

Technology Reports

2in1 Service System

In order to further differentiate the FOMA service from other carriers, we have developed a system for 2in1 service that makes it possible to assign two phone numbers and two mail addresses to one mobile terminal, and use them separately through the collaboration of the mobile terminal and the network.

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1. Introduction

In November 2005, NTT DoCoMo launched a multiple number service that makes more than one phone number available for use on one mobile terminal. However, due to the function limitations of an additional number compared to the basic subscriber number (differences in functions between the basic subscriber number and additional number), users had been strongly demanding the provision of functions similar to those for the basic subscriber number for the additional number as well. In order to meet such demand, we have conducted development aiming to provide a service that makes it possible to use one mobile terminal as two terminals by having the core network (hereinafter referred to as “NW”) collaborate with mobile terminals, which involved expansion of the NW services for providing additional numbers and mail addresses.

This article describes an overview

of the realization method to provide the 2in1 service, and explains its distinctive functions.

2. Service Overview

The 2in1 service provides two phone numbers — a basic subscriber number (“number A”^{*1}) and an additional number (“number B”^{*2}) — and provides main NW services to both

numbers A and B such as voice call origination/termination, Short Message Service (SMS)^{*3} termination, voice mail, call forwarding, melody call, and a missed call notification function^{*4}. **Table 1** shows the available functions.

The 2in1 service also supports three mobile terminal modes (dual mode, mode A, and mode B) and provides individual functions to manage the

Table 1 Available functions

Category	Item		Description of services provided	
			Number A	Number B
Basic services	Voice call	Origination	○	○
		Termination	○	○
	Packet	Origination	○	×*1
		Termination	○	×*1
	SMS	Origination	○	×
		Termination	○	○
Packet services	i-mode		○	×
	Mail		○ (i-mode mail)	○*2 (Web mail)
	PushTalk	Origination	○	×
		Termination	○	×
	NW services	Voice mail		Activate/Deactivate setting, message box, and count notification are number-specific, whereas other settings are common to both numbers
Call forwarding		Activate/Deactivate setting is number-specific, whereas other settings are common to both numbers		
Melody call		Tone and settings are common to both numbers		
Missed call notification function		Missed call notice is number-specific, whereas settings are common to both numbers		
Other services		Settings of call-originating number notification, rejection of nuisance calls and SMS message reception are common to both numbers		

*1 In mode B, packet origination/termination are possible using number A.

*2 Mail can be directly saved on the mobile terminal in the form of i-mode mail.

○ = Available

× = Not available

*1 **Number A:** Basic number in the 2in1 service. A phone number assigned at the time of general contract.

*2 **Number B:** Additional number in the 2in1 service. A new phone number that can be used by signing a 2in1 service contract.

*3 **SMS:** A service for transmitting/receiving short text-based messages. SMS is also used for transmitting/receiving mobile terminal control signals.

phone book, standby screen, call origination/termination log, mail, and SMS with respect to each mode through collaboration between the NW and mobile terminals.

3. Implementation Method

3.1 System Configuration and Implementation Method

Figure 1 shows the system configuration for realizing the 2in1 service; Table 2 shows the main functions.

Since the 2in1 service involves single mobile terminal and location information^{*5}, respectively, call control in the NW is performed using the information of number A.

The connection between the mobile terminal and NW is also done by using number A. Since the numbers are identified with respect to each calls, unique identification information (service code) is defined between the mobile terminal and NW. Upon call origination, the number used for originating a

call is selected and determined by assigning a service code from the mobile terminal, and upon call termination, the call-terminating number is identified by reporting the service code to the mobile terminal. However, the provision of this service is limited when roaming since the sending/receiving of the service code may not be possible depending on the roaming partner's environment where the user is located. In particular, even if the user chooses number B to originate a call, communication system of the overseas roaming partner would not be able to recognize the service code. Therefore, to prevent number A from being reported to the other party despite the user's intention, originating a call using number B is restricted on the mobile terminal so that the user can only originate a call using number A.

The following describes the voice call origination/termination operations when using number B, with reference

to specific examples.

3.2 Basic Operation of Voice Call Origination/Termination

1) Voice Call Origination from Number B

Figure 2 (a) shows the voice call origination process. If a call is originated by selecting number B on the call-originating mobile terminal, the mobile terminal issues a call origination request to the call-originating Local Mobile Multimedia switching System (LMMS)^{*6} by assigning a service code indicating number B to the dialed number, thus making the call-originating number identifiable in the NW (Fig. 2 (a) (1)). The call-originating LMMS that receives the call origination request then assigns the dialed number and service code to the Service Control Point (SCP)^{*7} accommodating number A based on the subscriber information, and reports the call origination event (Fig. 2 (a) (2)). The SCP that receives

