Safety | Emergency Call | Location Information

Notification of Location Information at Emergency Call

A function was developed to report a caller's location information to emergency service organizations when there are calls from a mobile terminal, thus providing the emergency service organization with information about precise location of the caller. Another function was also developed to allow the emergency service organization to search for location information of the caller making an emergency call.

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1. Introduction

The ratio of emergency calls (110, 118, and 119) originating from mobile terminals is rapidly increasing in line with the dissemination of mobile terminals. Since it is extremely important to determine where a caller originates an emergency call for enabling a rapid response by an emergency service organization (such as the police, Japan Coast Guard, or fire department), there are expectations for the early implementation of a function to report the caller's location information for emergency calls originating from mobile terminals. Against such a background, the Ministry of Internal Affairs and Communications received certain recommendations from the Telecommunications Council in June 2004 regarding "Technical Conditions Related to the Function of Providing Location Information on Callers sending Emergency Messages from Cell Phones" in "the Measures for Advancing Emergency Message Func-

tions in the Telecommunications Business" [1]. Based on these recommendations, mobile communication carriers will incorporate the following functions into emergency calls originating from Third-Generation (3G) mobile terminals starting from April 2007:

- Initial positioning function (to report the caller's location information to the emergency service organization concerned when an emergency call is made), and
- Location searching function (to acquire the caller's location information for the emergency service organization concerned)

Both functions are collectively referred to as advanced emergency call functions. The introduction of such functions will enable emergency service organizations to recognize the caller's location information and respond in a prompt and proper manner.

The Technical Conditions also stipulate that the caller's location information

must be reported to the emergency service organization concerned unless the caller adds "184" to the number dialed when originating an emergency call. Since the emergency service organization also requires the caller's phone number in order to display the emergency call associated with the reported location information, the Technical Conditions further stipulate that as far as emergency calls are concerned, the caller's phone number must be reported as a general rule, unless the caller adds "184" to the number dialed.

NTT DoCoMo has already provided location information services, namely i-area [2] and subsequently the location positioning function for FOMA terminals equipped with a built-in Global Positioning System (GPS)[*1] and the FOMA network [3] since October 2005. NTT DoCoMo has also been providing the location notification function and location provision function since March 2006 [4] in order to meet the growing needs among users, including those wanting to notify a

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BTS: Base Transceiver Station
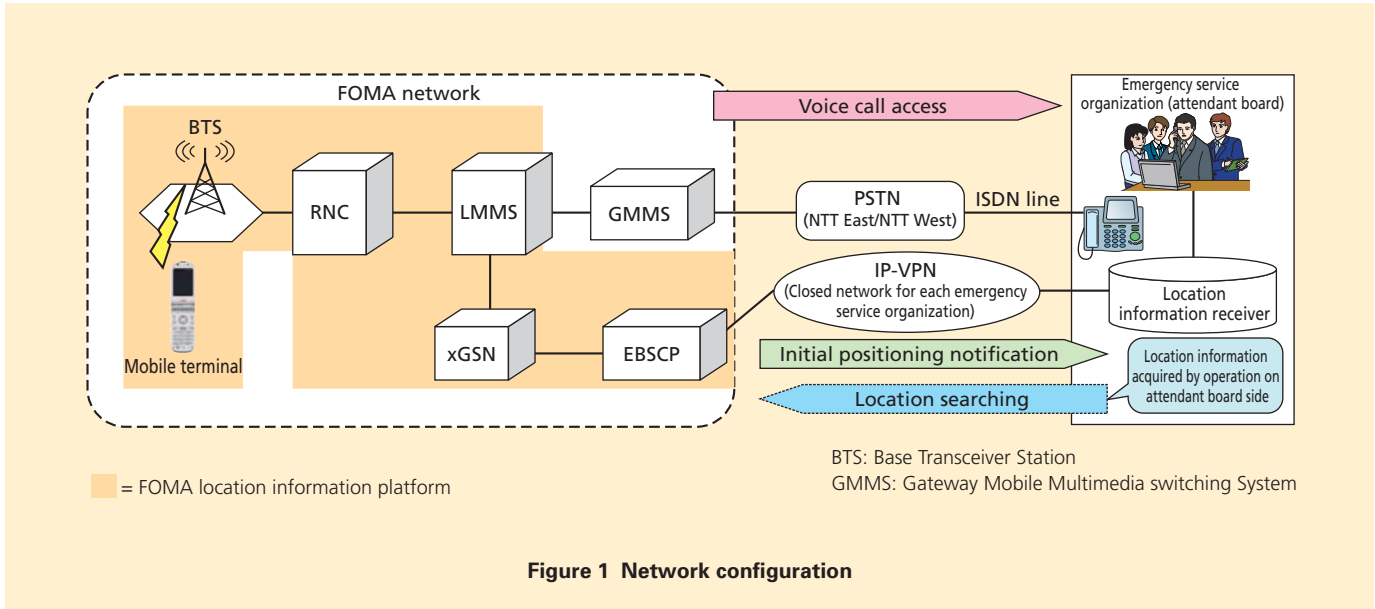GMMS: Gateway Mobile Multimedia switching System

