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한국에서 이동전화 번호이동성 시스템을 위한 데이터베이스 관리 시스템

(The Database management system for the MNP in Korea)

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요 약

본 논문은 이동전화 번호이동성을 위한 세상에서 가장 진화된 데이터베이스 관리 시스템에 관한 것이다. 데이터베이스 관리 시스템은 번호이동 절차를 30분안에 완료할 수 있고, 그것은 현재 세상에서 가장 빠른 것이다. 이동전화번호이동성 데이터베이스 관리시스템은 두개의 기능 블락으로 구성되어 있는데, 하나는 호처리시스템이고 하나는 이동전화번호이동성의 가입자들이다. 하드웨어와 처리구조가 본 논문에 제시되어 있다. 호처리를 위한 DB 는 각각의 이동전화 사업자망에 위치하고 있으며 L-NPDB라고 불리운다. 이동전화 번호이동성의 가입자를 다루는 DB는 L-NPDB와 한국통신사업자연합회에 있는 master-NPDBT로 구성되어 있다. 이동전화 번호이동성을 위한 하드웨어는 NPCDB와 L-NPDB와 M-NPDB간의 상호접속으로 구성되어 있다. master 데이터베이스는 L-NPDB와 전용선으로 연결되어 있으며, MNP 서비스를 실시간으로 처리할 수 있다. 본 논문에서 제안하는 이동전화 번호이동성 구조는 한국에서 실제로 구현되었고 이동전화 번호이동성을 위한 세계에서 가장 효율적이고 진화된 데이터베이스 관리 시스템이 되었다.

Abstract

This paper describe the most advanced database management system for the mobile number portability(MNP) in the world. The database management system can process the procedure of porting_out and porting_in in 30 minutes and it is the shortest time in the world. The MNP DB management system consists of two functional blocks, one is for the call processing system and the other is for the management of subscriber of MNP. The hardware and processing algorithm are presented in this paper. The DB for call processing is located at each mobile operator and be called local number portability database (L-NPDB). The DB for the management of subscriber of MNP consist of L-NPDB and master database which is located at the Korea telecommunications operators association(KTOA). The hardware database system for MNP consists of the interconnection system of master-NPCDB (NP customer database, M-NPCDB), local-NPCDB, M-NPDB and L-NPDB. The master database is interconnected to the local database through dedicated line and can process any MNP service in real time. The presented MNP structure in this paper has been implemented in Korea and became the most effective and advanced DB management system for MNP in the world.

Keywords: MNP, system, NP, communication, QoR

I. Introduction

MNP means that one person can change his cellular phone operator without changing his phone number. MNP call processing system and MNP customer management system must be constructed to enable MNP. In this paper, we invented a database system for MNP and effective subscriber management structure using interconnection between master DB system(M-NPCDB, M-NPDB) and local DB system(L-NPCDB, M-NPDB). We also describe the

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problem, performance and realization that are related with MNP system.

II. The database system for MNP call processing

MNP call processing system consists of intelligent network exchanges and NPDB etc. and it is in charge of processing of all the calls that are called to or calling from the MNP subscribers. We can process voice call and non-voice call in MNP system.

In Korea, MNP call processing is based on the QoR method. In QoR method, MNP query is activated by the originating network or the transit network after received release message from a doner network. A principle rule is QoR method and voice or non-voice call must be processed by QoR and all the network operators can adopt ACQ method internally but in this case QoR method must also be supported [1].

To process MNP calls, we allot a routing number (RN) to a telecommunication operator and save it to the NPDB and use it to discriminate the recipient network operator. L-NPDB which is located at the operators network hold four kinds of data such as RN of the doner network, RN of the recipient network, dialed number(DN), the starting date of MNP and if the NP query occurs, NPDB returns the required data for the MNP call processing.

MNP call processing system use the RN which includes final destination network's identifying address to route to the called number that is moved to another network and apply an address format where the RN and the DN is separated to the recipient address information. Therefore, the RN and the DN use different parameters from each other[2,3].

The QoR method that is based on the intelligent network is applied to the call processing of MNP. Every telecommunication operator's network is interconnected to another operator's network. The call processing of MNP voice call can be divided into two parts, one is a general voice call and the other is a freephone service call. Cellular phone originating calls, international calls and wired line originating calls must be processed by MNP system in Korea. VoIP originating call processing is the object for future study. The originating exchange processes NP calls in the case of cellular phone originating call, the transit network operator's G/W exchange processes NP calls in the case of receiving of the international calls and the wired line's G/W exchange process NP calls in the case of originating from the wired network[4].