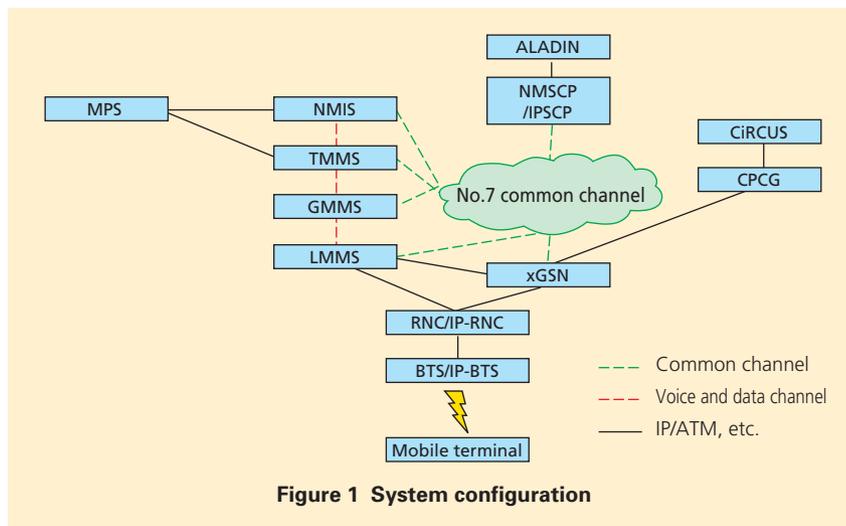


Figure 1 System configuration

Table 2 Main functions by device

Node	Main functions
Mobile terminal	• Call-originating/terminating number selection • Phone book, call origination/termination log, mail, SMS management
CIRCUS	• Web mail
NMSCP/IPSCP	• Subscription, location, service setting information management • Call control, service control
GMMS	• Call connection • SMS message forwarding
TMMS	• SMS message forwarding
LMMS	• Call connection • SMS message forwarding • Determination of SMS message-terminating terminal
xGSN	• SMS message forwarding • Determination of SMS message-terminating terminal
NMIS	• Storage of voice mail messages • Melody call tone management, transmission
MPS	• SMS message storage, forwarding

*4 Missed call notification function: A function to notify the call termination log via SMS when the mobile terminal is out of range or powered off.

*5 Location information: User location information at inter-system level, including user

registration status, inter-system location information, etc.

*6 LMMS: A switching system at the subscriber level for circuit-switching communication in the FOMA network.

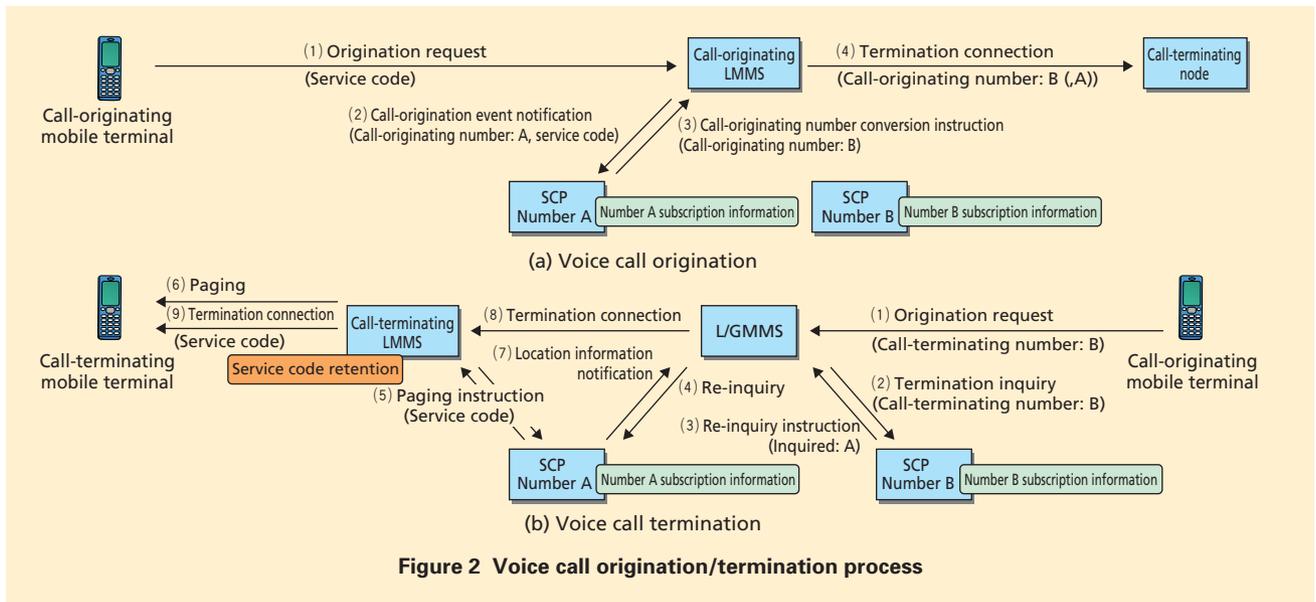


Figure 2 Voice call origination/termination process

this notification determines the call-originating number, judges that the call originated from number B, instructs the call-originating LMMS to convert the call-originating number to number B and establish a connection (Fig. 2 (a) (3)). The call-originating LMMS executes a process to establish a connection to the dialed number as instructed (Fig. 2 (a) (4)).

