

Prepaid Type Cellular Phone Service “Pre-Call”

Prepaid type mobile phone services are becoming widespread in the European mobile telecommunications market. Keeping pace with this trend, DoCoMo started the “Pre-Call” service on 20 May 1999. This is the first such service to be deployed nationwide in Japan, whereby the user prepays call charges, and is able to make calls up to the prepaid limit. The concept is totally different from that of conventional mobile phone services. The following is an overview of this functionality from the perspectives of “service” “network” and “mobile station” .

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Introduction

European mobile operators have been rapidly increasing the number of their subscribers by attracting people with the prepaid style services that do not require such procedures as registration of personal information, etc.

The main features of the prepaid type mobile phone are as follows :

(1) No monthly basic charge

In the billing system of this kind of phone, there is no basic charge. Only dialing charge shall be concerned. Therefore, no invoice for monthly charge shall be issued.

(2) Easy and simple application

Since there is no monthly bill, no credit check of the applicant shall be necessary, thereby making the application procedures easy and simple.

(3) No need to worry about overuse

It employs “prepaid system” which you pay dialing charge in advance. You make calls which are worth the payment, so you do not have to worry about the dialing charge becoming too much because of overuse.

It is said that the above features shall become the factors for proliferation of prepaid type mobile phone.

Since it is assumed that there will be the same type of needs also in Japan, DoCoMo has decided to offer “Pre-Call” , a prepaid type mobile phone service. This service allows us to provide “the new style of ownership and use scenario” .

In the followings, functions and implementation methods of the “Pre-Call” service are explained.

Service

■ Service Overview

In conventional mobile phone services, a user is charged for dialing charge at a later date for the amount he or she has talked. On the other hand, “Pre-Call” is the service in which you pay the dialing charge in advance and make calls which are worth the payment. In the actual operation, “the unit which is worth the prepaid amount” and “the unit validity period” is registered directly to the network from a subscriber management workstation at a contact office. Each time the user makes calls within the unit limit, the unit immediately decrements.

To use “Pre-Call” service, a user has to apply for the service and that he or she has a Pre-Call support mobile station.

■ Service Specifications

DoCoMo’s current service specifications for “Pre-Call”

Table 1 Service Specification of “Pre-Call”

Type of Subscription	Prepaid-type (No need to fill out the application form nor to go under the examination)
Registration Charge	<ul style="list-style-type: none"> • Minimum registration charge ¥3,000 (300 units) • Maximum registration charge on a single occasion ¥9,000 (900 units) • Maximum accumulated registration charge ¥50,000 (5000 units)
Terminal to be Provided	Digital mobile phone Pre-Call support type only
Area	Digital (800M)

are shown in Table 1.

■ Overview of the Functions

(1) Registration of the unit and the unit validity period

There is validity period with the unit registered from the subscriber management workstation. When the validity period expired, any remaining unit, become ineffective. It will not be possible to make or receive calls after the validity expiration unless the units are registered again, with the exception of emergency calls (110, 119) and user support calls (151, 113) that will be able to make even in such case.

The unit validity period is the effective period of use which is set in accordance with the registered units. The maximum unit validity period is 90 days (Table 2).

When you register the units again within the unit validity period, the re-registered units shall be added to the remaining units, and the unit validity period for the re-registered units shall be counted from the day following the expiration of the previously registered units to set a new validity period.

When you make the re-registration after the unit validity period has expired, the re-registered unit shall become the remaining units. The remaining units from the previous registration shall not be counted because it has already expired. The validity period for the re-registered units shall be counted from the day following the re-registration to set a new

validity period.

In the unit registration process, “the unit” and the value of “the unit validity period” notified from the subscriber management system shall be overwritten to the subscriber data and controlled under the network.

(2) Decrement process of the call units when a “Pre-Call” user generates a call

Decrement of the units starts at the time a call is made, which is just the same as the case for a public phone. If the remaining units becomes 6 (units) by decrementing the units during conversation, the network shall instruct the “Pre-Call” user’s terminal to send the alarm to notify the user that the remaining units is nearing zero. If the remaining units is already 6 or below at a point of time that a user starts conversation, the network shall instruct the terminal to send the alarm when the user starts conversation. When the remaining unit becomes zero later time, the call shall be disconnected forcibly at the decrement timing in the next cycle (Figure 1).

(3) Call origination and termination process of “Pre-Call”

When a “Pre-Call” user makes a call, the process of call origination and termination considering the status of “the remaining units” and “the unit validity period” shall take place.