The called party number(CdPN) can be a routing number(RN) or dialed number(DN) in MNP system and we add "0000110"(specific national RN) to nature of address(NoA) field of CdPN. Therefore, If CdPN is used as RN, the value of NoA becomes 0000110 and the value of NoA becomes 0000001 or 0000011 in case of DN.

To process NP, we add number portability forward indication (NPFI) field to the initial address message (IAM). The value of status indicator of NP in NPFI is "11"(NP queried and ported out subscriber). The value of the cause indicator (CI) in release message is "0001110" (NP) and inform originating network that the called number is ported out using it.

The originating network routes the call to a doner network using DN received from the caller and the doner network notify the "ported out" to the originating network using release message. Thereafter, the originating network raises a query to L-NPDB, acquires the RN of the recipient network from L-NPDB, and routes the call to the recipient network.

The recipient network routes a call to final recipient exchange where the subscriber is registered and connect it to a called party. In case of the transit

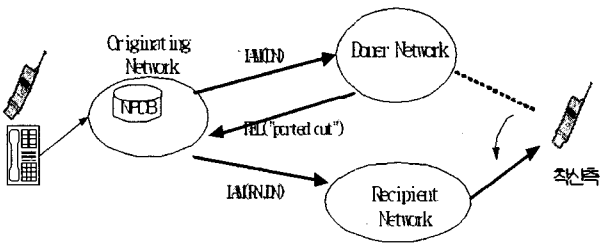

그림 1. MNP 시스템에서 발신망에서의 일반호처리
Fig. 1. General call processing at the originating network of MNP.

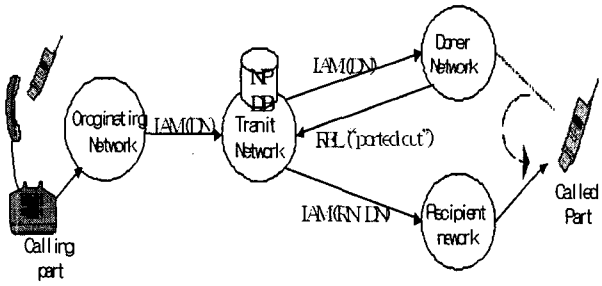

그림 2. 중계호일 경우의 MNP 호처리
Fig. 2. MNP processing in case of transit call.

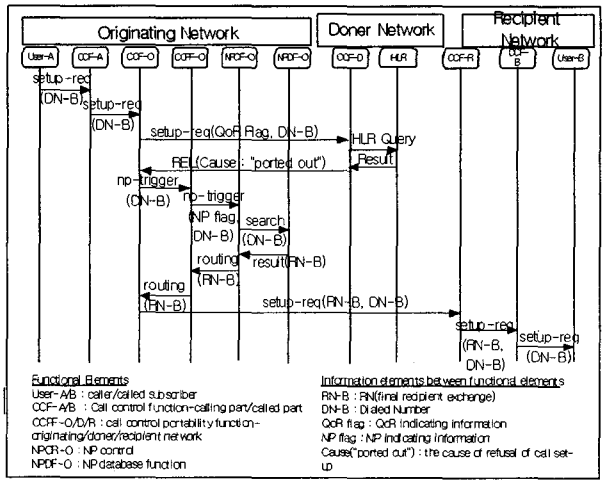

그림 3. MNP 호처리의 정보흐름
Fig. 3. Information flow of MNP call processing.

call (transit call to another network and international call), transient network with NPDB which is showed in Fig. 2 acquires the routing information of the recipient network.

The intelligent network information flow according to the processing of a general voice call is the same as follows. The doner network routes a call from User-A to the gateway mobile switching center (GMSC)(CCF-D) using DN-B dialed by User-A. Specially, the call originating from wired line can make a query to HLR of recipient network and receive the information whether the called number is ported out or not[1].

The global mobile switching center (GMSC)of the doner network makes a query to HLR and if the called number is ported out, GMSC returns the call to the originating network (CCF-O) that is requested routing.

The switch of the originating network triggers the number portability function and makes a query about routing number to the function of number portability control (NPCF-O) using dialed number. Especially, if the originating network is a wired line network and the result of direct query to HLR is that the dialed number is ported out, then the switch of originating network triggers and can make a query to the number portability control function(NPCF-O) using dialed number[5].