2) Voice Call Termination at Number B

Fig. 2 (b) shows the voice call termination process. The Gateway MMS (L/GMMS^{*8}) that receives a call origination request targeted at number B (Fig. 2 (b) (1)) makes a call-termination inquiry to the SCP accommodating number B (Fig. 2 (b) (2)). The SCP inquired determines process of call termination at number B based on the subscription information it retains, specifies number A, and then issues a re-inquiry instruction to L/GMMS (Fig. 2

(b) (3)). The L/GMMS that receives this instruction makes another call-termination inquiry to the SCP accommodating number A (Fig. 2 (b) (4)). The SCP inquired then determines the call termination at number B, assigns a service code indicating call termination at number B, and issues a paging instruction^{*9} to the call-terminating LMMS based on the location information (Fig. 2 (b) (5)). The call-terminating LMMS that receives this instruction retains the service code and pages the call-terminating mobile terminal (Fig. 2 (b) (6)). The SCP reports the location information regarding number A to the L/GMMS that made the call-termination inquiry (Fig. 2 (b) (7)). The L/GMMS notified establishes a connection to the call-terminating LMMS (Fig. 2 (b) (8)). The call-terminating LMMS then sets the service code specified in the paging instruction and establishes a connection

to the call-terminating mobile terminal (Fig. 2 (b) (9)). The call-terminating mobile terminal judges that the call terminated at number B based on the service code, and then displays and logs call termination at number B.

4. Distinctive Functions

4.1 Display Control Unit and Data

Management of the Mobile Terminal

1) Types of Operating States and Switching Process

Mobile terminals that support the 2in1 service have four states of operation: idle, dual mode, mode A, and mode B. The default state of a mobile terminal is “idle” where the 2in1 function does not work. The user must manually switch the mobile terminal to an active state in order to use the 2in1 service.

When the mobile terminal is active, there are three operating modes (2in1

*7 **SCP**: A device having a function to manage subscriber service information (subscription and settings information) and a service control function.

*8 **GMMS**: A gateway switching system with other operators for circuit-switching communi-

cations in the FOMA network.

*9 **Paging instruction**: Requests LMMS to execute a process to communicate with a mobile terminal prior to establishing call-termination connection with the mobile terminal and acquire the location registration status (paging).

mode settings): dual mode, mode A, and mode B. The user can manually switch between these modes depending on the purpose of using the 2in1 service. A different standby image can be set for each mode to distinguish the currently set 2in1 mode. Since mode A is the basic operating mode when using the 2in1 service, however, this mode adopts the same standby screen as used when the mobile terminal is idle.

The mobile terminal inquires the NW about subscription information when switching from idle to active, because it lacks subscription information in 2in1 service. In the process of switching between other modes, the mobile terminal gives priority to operability and does not inquire the NW about subscription information. **Figure 3** shows the switching between operating states.

2) Data Management by Operating State

The 2in1-service-related data stored on a 2in1-service-enabled mobile terminal can be categorized in terms of a number of attributes. There are three attributes of phone book data and My Profile^{*10} data: attribute A, attribute B, and common attribute. The user determines and changes the attribute of each data manually. The call origination/termination log, SMS, i-mode mail, and other features are set for either number (address) A or number (address) B, as determined by the number used to originate or terminate a call, and used for

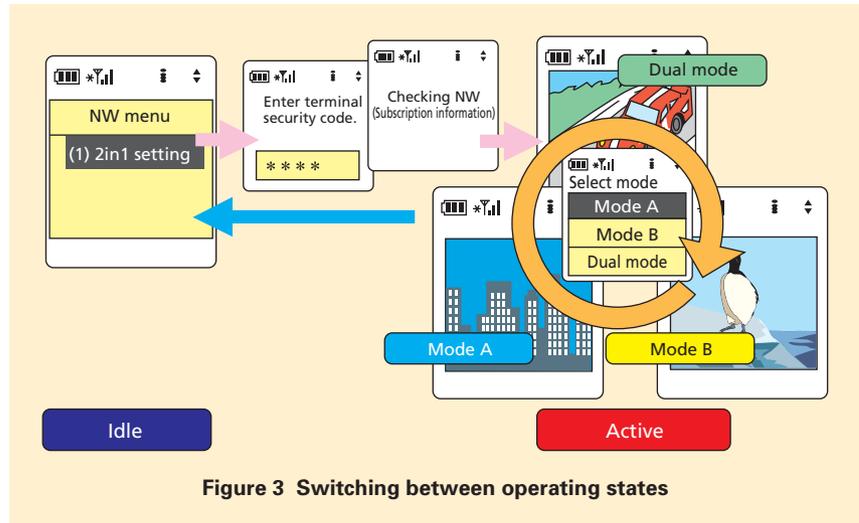


Figure 3 Switching between operating states

transmission/reception operations.