Figure 1 Network configuration

third party of their whereabouts and those wanting to search for a third party. At the same time, NTT DoCoMo has provided "imadoco search" service to help parents find their children, with the number of subscribers to this service reaching approximately 390,000 as of the end of February 2007. As GPS has become a standard feature for FOMA 903i series terminals and later models, the ratio of GPS-enabled FOMA terminals will undoubtedly increase in the future. This will make it possible for more mobile terminals used in originating an emergency call to report the caller's precise location information to emergency service organizations.

This article provides an overview of the advanced emergency call functions and explains the control methods adopted in the FOMA network and mobile terminals.

2. Control Methods for Advanced Emergency Call Functions

Figure 1 shows the configuration of networks that handle emergency calls and provide advanced emergency call functions. As shown in the figure, emergency calls are made via the Public Switched Telephone Networks (PSTN) of either NTT East or NTT West, while location information provided by mobile communication carriers is reported to emergency service organizations via IP-Virtual Private Network (IP-VPN)[*2].

The following describes the respective control methods for the initial positioning function and location searching function. Pursuant to the aforementioned Technical Conditions, the protocol for notifying location information from mobile communication carriers to emergency service organizations and must comply with Mobile Location Protocol (MLP)[*3] as defined by the Open Mobile Alliance (OMA)[*4].

2.1 Initial Positioning Function

The characteristics of the initial positioning function are as follows:

- Complying with the Network Induced-Location Request (NI-LR)[*5] system defined by the 3rd Generation Partnership Project (3GPP) [5].
- Equipped with a two-step positioning function: In the first step, it reports the approximate location information acquired as a result of approximate positioning at the cell level, and in the second step, it provides detailed location information acquired through detailed positioning by GPS.