The CCF-O function identifies recipient network using routing number (RN-B) which is acquired by NP query and routes a call to GMSC of the recipient network. The GMSC confirms the dialed number at its HLR and routes the call to appropriate MSC. The final MSC completes the call.

III. MNP database system for the subscriber management

The subscriber management system for mobile number portability consists of two functional blocks. The one is NPCDB system for affiliation, withdrawal and retraction of the mobile number portability and the other is NPDB system for storing of the information which is needed for the NP call processing and answer the NP query.

The information that is contained in the NPCDB is changed in the case of affiliation, withdrawal, retraction and the NPCDB system is not accessed after the NP process is completed. After the NP process for a subscriber, the main four data for the NP call processing such as phone number, routing number of the doner network, routing number of the recipient network, NP date will be entered to the NPDB system. Thereafter, the NPDB will be accessed whenever the phone number is called.

The basic structure of the NPDB and NPCDB is the same as Fig. 4. The master DB system maintained by KTOA (Korea Telecommunications Operators Association) consists of master NPDB and the master NPCDB. The M-NPDB is interconnected with L-NPDBs of the communication operators and the M-NPCDB is connected with the subscriber management system of mobile phone operators by TCP/IP.

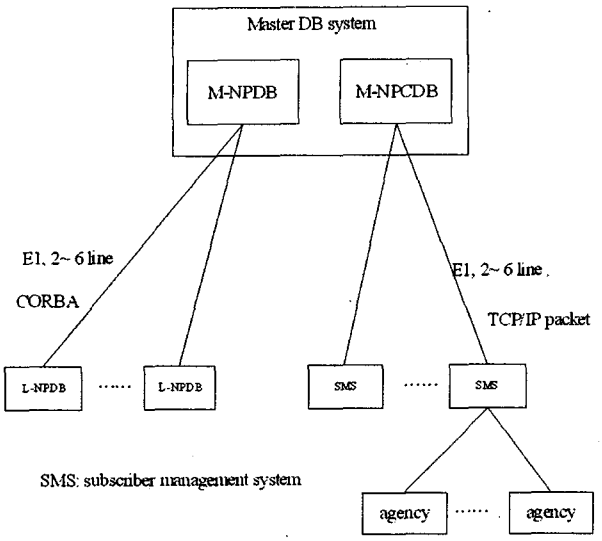

그림 4. NP 가입자 관리 시스템
Fig. 4. NP subscriber management system.

We explain about the two database system for the NP subscriber management system.

1. NPCDB system

The NPCDB system is a database system used for approval and NP processing when a subscriber applies NP service. The M-NPCDB system is interconnected with mobile phone operators such as SKT, KTF, LGT by TCP/IP. They interchange the information for NP processing with each other by standardized interface packet. The interface packet format is the same as follows.

The common part of the interface packet is contained such information as packet length, transfer operator, transfer time etc. and its length is 90 bytes. The contents parts is contained such commands as request of verification, withdrawal of NP, approval, port-in, port-out, complete of NP process and its length is 350 bytes.

The M-NPCDB of KTOA is connected with the subscriber management system of the mobile operators such as SKT, KTF, LGT by dedicated line and exchange the information for NP processing by the interface packet on TCP/IP.

A subscriber who wants NP service go to the agent of mobile phone operator that the subscriber wants to subscribe and apply for the NP service, then that operator examines the applying form and

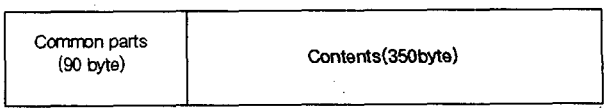

그림 5. 인터페이스 패킷 형식 구조
Fig. 5. The structure of interface packet format.