A mobile terminal in mode B cannot use the data of attribute A or number (address) A, while a mobile terminal in mode A cannot use the data of attribute B or number (address) B. The data cannot be used since it is considered nonexistent when the mobile terminal is being operated.

On the other hand, all data can be used when the mobile terminal is in dual mode with the data attribute displayed for the sake of user convenience. For example, an icon representing A, B, or common is used to display the attribute of phone book data. The attribute of the call origination/termination log is displayed in the form of an icon representing number (address) A or number (address) B.

Figure 4 shows the screens displaying the phone book in each operating state for information registered as the phone book data shown in **Table 3**. Moreover, **Figure 5** shows the call

origination log displayed in each operating state for a voice call originated as shown in **Table 4**. Since the number used to originate a call serves as the key to controlling the data displayed on the call-origination log screen, whether the information is registered in the phone book and the attribute of the phone book data are both irrelevant.

3) Call Origination/Termination, Transmission/Reception Operations according to the User's Own Number

a) Voice Call and Video Call

According to the 2in1 mode setting policy, a mobile terminal can only originate a call from number A when in mode A, and only from number B when in mode B. When the mobile terminal is in dual mode, however, the user can select and use either number to originate a call depending on the situation. Furthermore, in order to prevent erroneous call origination, the attribute of the

*10 **My Profile**: A function that enables the user to register his/her phone number in addition to such personal data as mail address and postal address on the mobile terminal. Can be displayed by pressing "Menu button + 0."

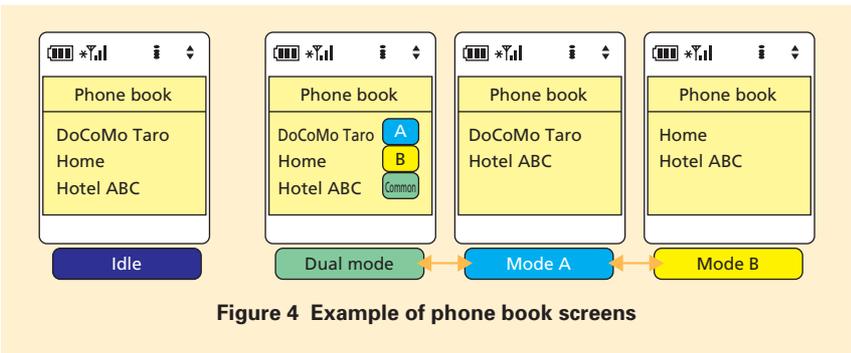


Figure 4 Example of phone book screens

Table 3 Example of phone book data

Entry No.	Registered name	Phone number	2in1 setting
001	DoCoMo Taro	090-XXXX-XXXX	Attribute A
002	Home	044-XXX-XXXX	Attribute B
003	Hotel ABC	046-XXX-XXXX	Common attribute

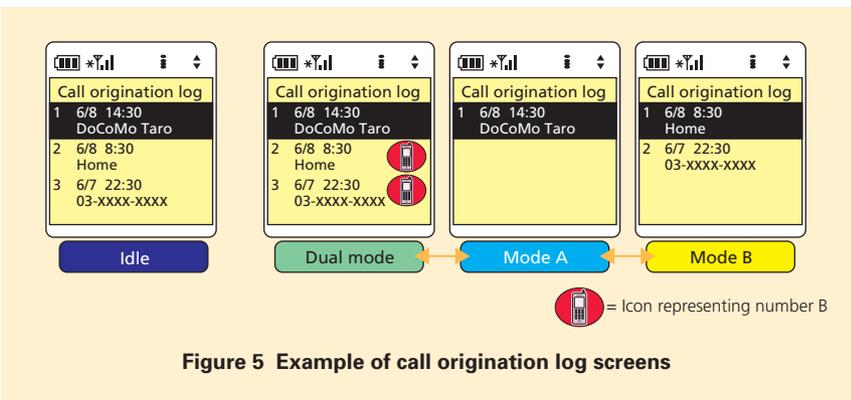


Figure 5 Example of call origination log screens

Table 4 Example of voice call origination operation

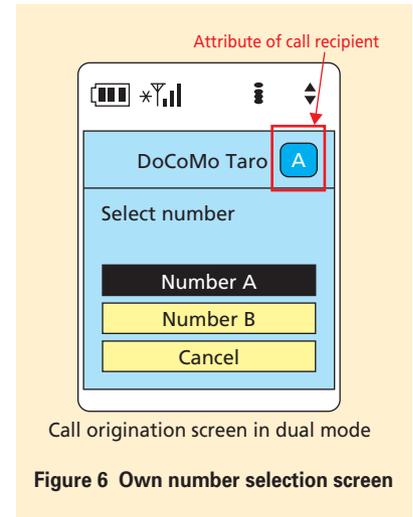
Order	Call recipient (Name registered in phone book)	Call origination time	Own number
1	03-XXXX-XXXX (Not registered)	2007/6/7 22:30	Number B
2	044-XXX-XXXX (Home)	2007/6/8 8:30	Number B
3	090-XXXX-XXXX (DoCoMo Taro)	2007/6/8 14:30	Number A