Figure 2 shows the network control method for the initial positioning function. Upon receiving a request for emergency call origination from a mobile terminal (Fig. 2 (1)), the Local Mobile Multimedia switching System (LMMS)[*6] determines the caller number notification (Fig. 2 (2)), and then sends an access request to the
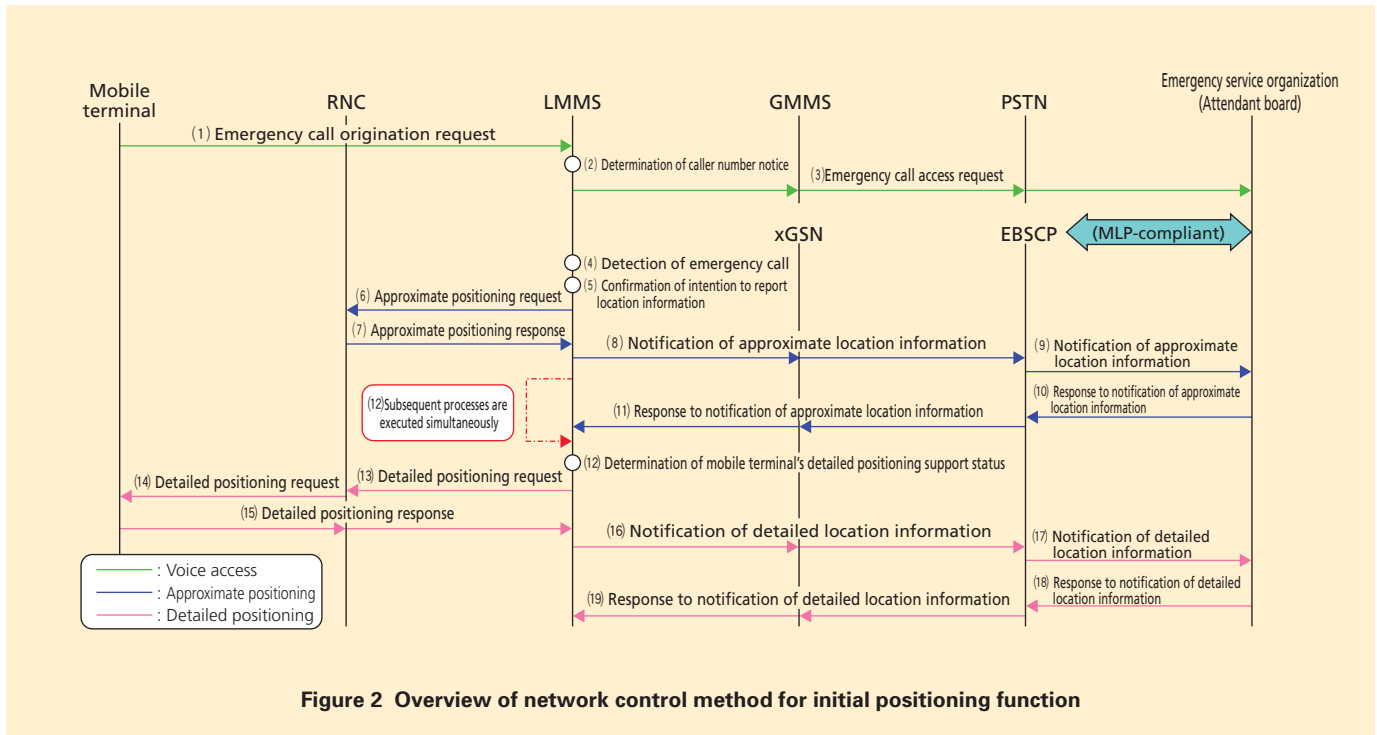

Figure 2 Overview of network control method for initial positioning function

emergency service organization concerned (Fig. 2 (3)). In conjunction with the access processing of a voice call made to the emergency service organization, the LMMS that detected the emergency call origination (Fig. 2 (4)) confirms the caller's intention to report location information to the emergency service organization based on whether the number dialed includes "184" (Fig. 2 (5)), and then requests the Radio Network Controller (RNC)[*7] to perform approximate positioning at the cell level of base stations (Fig. 2 (6)). Upon receiving the approximate location information (Fig. 2 (7)), the LMMS sends the LoCation Services (LCS) Client ID[*8] corresponding to the emergency call attendant board, as well as the approximate location information to the External Business user Service Control Point (EBSCP)[*9] [6] via the serv-

ing/gateway General packet radio service Support Node (xGSN)[*10] (Fig. 2 (8)), and then EBSCP notifies the emergency service organization receiving the emergency call (Fig. 2 (9)). The emergency service organization returns a response acknowledging receipt of the approximate location information (Fig. 2 (10)), and then EBSCP notifies the LMMS of said receipt via xGSN (Fig. 2 (11)).