① The call origination and termination process when the

Table 2 Relation between Registration Charge and Unit Validity Period

Registration Charge, Units and Unit Validity Period							
Registration Charge	¥3,000	¥4,000	¥5,000	¥6,000	¥7,000	¥8,000	¥9,000
Units	300units	400units	500units	600units	700units	800units	900units
Unit Validity Period	30days	40days	50days	60days	70days	80days	90days

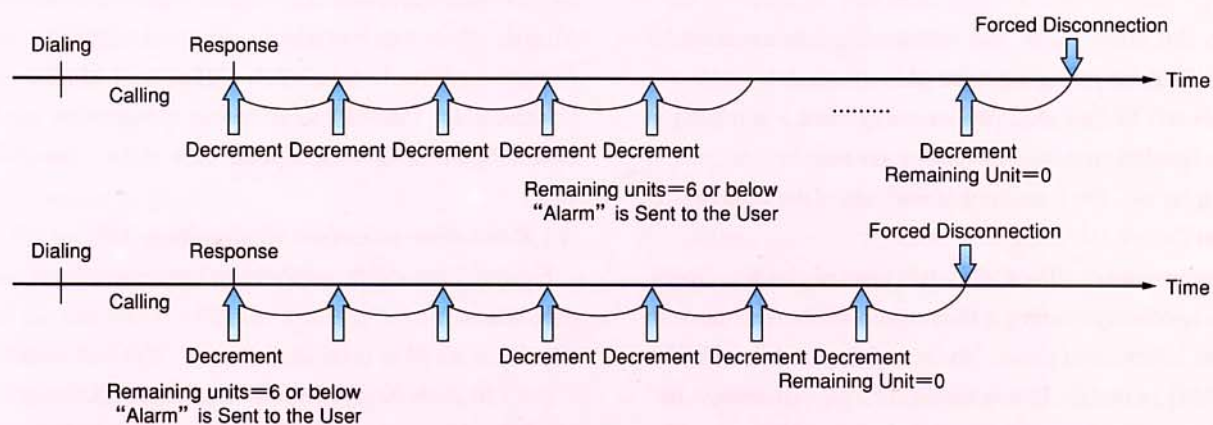


Figure 1 Decrement of Call Units

In case there is the remaining units, within the unit validity period



In case there is no remaining unit, within the unit validity period



In case the unit validity period has passed



In case the remaining units nears 0 (becomes 6 or below)

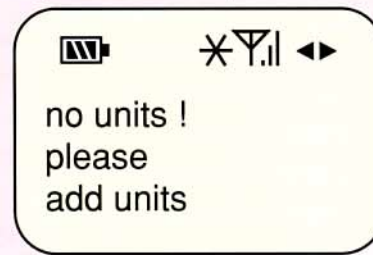


Figure 2 Display of Remaining Units and Unit Validity Period

remaining unit is "0"

"Pre-Call" user cannot originate but can terminate a call. If the user still tries to originate a call under such situation, he or she shall hear the following guidance :

"There is no remaining unit. Please register the units again for making a call."

- ② The call origination and termination process when the unit validity period has passed

A Pre-Call user can neither originate nor terminate a call. If the user still tries to originate a call under such situation, he or se shall hear the following guidance :

"The validity period of the units you have registered has passed. Please register the units again for making make a call."

On the other hand, the following guidance shall be heard for the terminating call in this situation :

"This is NTT DoCoMo. We are sorry but the number you have dialed cannot be connected at present."

- (4) Display of "the remaining units" and "the unit validity period"

Since the units of "Pre-Call" shall instantly be decremented, it is necessary to have a measure to keep users up with the latest information about "the remaining units" and "the unit validity period." The indication of "the remaining unit" and "the unit validity period" shall appear on the screen display of user's mobile station, when a user makes inquiries by operating the mobile stations (menu +61), makes and dis-

connects a call, allowing the user to check these information. The display of the mobile station switches according to "the remaining units" and "the unit validity period" each time (Figure 2).

Network

Functions of "Pre-Call" have been implemented in the existing network, where control of "the remaining unit" and "the unit validity period" and unit decrement process are being conducted.