intended call recipient is displayed on the phone number selection screen, provided that the call recipient is registered in the phone book (Figure 6). To terminate a call, either number A or B can be used in all operating states. Accordingly, the attributes of numbers A and B are shown in colored text or using

different fonts on the call origination/termination screen and the calling screen. Figure 7 shows an example of the call termination screens.

b) i-mode Mail and SMS

The 2in1 service does not support SMS message transmission from number B or i-mode mail



Call origination screen in dual mode

Figure 6 Own number selection screen

transmission from address B. Therefore, the mobile terminal prohibits SMS message and i-mode mail transmission operations in mode B, while enabling SMS message transmission from number A and i-mode mail transmission from address A in dual mode and mode A.

Both numbers (addresses) A and B can be used in all operating states for the reception of SMS message and i-mode mail. However, the use of SMS message and i-mode mail data received and saved on the mobile terminal may not be possible depending on the 2in1 mode settings. For instance, if SMS message or i-mode mail that cannot be used in the current mode is received, it is excluded from the count indicated in the reception results (Figure 8 (a)), with no icon displayed to indicate the existence of unread messages (Fig. 8 (b)).

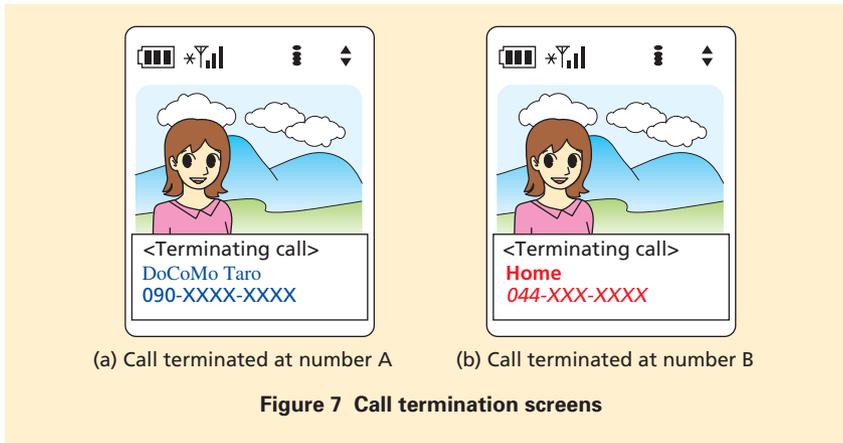


Figure 7 Call termination screens

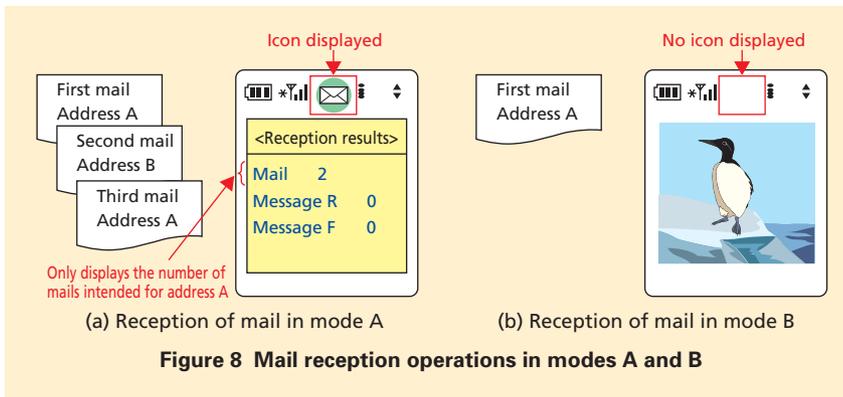


Figure 8 Mail reception operations in modes A and B

4.2 Enhancement of NW Service Function

1) Retention of Various Types of Information for Number B and Service Control

NW services are provided upon determining whether it is necessary to activate the services at the SCP based on the subscription information, user settings information, location information, and other information. Since the 2in1 service provides two numbers (numbers A and B) and has subscriber information with respect to each number retained at the SCP, however, numbers A and B are not necessarily accommodated at the same SCP. A

method assuming the following policies was considered in dealing with this situation.

- Limit the association between the two numbers only to the SCP.
- Perform service control at either SCP instead of doing so at the respective SCPs of numbers A and B.
- Limit the volume of NW traffic associated with data transfers between numbers.