The LMMS sends the approximate location information to xGSN and simultaneously determines whether the mobile terminal supports detailed positioning (Fig. 2 (12)). If the mobile terminal supports detailed positioning, the LMMS sends a request for detailed positioning by GPS to the RNC (Fig. 2 (13)). If the mobile terminal does not support detailed positioning, the procedure for reporting the approximate location information

acquired in Fig. 2 (7) to the emergency service organization is repeated. Upon receiving the request for detailed positioning, the RNC instructs the mobile terminal to execute detailed positioning and delivers assist data[*11] (Fig. 2 (14)). The mobile terminal then executes detailed positioning, after which it reports the positioning results to the LMMS via the RNC (Fig. 2 (15)). As in the case of approximate location information, the LMMS sets the LCS Client ID and reports the detailed location information to the emergency service organization via xGSN and EBSCP (Fig. 2 (16) and (17)). The emergency service organization then returns a response acknowledging receipt, as in the case of being notified of approximate location information (Fig. 2 (18)), to the LMMS (Fig. 2 (19)). This completes the two-step positioning process.

2.2 Location Searching Function

The characteristics of the location searching function are as follows:

- Compliant with Mobile Terminated-Location Request (MT-LR)[*12] defined by 3GPP [5].
- Only accepts the acquisition of location information while a call is being made to an emergency service organization or within 20 seconds of the call being completed (as stipulated in the aforementioned Technical Conditions).
- Skips codeword[*13] authentication.
- Provides a function to convert the LCS Client ID indicating the searcher of location information into the number dialed by the caller.

Figure 3 shows the network control method for the location searching function. The emergency service organization concerned sends a request to acquire location information that specifies the phone number of the person being searched for which location information must be acquired (Fig. 3 (1)). Upon receiving this request, EBSCP authenticates the emergency service organization, after which it skips codeword authentication—executed by the FOMA location information function to authenticate the person being searched—only in cases where a request to acquire location information is made from an emergency service organization (Fig. 3 (2)), and sends a request to acquire location information to the LMMS via xGSN (Fig. 3 (3)). This is based on judgment that a request to acquire location information is made in cases where justification[*14] is accepted by the emergency service organization, and that the person being searched does not have to perform operations to give permission for position-ing. EBSCP sends a request to acquire location information to xGSN and at the same time returns a response acknowledging receipt to the emergency service organization (Fig. 3 (4)), and then cuts off the HTTP connection (Fig. 3 (5)).

The LMMS refers to the LCS Client ID that identifies the emergency service organization set in the request to acquire location information as well as the call log of the person being searched, and judges whether that person is still talking to the corresponding emergency service organization or no more than 20 seconds has elapsed since the person completed the call (Fig. 3 (6)). Provided that the judgment condition has been met, the LCS Client ID and name of the searcher are converted as described in paragraph 2) below (Fig. 3 (7)), after which a request for detailed positioning is sent to the RNC (Fig. 3 (8)). A request for detailed posi-
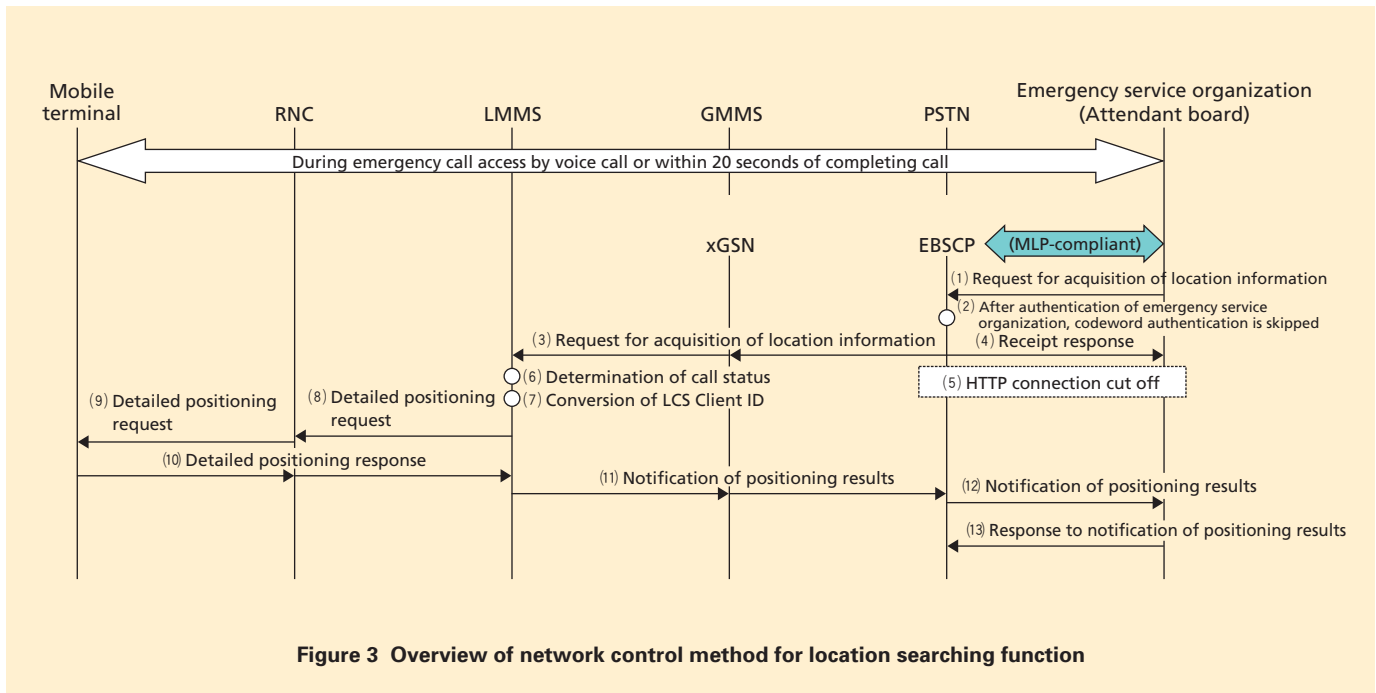

