

Routing Mechanism for VoIP Emergency Calls in IP Multimedia System

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Abstract—The emergency call service is to forward the emergency call originated from subscribers in an emergency situation to the nearest PSAP (Public Safety Answering Point) based on their location. However, it is relatively difficult to measure an accurate location of subscribers of the internet telephone based on the IP address. Therefore, the paper introduces methods and implemented examples in the KT for routing an emergency call as well as it proposes the structure of routing tables based on the location information of the subscribers in IMS (IP Multimedia System).

Keywords— VoIP, Emergency, Internet telephone, Routing, Service, IMS, location service

I. INTRODUCTION

The internet telephone provides main services such as voice and multimedia calls as well as additional application services such as presence and SMS. In addition, one of the required telephone services from the perspective of telecom companies is an emergency call service which traces the location of the caller where the emergency situation occurs and forwards the emergency call to the nearest PSAP (Public Safety Answering Point) according to the traced location.

However, it is relatively difficult for the mechanism tracing locations based on IP address to measure an accurate location. Alternatively, it is necessary for the emergency call service to manage the residential address of subscribers in order for tracing the precise location information when initially subscribing or changing the residential address. Therefore, the emergency call established by E-CSCF (Emergency Call Session Control Function) needs to be forwarded to the appropriate PSAP by ECS (Emergency Call Server) with retrieval of subscriber's district codes from database. The paper presents the method for not only routing an emergency call but also gathering and composing the location information of the caller in the fixed broadband.

The remainder of the paper is structured as follows: Section II shows the routing system structure and call flow according to scenarios of the emergency call service in KT IMS. Section III proposes the routing number used by the routing code associated with the emergency call number. Section IV presents the procedures of searching and

composing the routing code. Section V mentions policies to deal with exceptions. Section VI concludes the paper.

II. ROUTING SCENARIOS OF EMERGENCY CALL SERVICE IN KT IMS

For the first time, the emergency call service of the internet telephone on IMS requires changing the routing structure and adding system components such as E-CSCF and ECS with a database based on the subscriber's location. Because PSTN and cellular network already have functionalities for the emergency service in KT, the new system components and routing mechanism for the emergency service are only applied for the following internet telephone services:

- VoIP (Voice over IP) on IMS
- H.323
- Legacy VoIP based on non-IMS

The internet telephone services can be realized by either the VoIP based on IMS or the H.323 and legacy VoIP based on non-IMS. The architecture for the emergency call service introduced in the paper considers the above all cases in order to incorporate the internet telephone based on non-IMS into one system for the emergency call service.

Even though the emergency call from all of the VoIP on IMS, H.323, and legacy VoIP is forwarded to ECS and then it searches the nearest PSAP in PSTN, the entry call path of VoIP on IMS is basically different from that of H.323 and legacy VoIP due to the fact that H.323 is different protocol from SIP and the legacy VoIP is based on non-IMS.

A. Routing Scenarios for the VoIP on IMS

The Figure 1 shows the routing structures and scenarios when a subscriber of VoIP on IMS makes an emergency call.

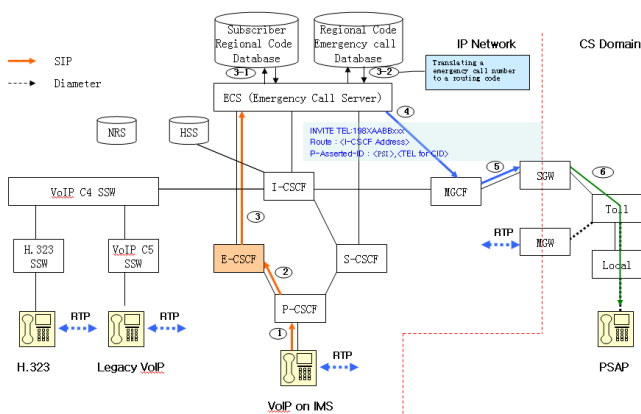


Figure 1. Routing Scenarios for a subscriber of VoIP on IMS

1) Making an emergency call: a subscriber of VoIP on IMS tries to make an emergency call.

2) Forwarding an emergency call to E-CSCF: P-CSCF which received an emergency call detects whether it is an emergency session or not. If it is the emergency session, P-CSCF forwards it to E-CSCF.

3) E-CSCF routes an emergency call to ECS: E-CSCF which received an emergency session routes it to ECS for further process.

- 3.1) **Searching a district code:** ECS searches the district code by the subscriber's internet phone number. In case of failing to search it, it also searches the residential address information by the district code. It is mentioned in detail at Section IV.
- 3.2) **Searching a routing code:** ECS searches the routing code for the nearest routing to PSAP by the district code or the residential address information which has been found in 3.1). It is also mentioned in detail at Section IV.

4) ECS requests the terminating call to MGCF: ECS requests the terminating call with the routing number to MGCF (Media Gateway Controller Function).

