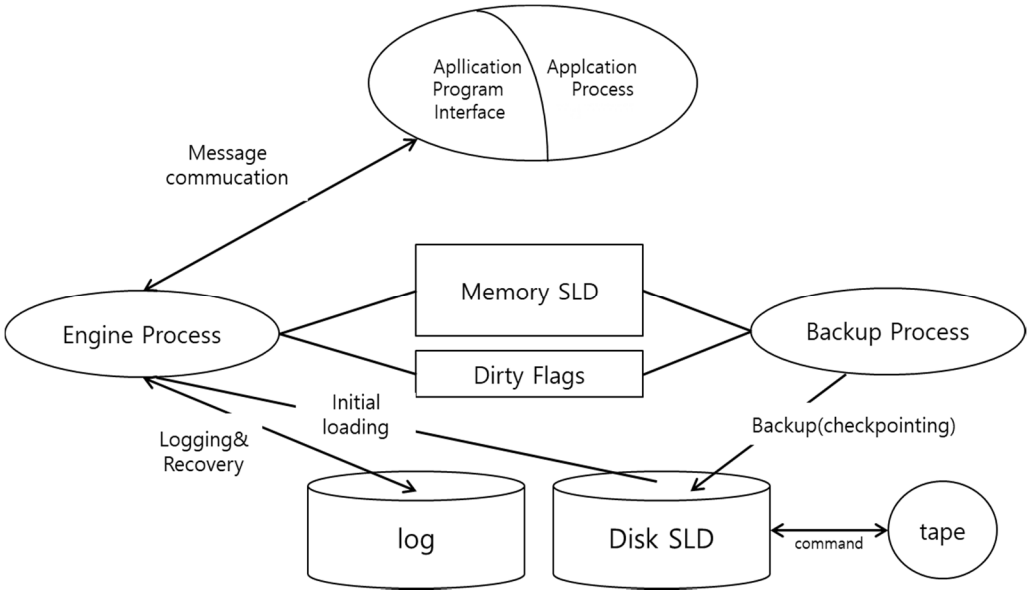

Figure 2. Proposed Location Register database system architecture

Engine processes receive and execute database task requests of application process and play a role in returning the results. The existing engine process structure consists of message management, query processing, table management, and index management, including initial processing. There are many problems about backup in this engine process. In this section, I explain the structure and function of engine process, which accommodate the improvements of such problems. The new engine process consists of existing parts with improved functions, adding recovery and logging managements. The structure is designed to keep frames of the existing engine process and improve performance and safety. The initial processing part executes recovery function through recovery management in case of crash and initializing function of new index structure. The query processing part executes information processing tasks of subscribers by separate messages in addition to the existing database jobs. The table management part is similar with the existing one except the inclusion of the function to support logging. Finally, the recovery and logging managements take charge of database restoration, keeping consistency when crash happens. Each part belonging to engine process is described in order in this section. The existing initializing process performed in engine process is as follows. First of all, generate identifiers of message queue, execute database loading from disk SLD to memory SLD, and initialize updating flag for backup. Next, check the number of tables and the size of tuples, create initial index structure, and generate backup process and tape backup process. The suggested query processing executes the function to integrate the message connection and the query processing. The existing message connection executes the function to require the database work from application process to engine process and transfer the result from engine process to application process. Such function is intactly used in the query processing part of the suggested engine process. Next, the processing function about tuple searching, inserting, deleting, and altering messages of the existing query processing part and the newly additional messages are included and dealt with in the new query processing part. The query processing in the suggested engine process provides the additional messages related with information processing of subscribers. As these messages are focused on safe backup or data consistency rather than real time processing and each message are executed by transaction concept , several database jobs occur in

practical engine process.

3.2 Efficient Backup methods for Location Register System

I suggest a new effective backup method based on the problems of backup used by current LR database system in this section.

Main memory database system used in LR system, owing to the characteristics of mobile network, is different from general main memory database system as the following. First of all, it is possible to recover without the traditional recovery method even if the location information of subscribers is lost on account of system error.

LR system has the following features. First, the hardware of that takes fault tolerance. Second, even if the location information with most tasks of database is lost, it is possible to restore that in short time. Therefore, to maximize the performance of LR system, it needs to execute essential functions and take very limited backup method. Each backup method about two kinds of transaction is suggested by different way each other. One is regular backup method of the function as location registration which does not need quick backup and require fast response time. Another is quick backup method not to lose information as the new subscriber register. The location information of subscribers altered by location registration occurred frequently has characteristics that recovery is automatically achieved very fast. While location registration of each subscriber happen frequently, the possibility to complete call is very high if using prior location information before error of the relevant subscribers, even if location information of each subscriber is earlier than time recovered by next location registration in restarting LR system. To use location information earlier than time of restarting LR system, it is desirable to copy and use the latest location information for each subscriber. But if copying location information every time as seeing until now, whole performance of LR system can be very seriously affected. As LR system is based on specific region, it has a feature that location information of most subscribers is not changed easily. The updating information as location information alteration therefore needs keeping the information by executing periodic backup.

The periodic backup can be achieved by the following order. First of all, it accepts the request of location information alteration. Next, engine process executes updating function of database, after which the relevant updating flag of updating page is changed into 1. Thus, for the pages with updating flag of 1, different from the existing backup method, backup process can be taken by request of operator or in the most rare time of system's use.

While location information makes it possible to take periodic backup, the operation function related with subscribers as new subscription should immediately be executed. To achieve the above, two methods can largely be considered. The first method is to use the existing backup process as it is. The second method is to execute logging of each transaction for operation function related with subscribers by introducing the concept of transaction and perform recovery using SLD disk stored by log and periodic backup in error.

To use the existing backup process method, updating flags are altered to 2, different from location information alteration, about the pages changed by operation function related with subscribers from engine process, and backup process executes the function to copy the changed pages with 2 in SLD disk as examining updating flags continuously. This method has a good point to be implemented without altering the existing structure largely. But the restarts due to errors can bring inconsistency because the alteration and backup of information are separately achieved by different process each other.

This method can solve the problem of degradation according to frequent location registration but when errors occur in the process of being registered in disk, a problem with inconsistency remains. Next section explains the improvement of this problem.

4. Conclusion

In this paper, I suggested effective S/W architecture or backup method based on the problems found in LR system operated in current mobile communication network. On the other hand, the existing backup method brought system degradation as making backup without differentiating location information alteration with location registration from information alteration with operation function related with subscribers. To overcome this problem in this paper, more effective backup method was suggested by separating two kinds of alteration function. Information alteration which make it possible to be recovered automatically as location information execute only periodic backup, and information alteration with operation function related with subscribers makes quick backup as the existing method to prevent information loss.

The other research directions hereafter are as follows. To minimize the increase of signalling traffics with assistance of personal mobility, additional attributes to differentiate and manage terminal status information need. To assist new supplementary service, the research to support dynamic scheme evolution is required. Subscriber migration among LR systems happening according to the growth of subscribers has to be considered and the research for special supplementary service which needs separate management from subscriber tables should be required.

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