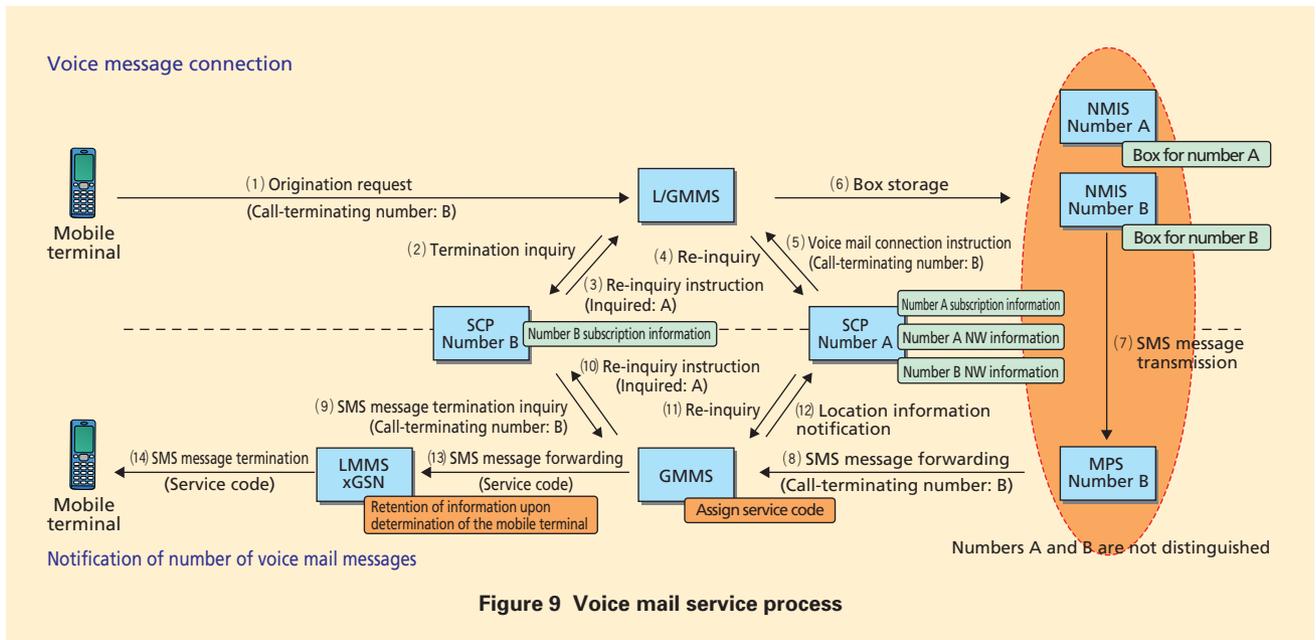
We have consequently adopted a method of uniformly performing call control and determining service activation at the SCP of number A, regardless

of whether the number is A or B, by placing the NW service information of number B at the SCP of number A and making a call-termination inquiry to the SCP of number A, even when a call terminates at number B. This arrangement makes it possible to conceal the association between both numbers to devices other than the SCP. In particular, it can provide a voice mail message box of the New Mobile Information Storage system (NMIS), as well as SMS storage and transfer processes of the Message Processing System (MPS) without having to add functions to the MPS. Moreover, performing call control only at the SCP of number A suppresses the need to add functions to the SCP of number B and other devices, makes it easier to expand functions in the future, and limits the impact in a small area. This arrangement also enables a re-inquiry process that maximizes use of the existing call control function and limits the volume of data transferred over the NW.

2) NW Service Control

As explained in Chapter 2, NW services are provided to numbers A and B individually. The following describes the voice mail service, a typical example of NW service implementation.

Figure 9 shows the connection to the message box of the voice mail service and notification of the number of voice mail messages received. To realize the voice mail service, it is necessary to determine the service activation status of each number and connect to the mes-



message box corresponding to each number. The need for activating the service is determined based on the voice mail subscription status, activate/deactivate status, location registration status, and other conditions when distinguishing whether the call terminates at number A or number B by using the NW-service-related information of numbers A and B retained at the SCP of number A. Once activation of the voice mail service is determined, the connection destination NMIS is determined at the SCP, a voice mail connection instruction to the NMIS accommodating each number is transmitted to L/GMMS, and connection to NMIS is made without distinguishing between numbers A and B (Fig. 9 (5)). Also for the call forwarding service, the connection process for each number is executed based on similar processing procedures.

3) SMS Message Origination/Termination

As in the case of voice call origination/termination, it is necessary to realize SMS message termination so that the SMS message-terminating number is distinguishable on the mobile terminal. **Figure 10** shows the origination/termination process for general SMS message addressed to numbers A and B. When processing the origination/termination of SMS message addressed to number B, the SCP inquiry process is executed in the form of a re-inquiry process similar to when terminating a voice call (Fig. 10 (3) to (5), (8) to (11)). Moreover, numbers A and B are made distinguishable on the mobile terminal by assigning a service code indicating number B in the SMS message header when SMS message terminates at number B (Fig. 10 (12)). The pro-

cessing procedures used for SMS to report the number of voice mail/Audio Visual (AV) voice mail messages received is the same as the procedures shown in Fig. 9.