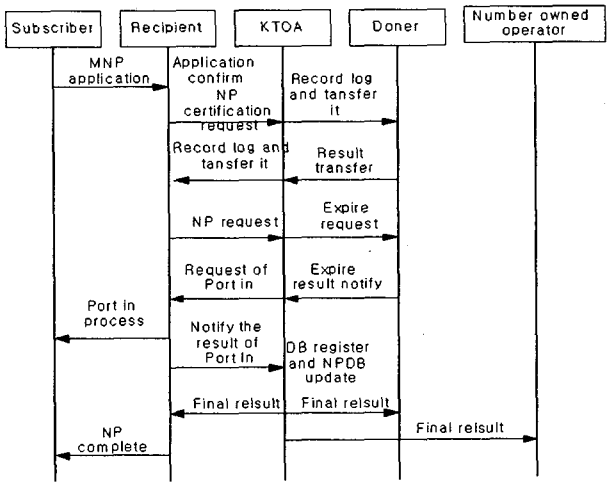

그림 6. 번호이동성 처리절차
Fig. 6. Number portability processing procedure.

requests the approval of the NP to the doner network by sanding the predefined interface data packet to KTOA. After the request of NP, KTOA save a log file and relayesit to the doner network operator. The NP server that is requested NP approval must examine the defined NP refusal condition using the transferd data from KTOA, makes a hotbill and transfers the result to KTOA in 120 seconds.

After the log is saved, KTOA sands the result to the recipient network and the NP server of the recipient network which is interconnected with its own subscriber management system inform the approval of NP to the terminal of agent. The terminal of the agent of the recipient network will knows the result of approval of NP and the charge which the subscriber must to pay, the subscriber pay the charge by card or in cash and requests of the NP to KTOA.

KTOA which is requested of NP request a port-out to the doner network operator, the operator of doner network must complete the port-out and notify it to KTOA in 120 seconds. KTOA which is informed that the doner network is ported-out of the phone number requests a port-in to the recipient

network, the recipient network operator notifies KTOA that the port-in is completed.

KTOA which is informed of the completion of NP process registers it to the M-NPDB, notifies the doner network, recipient network, phone number hold network of the final result of NP processing and the agent of the recipient network notifies the subscriber who applied for NP that the NP Process is completed.

2. NPDB system

The NPDB system is a database which is queried whenever the NP call is processed, KTOA has a M-NPDB and the mobile operators have each own L-NPDB and they are interconnected by CORBA. The M-NPDB in KTOA is not accessed for the NP call processing, it just exist for the completion of the MNP procedure. L-NPDB constructed by each mobile phone operator takes charge the call processing. The changed item of M-NPDB is transfered to L-NPDB immediately and the auditing of M-NPDB and L-NPDB for the coincidence of data is practiced periodically and whenever the operator needs it.

The M-NPDB and the L-NPDB is connected by two or four dedicated line in physically. Because, The capacity of the database system determine the capacity of the NP call processing, each operators calculate the capacity in accord to the statistics such as the most busy hour call attempt count etc. and build their NP database system using it.

The M-NPDB and L-NPDB are built to have the completely same data that are phone number, routing number of the doner network, routing number of the recipient network, NP date and the completion of NP call processing is possible using the four data only[6].

IV. Performance appraisal of the MNP database management system

The appraisal of the MNP database system can be divided into two parts. The one is the capacity of the system for call processing and the other is the speed of the completion of NP process when a subscriber wants to NP service.

In other words, we can appraisal the performance of the MNP database system by divide it into the call processing system and the subscriber management system. The call processing capability is closely related with the satisfaction after the NP and the capacity of the subscriber management system determine the maximum number of subscriber who can subscribe the NP service newly in a day.

1. call processing capability of the L-NPDB

In QoR method, to process outwarding NP calls, we make a query to the L-NPDB after received the ported out message from the doner network, get the routing number of the recipient network and process the call using the routing number. We send a release message that is contained the ported-out message when the called number is ported out

In its own network, to process sanding NP calls swiftly, the capacity of L-NPDB is sufficient to process the NP queries and the processing capacity of the receiving calls from the other network is not related the capacity of the L-NPDB.

In certain mobile phone network, 350 million calls are occurred in daily average and if the NP calls occupy 12 percent of all calls, 4050 calls occurred per second and 486 calls of them are the NP calls. We assume that the most busy hour traffic is 1.8 times more than the average daily traffic, 875 calls must be processed by NPDB system in a second.

Therefore, the capacity of the NPDB system of the operater must be larger than 875 calls per second. In this case, the operator is now managing a NPDB system that can process 1000 NP calls per second.

Each operators build up the NPDB sytem which is sufficient to process current NP calls and any mobile communication cessation which is caused by unable to make a query to L-NPDB is not occurred in Korea. The M-NPDB and L-NPDB to process the NP calls are connected by CORBA and synchronize immediately with each others whenever the data of M-NPDB is changed.