Figure 3 Overview of network control method for location searching function

tioning is then sent to the mobile terminal as in the case of the initial positioning function (Fig. 3 (9)), and upon receiving the detailed positioning results (Fig. 3 (10)), the LMMS reports those results to the emergency service organization via xGSN and EBSCP (Fig. 3 (11) and (12)). Once the emergency service organization is notified of the positioning results, it returns a response acknowledging receipt of the positioning results to EBSCP (Fig. 3 (13)), and this completes the location searching function.

The technical characteristics are described below.

1) Effective Utilization of Network Resources

When an emergency service organization sends a request to acquire location information, an HTTP connection is established between the mobile communication carrier and emergency service organization. Should this HTTP connection between the mobile communication carrier and emergency service organization be maintained until the positioning results are reported to the emergency service organization, unnecessary network resources consumption and network resources shortage might arise if many emergency calls are made all at once, such as in the event of a disaster. For this reason, emergency service organizations and other mobile communication carriers have adopted NTT DoCoMo's proposal for a system to return a response acknowledging receipt to the emergency service organization with a receipt number assigned to the request to acquire location information (Fig. 3 (4)),

and then cut off the HTTP connection temporarily until the positioning results are reported. Assigning the same number to the reporting of the positioning results as the receipt number returned in the response acknowledging receipt makes it possible to link both the request and the response, thus resolving the issue of retaining unnecessary network resources as mentioned above.

2) Method of Explicitly Showing Searcher Information

When an emergency service organization requests to acquire location information, the LCS Client ID is reported as information to identify the attendant board of an emergency service organization. A unique number that differs from such emergency phone numbers as 110, 118, and 119 is assigned with respect to each emergency service organization's attendant board. Reporting this ID to the person being searched in its original form during a search runs the risk of causing confusion due to the person's location information being searched based on an ID for which permission has not been given in advance. Therefore, the system was equipped with a function to convert the LCS Client ID reported from the emergency service organization at the LMMS into emergency phone numbers 110, 118, and 119 of the police, Japan Coast Guard, and fire department, respectively, and then report it to the person being searched (Fig. 3 (7)). Moreover, a function was added to the LMMS to set "police," "Japan Coast Guard," or "fire department" as the searcher name. This function notifies the

person being searched of the same phone number that the person called in the form of a LCS Client ID, and explicitly shows the name of the emergency service organization concerned. As in the case of the initial positioning function, the LMMS is also equipped with this function so that the LCS Client ID and searcher name reported to the person being searched would be the same as described above.