For a missed call notification by SMS prepared by using the missed call notification log retained at the SCP by bypassing MPS, it is also necessary to manage the log itself with respect to each number in addition to distinguishing between numbers A and B. Accordingly, numbers A and B are distinguished from each other at the SCP of number A when a call terminates, the log is managed with respect to each number, and only the SCP of number A transmits an instruction to compose a missed call notification by SMS. The L/GMMS that receives this instruction transmits a SMS message with an address-identifying service code

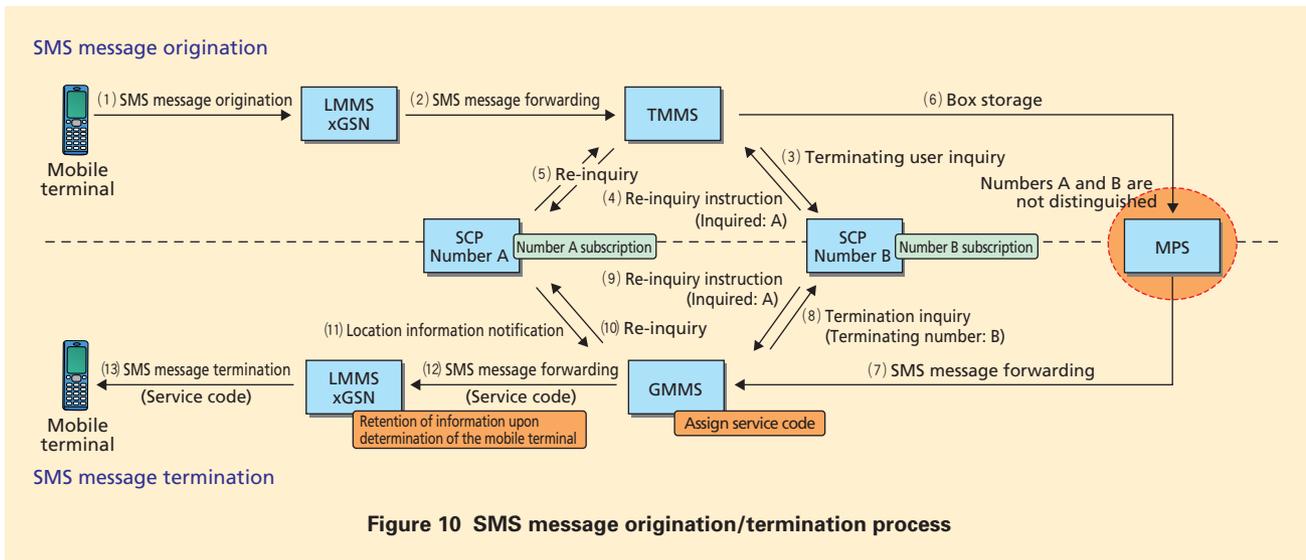


Figure 10 SMS message origination/termination process

assigned to each number.

If a SMS message addressed to number B terminates on a mobile terminal that does not support the 2in1 service, the address-identifying service code will be displayed, and thus entails the need to restrict the termination of SMS message addressed to number B on mobile terminals that do not support the 2in1 service. To deal with this situation, LMMS determines the model of mobile terminal upon the termination of SMS message addressed to number B, and restricts the termination of such SMS message on mobile terminals that do not support the 2in1 service. Restricted SMS message is stored in the MPS and SCP, and assuming that it would be stored and retransmitted on a continual basis over a certain period of time, a long SMS message retransmission interval is set to limit unnecessary NW traffic.

4.3 Provision of Web Mail (CiRCUS)

1) Service Overview

As shown in Table 1, we have given 2in1 service subscribers a Web mail address (address B) in addition to the existing i-mode mail address (address A), and allow them to check received mail and transmit mail on the Web mail site screen.

2) Available Functions

a) Basic Mail Functions

A Web mail address is given to each 2in1 service subscriber. Subscribers have number B in addition to number A; the Web mail address is associated with number A.

In the 2in1 service, the phone number contract is transferable in the sense that the number used as number A (basic subscriber number) can be transferred to number B (additional number), and the number used as number B (additional number) can be transferred to num-

ber A (basic subscriber number). The mail address can also be transferred in conjunction with this transfer of numbers.

When there is new mail at address B, a new message notification mail is transmitted to the mobile terminal. A header indicating that this mail is intended for address B is added so that the user knows that the mail is intended for address B upon reception by the mobile terminal.