5) MGCF forwards the terminating call to SGW: MGCF forwards the terminating call to SGW (Signalling Gateway) in order to transit it into CS network.

6) SGW forwards the terminating call to PSAP: Finally, SGW forwards the terminating call to the nearest PSAP via Toll and Local in PSTN.

B. Routing Scenarios for the H.323 and legacy VoIP

The routing structures and scenarios are in Figure 2 when a subscriber of H.323 or Legacy VoIP makes an emergency call.

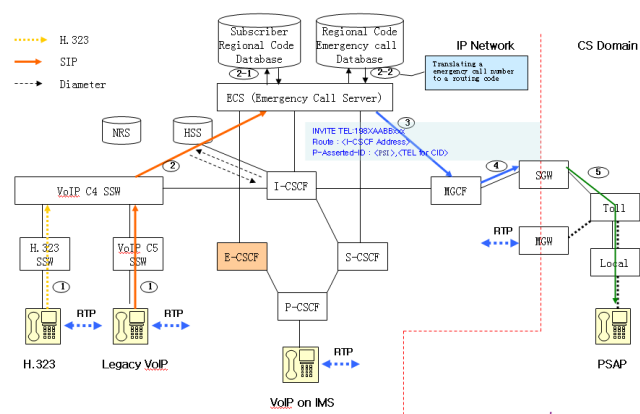


Figure 2. Routing Scenarios for a subscriber of H.323 or legacy VoIP

1) Making an emergency call: a subscriber of H.323 or legacy VoIP on non-IMS tries to make an emergency call.

2) Forwarding an emergency call to VoIP C4 SSW: VoIP C4 SSW (Software Switch) which received an emergency call detects whether it is an emergency session or not. If it is the emergency session, VoIP C4 SSW forwards it to ECS.

- 2.1) **Searching a district code:** ECS searches the district code by the subscriber's internet phone number. In case of failing to search it, it searches the residential address information by the district code. It is mentioned in detail at Section IV.
- 2.2) **Searching a routing code:** ECS searches the routing code for the nearest routing to PSAP by the district code or residential address information which has been found in 3.1). It is mentioned in detail at Section IV.

3) ECS requests the terminating call to MGCF: ECS requests the terminating call with the routing number to MGCF (Media Gateway Controller Function).

4) MGCF forwards the terminating call to SGW: MGCF forwards the terminating call to SGW (Signalling Gateway) in order to transit it into CS network.

5) SGW forwards the terminating call to PSAP: Finally, SGW forwards the terminating call to the nearest PSAP via Toll and Local in PSTN.

III. ROUTING NUMBER STRUCTURE

In the middle of the emergency call service, the ECS inserts the routing code between a prefix and post-number which is either AABB in (1) or AC in (2) obtained from the subscriber's database. It is called a routing number which is represented by:

$$PREFIX-NUMBER+AA+BB+POSTFIX-NUMBER. \quad (1)$$

$$PREFIX-NUMBER+AC+POSTFIX-NUMBER. \quad (2)$$

The routing numbers typed of either (1) or (2) are used to be forwarded to the final PSAP in PSTN. Example of the routing

number associated with an emergency phone number is shown in Table 1.

Table 1. Example of the Routing Number

Emergency Phone #	Routing Number	Comments
Ex.) 911	XXXXX+AA+BB+911	AA: Specific codes divided by a district BB: Organization codes for an emergency
Ex.) 911	XXXXX+AC+911	AC: Predefined district codes

The above AA could be the same as AC depending on the implementation environment of telecom companies.

IV. SEARCHING MECHANISM FOR ROUTING CODE

The telecom company stores subscriber's information to its database whenever new users subscribe the internet phone service or the previous subscribers change their residential address. It results in maintaining the recent location of the subscriber. Thus, the emergency call service retrieves the exact location of the subscriber based on the subscriber's information management system in the emergency situation.

A. Procedures for searching the routing code

Figure 3 shows the procedures to search the routing code associated with a subscriber's information from the database.

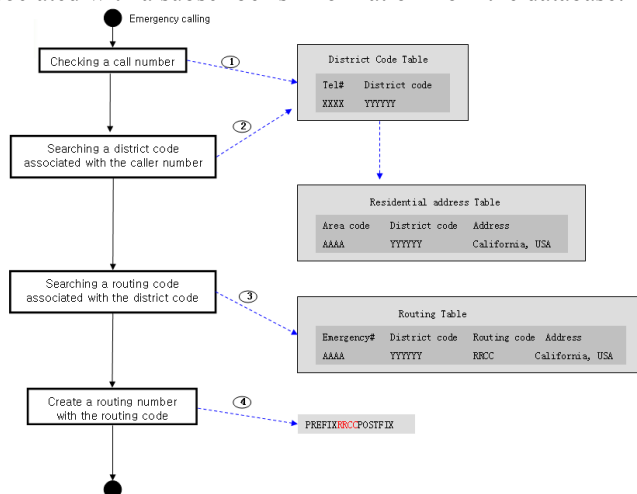


Figure 3. Example of Searching the Routing Code from the Routing Table

1) Checking a call number: for the first time, the call is check whether it is a proper subscriber's phone number or not.