3. Contention Control Methods

The previous chapter explained the basic control methods used in advanced emergency call functions. This chapter describes more complex control patterns with reference to the cases where the positioning processes of advanced emergency call functions contends with the positioning processes in the FOMA location information function. **Figure 4** shows the classifications of distinctive contention patterns, and the following explains the control method with respect to each pattern.

Case 1: Receiving a positioning request for the advanced emergency call functions during positioning based on the FOMA location information function or advanced emergency call functions

If a positioning request for the advanced emergency call functions is subsequently received, the reactivation of positioning after performing the preceding process may pose a problem that there may be a delay in reporting the location information to the emergency service organization. Here, the initial positioning function allows the caller to choose whether to activate positioning when orig-

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*13 **Codeword**: A password set by the person being searched in order to determine whether to accept positioning of the person being searched by the LCS Client in MT-LR.

*14 **Justification**: An act presumed illegal is deemed not to be illegal due to special circumstances. This includes acts prescribed by laws and regulations, justifiable defense, and emergency evacuation.
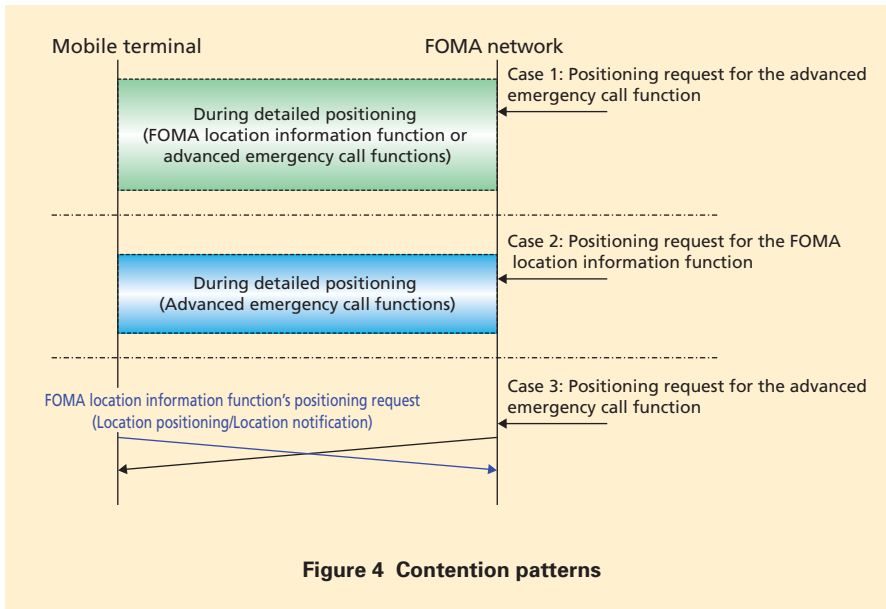
Figure 4 Contention patterns

inating a call, and the location searching function does not require permission by the person being searched. Accordingly, a function was developed to report the preceding positioning results to the emergency service organization concerning a subsequent positioning request, provided that the positioning request is made based on the advanced emergency call functions. This makes it possible to promptly report positioning results obtained by the advanced emergency call functions, even when multiple positioning processes are involved.

Case 2: Receiving a positioning request for the FOMA location information function during positioning based on the advanced emergency functions

If a positioning request for the FOMA location information function is received after the activation of positioning based on the advanced emergency call functions, priority is given to the advanced emergency call functions. Therefore, a

function was developed to return an error response indicating contention against all subsequently received positioning requests.

Case 3: Simultaneous activation of the FOMA location information function on the mobile terminal and advanced emergency call functions at the LMMS.