Address B has mail storage space separate from address A that is limited in capacity as follows:

- Received mail: 500 messages, 20 MB
- Transmitted mail: 100 messages, 4 MB
- Saved mail: 20 messages, 2 MB

In cases where received mail reaches the capacity due to unread

mail or protected mail at address B, and mail is subsequently transmitted to address B, an error stating that the mailbox is full is returned to the sender without storing the sent mail. In such cases, “alarm mail” indicating that the mail could not be stored is received at address A to alert the 2in1 service user. As in the case of new message notification mail, a header indicating that this mail is intended for address B is added so that the user knows that the mail is intended for address B.

The user can check received mail, compose/transmit mail, and enter various settings for address B on the Web mail site. **Figure 11** shows the Web mail screen. When logging in to the Web mail site, authentication is performed based on the i-mode password. The Web mail site is accessible from a 2in1-enabled mobile terminal by clicking the URL link in the “New message notification mail” or selecting the URL embedded in the mobile terminal. Available functions include converting the sender’s address in received mail to a name registered in the phone book when displayed on the Web mail site in conjunction with phone book data stored on the phone book storage server, and citing the intended recipient’s address for mail to be transmitted from the phone book.

b) Mobile Terminal Save Function

Mail received at address B can

be saved on a mobile terminal. When saving mail on a mobile terminal, treasure Casket of i-mode service, high Reliability platform for CUSomer (CiRCUS)^{*11} terminates mail on the mobile terminal by copying the original mail to the memory for address A. A header indicating that the mail is intended for address B is added to the mail.

Only the names, sizes, and types of attached files can be checked on the Web mail site; the attached files can be checked after saving the files to the mobile terminal.

c) Digital Rights Management (DRM) Control Function

Files received by mail or saved using the i-mode browser at address A that are prohibited from being redistributed cannot be attached to mail due to copyright protection. Similarly, when forwarding mail received at address B, the attachment feature is cancelled with respect to any files attached to received mail that are prohibited from being redistributed. Four types of content are subject to control: Joint Photographic Experts Group (JPEG), Graphic Interchange Format (GIF), i-motion, and ToruCa^{*12}.

Attached files prohibited from being redistributed are also deleted from the address B side when the user manually saves mail to the mobile terminal.

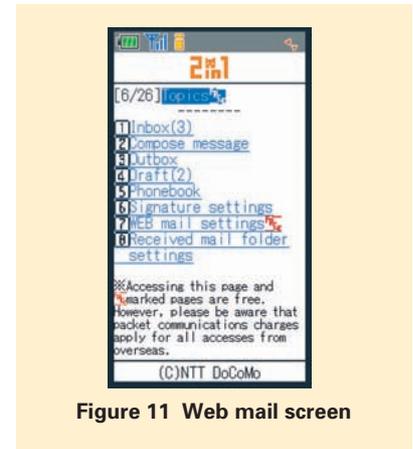


Figure 11 Web mail screen

d) Mail Operation Function

A folder can be created under the received mail folder on the Web mail site. Mail is stored the same way as being stored in a mailbox, although the mail’s folder location is managed along with a folder sorting function being provided. “Subject” and “From: address” can be specified as sorting criteria, so that mail consisting of the specified text is sorted into the corresponding folder.

Mail received at address B can also be searched on the Web mail site based on the following search criteria:

- From: address
- Subject text
- Read/Unread
- Existence of attached files
- Protection status

e) Web Mail Setting Function

Address modification/confirmation functions and such mail setting functions as a spam filter provided for address A are also available for address B. **Figure 12** shows the set-

^{*11} **CiRCUS**: A device that serves as an interface between the core network and the Internet, which provides i-mode mail, i-mode menu, ordinary Internet access, and other functions.

^{*12} **ToruCa**: A service that can incorporate such cards as restaurant cards and coupons tradition-

ally distributed at shops in paper media format into mobile terminals.



Figure 12 Settings screen

tings screen. The functions for address B can be set similarly to those for address A. Whether to receive “alarm mail” and new message notification mail can also be set.

Spam filter, address modification, and other various settings can be changed and checked from MyDoCoMo^{*13} as well.

The response to a request for acquiring a mail address from “My Profile” of the mobile terminal includes both address A and address B for 2in1 service subscribers.

5. Conclusion

This article described the functions of the 2in1 service, the method of implementation, and provided an overview of the processes involved.

This development is deemed to meet user needs and highlights NTT DoCoMo’s

spirit of innovation in building a platform for providing NW services to additional numbers and realizing services not available from other companies, whereby the functions equivalent to two mobile terminals can be used on a single mobile terminal.

Users are now demanding the provision of functions that currently cannot be used with number B, as well as new functions in using the 2in1 service. Therefore, we are engaged in ongoing development toward enhancing services in order to further improve user convenience.

*13 **MyDoCoMo**: A computer-oriented comprehensive support site for DoCoMo users, where a wide range of services can be used including checking the usage fee, performing various procedures, and checking and redeeming points.