2) Searching a district code: retrieves the district code associated with the subscriber's phone number.

3) Searching a routing code: retrieves the routing code associated with the district code found in the previous step.

4) Creating a routing number: inserts the routing code found in the previous step between the prefix and postfix in order to create the routing number.

B. Procedures for composing routing code

The procedures to compose the routing code associated with a subscriber's information to database are shown in Figure 4.

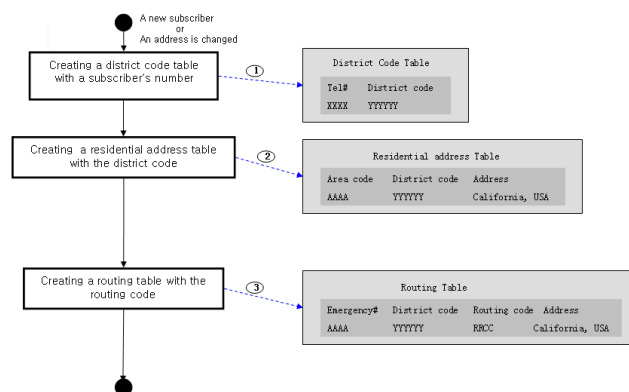


Figure 4. Example of Composing the Routing Code to the Routing Table

When a new subscriber attempt to subscribe the internet telephone or a subscriber changes his/her address, the routing table is added and modified as the following order.

1) Creating a district code table: creates a district code table with a subscriber's telephone number.

2) Creating a residential address table: creates a residential address table with the district code. Other fields may be added according to requirements of telecom companies.

3) Creating a routing table: creates a routing table with the routing code. Other fields may also be added according to requirements of telecom companies.

V. HANDLING EXCEPTIONS

When the emergency call is originated from a caller, the emergency call service searches the routing code associated with caller's location information in order to get the routing number. However, it is necessary to handle exceptions which may occur due to failures caused by wrong codes, wrong call numbers, or wrong residential addresses in the middle of searching the routing number. The basic rules of handling exceptions are that:

- the default routing number is used in the case of failing to search
- the similar code is used in the case of wrong codes

The specific flow to handle such exceptions is shown in Figure 5.

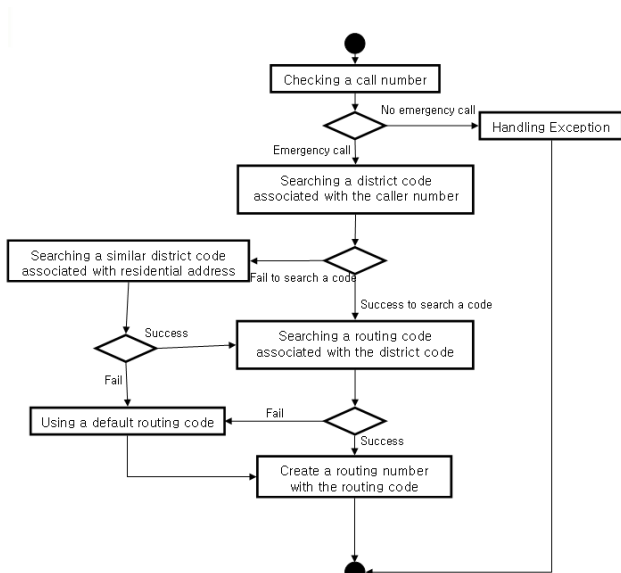


Figure 5. Flow of handling exceptions

The policy to deal with the exceptions is summarized in Table 2.

Table 2. Policies for Handling Exceptions

Exceptions	Policies
Wrong emergency call numbers	1. Logging the routing code 2. Occurring a fault 3. Relaying the call.
Fail to search routing codes	1. Logging the routing code and district code 2. Occurring a fault 3. Using the default routing code
Fail to search subscribers	1. Logging the subscriber 2. Occurring a fault

	3. Using the default routing code
No district code in the master code of DB	Searching a district code associated with residential address
Searching a similar district code	If no district code in a master record, it uses the similar code

VI. CONCLUSIONS

The paper introduces the example of the implementation of the emergency call service for the internet telephone in KT IMS. In addition, it proposes the mechanism for routing the emergency call and the method for composing the routing table to database based on the district information in order to search the nearest location of PSAP in the fixed broadband.

However, as the VoIP based on IMS has been getting more popular, the internet telephone with WiMax which could have a mobility characteristic are used by users. Therefore, it is necessary to add functionalities to consider such mobile VoIP with WiMax for the further work.

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