One element which is related to the NP call

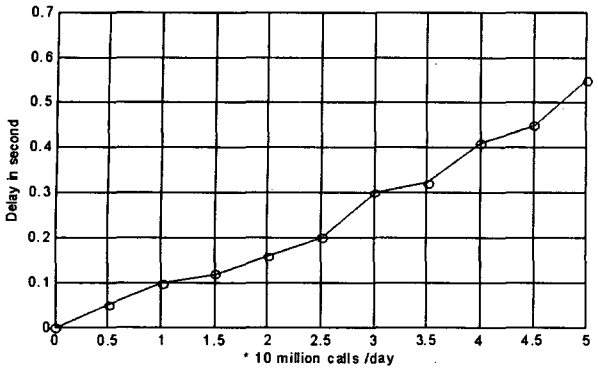

그림 7. QoR 질의에 따른 호처리지연
Fig. 7. Call setup Delay caused by QoR query in real system
** 'o' : real captured data, line: interpolated data

processing capacity is the capability of the intelligent network switch. To complete a NP call by QoR, the doner network and the recipient network is interconnected and all the recipient networks also be connected by No.7 signaling networks.

Therefore, the call set-up time will be determined by the switching capacity of the intelligent network, the capacity of L-NPDB, the capacity of interconnection etc.

Fig.7. shows that the call setup delay caused by QoR query on L-NPDB and the delay time is less than 0.6 second in the case of that 50 million query on L-NPDN in a day.

The increase of the call set-up time is less than 1 second caused by the query on L-NPDB and the NP call processing. It is so short a time that any subscriber cannot perceive the delay, thus the communication quality is not degraded by the MNP processing in Korea.

2. Processing capability of the NP management system for the NP subscriber of MNP DB system

The processing time of the NP request of a subscriber is the time interval from the application of the NP service to the completion of processing of the NP subscriber management and a subscriber can make a call and can receive by his NP mobile phone.

The capacity of the processing of the NP request is 150 thousands in a day and 60 thousand NP request was processed in a day without any error.

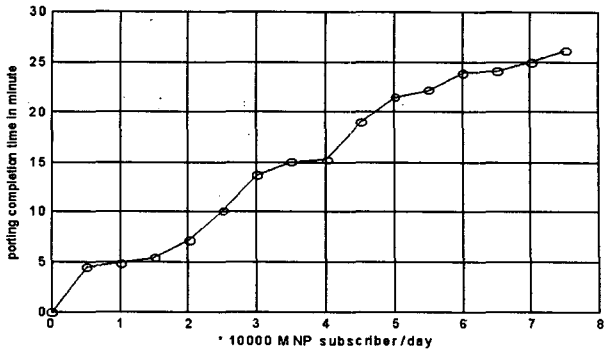

그림 8. 실제 시스템에서의 번호이동 완료시간
Fig. 8. Porting completion time interval in real system
** 'o' : real captured data, line: interpolated data

The porting completion time interval is shown in Fig. 8. and that shows the porting completion time is less than 30 minutes in case of that 75,000 subscriber applied MNP service.

It takes only 30 minute from the request of the NP to the completion of NP process because of the computerization of the almost all of the NP process. It is shortest time in the world to process NP request of a subscriber. In other countries, it takes 8 hour in short or several days in long.

V. Conclusion

The realized MNP database management system can be divided into two parts. The one is for the call processing system and the other is for the NP subscriber management system. The call processing system consists of L-NPDB and intelligent network switches, the NP subscriber management system consists of NPCDB, NPDB, terminals of the agent of the operators and subscriber management system of the operators. The MNP user cannot feel any inconvenience by MNP because of the increase of the call-set-up-time is less than 1 second.

To minimize the initial investment, the QoR method is adopted for the processing the NP calls, but if more than 35 percent of the all mobile phone user become the NP subscriber, the ACQ method is economical than QoR method. In this case, the NP subscriber management system will be changed a little, but the NP call processing system which

consists of switch and NPDB must be changed.

The completion time interval from the request of NP to completion of NP is less than 30 minute because of the most of the work which is related with NP is automated by computerization and KTOA communicates with the server of mobile phone operator using standardized interface packet in Korea. MNP system of Korea is takes shortest time in the world to register a new MNP subscriber and to enable mobile phone of MNP. More than 7 million subscribers are using MNP service in Korea currently. The MNP database system structure in this paper is adopted by the MNP system in Korea. The MNP database system in Korea is effectively designed for the low cost of the operators and the convenience of the user and it is well operating now in technical views.

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