The mobile terminal interprets a positioning request for the advanced emergency call functions as being made after activation of the FOMA location information function. Normally, such a case does not arise due to the function mentioned in Case 1 above, but contention may possibly occur if positioning based on the advanced emergency call functions is activated simultaneously at the LMMS. Therefore, a function was developed to make the mobile terminal automatically cancel the FOMA location information function and retain the advanced emergency call functions in consideration of positioning priority order.

4. Mobile Terminal Control Method

This chapter explains the mobile terminal control method for the advanced emergency call functions.

4.1 Mobile Terminal Screen Display Control during Positioning

When executing the initial positioning function and location searching function, the mobile terminal user must be notified that positioning will be performed. For this purpose, when the mobile terminal receives a positioning request, its screen displays a message indicating that positioning will be performed (**Figure 5**).

4.2 Positioning Cancellation Revocation Control

As explained in Section 4.1, the mobile terminal's screen displays a message indicating that positioning is being performed based on the advanced emergency call functions. The FOMA location information function allows positioning to be canceled subject to operations performed by the mobile terminal user. However, the advanced emergency call functions require a function that revokes the cancellation of positioning, and thus prevents the mobile terminal user from canceling positioning through inappropriate operations. For this reason, a function was realized to revoke the cancellation of positioning, provided that the LCS Client ID is 110, 118, or 119.

4.3 Control when Locating is Denied by Setup
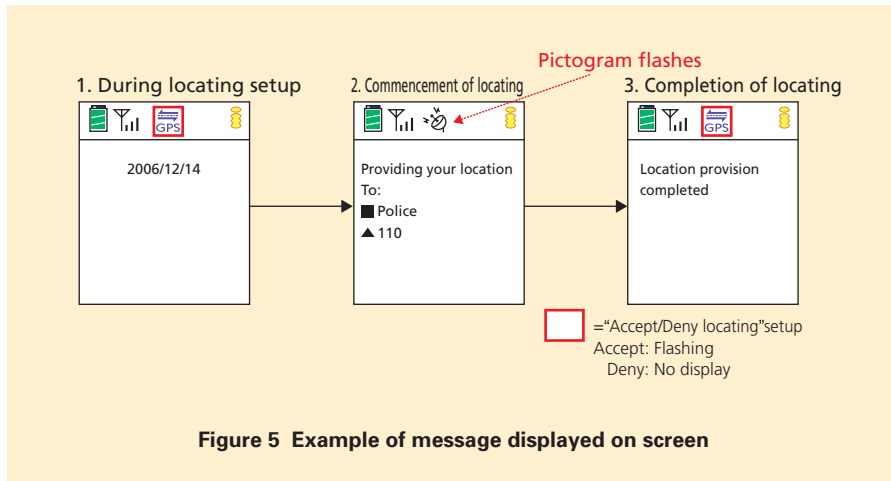
The mobile terminal user can set the

Figure 5 Example of message displayed on screen

location provision function to either accept or deny locating. Usually, permission-Granted is returned in response to a positioning request sent from a network when "accept locating" is set, and permissionDenied is returned when "deny locating" is set. However, positioning based on the advanced emergency call functions requires a function to report permission-Granted and continue positioning even "deny locating" is set, in consideration of urgency. Therefore, a function was realized to revoke the denial setting made by the mobile terminal user after making judgment based on the LCS Client ID, as in the case of revoking positioning cancellation.

On the mobile terminal's screen, the "deny" setting in "accept/deny locating" is temporarily disabled and the display exhibits the same behavior as in the "accept" setting. The mobile terminal user can therefore recognize that a search is being conducted.

5. Conclusion

This article explained the control methods for the initial positioning function and location searching function, both of which are advanced emergency call functions, the control method when there is contention against the FOMA location information function, and the mobile terminal control method. These functions may be considered a platform whereby NTT DoCoMo provides a "sense of security and safety," and serves an extremely important role in contributing to society.

We intend to further enhance the functions by conducting studies including those aimed at improving the precision of

positioning and reporting of location information by e-mail with respect to emergency calls.

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