■ Network Configuration

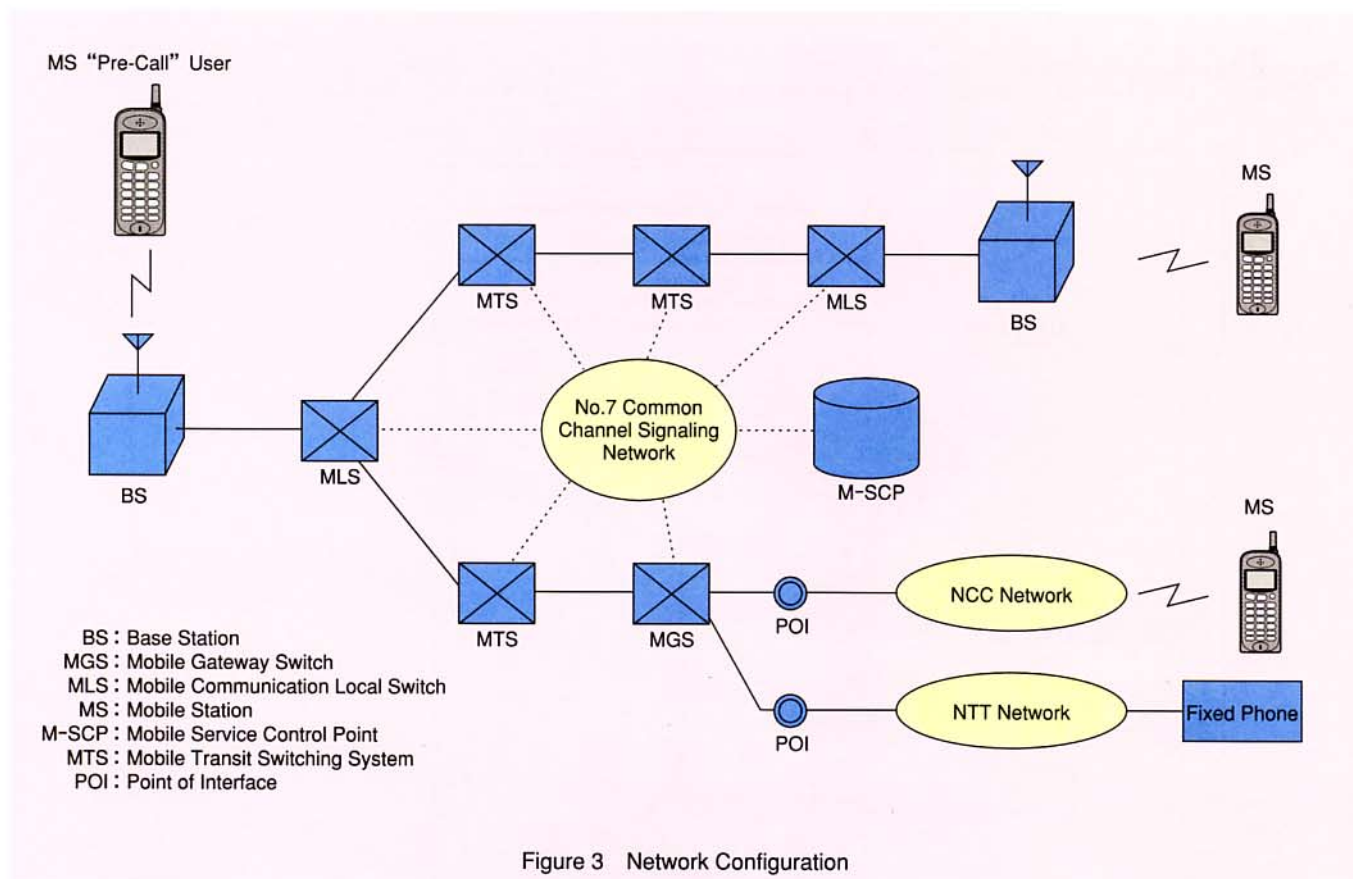
"Pre-Call" is provided by Mobile Gateway Switch (MBS), Mobile Transit Switching System (MTS), Mobile Communication Local Switch (MLS) and Mobile Service Control Point (M-SCP) as shown in the network configuration of Figure 3, allowing to make calls of the "Pre-Call" service.

- (1) Connection procedure of originating call

Figure 4 shows the connection procedure from an available MS.

- ① Once a call is originated from a "Pre-Call" user's MS, the call shall be connected to MLS (SETUP signal) and inquire M-SCP about caller's information (Caller information read request signal).

Based on the caller information read request signal, M-



SCP shall notify MLS of the result of checking the subscriber data (whether the caller is receiving this service or not, the remaining unit, the unit validity period and the billing plan). (Caller information read response signal)

- ② If MLS decides the call is made to the number allowing origination even when the service is stopped (110, 119 etc.), it shall skip the process of checking the unit validity period and the remaining units and move to the regular call originating process.
- ③ If the call is made to the number except the number allowing origination even when the service is stopped (110, 119 etc.), it shall move to the process of checking the unit validity period and the remaining units.

If the unit validity period has expired or the remaining unit is zero, MLS shall notify the originating MS about such situation by guidance.

- ④ If the remaining units at the start of conversation is 1 or more but not greater than 6 (unit), MLS shall indicate to send the alarm to the MS and move to the remaining units check process (⑤).

Also, if the remaining units is not between 1 and 6 (units), MLS shall not send the indication of sending the alarm to the MS and move to the remaining units check process (⑤).

- ⑤ The remaining units shall be checked. If it is 0 (zero), the call shall be disconnected.
- ⑥ If the remaining units is 7 or more, the units shall be decremented by a unit in the same way as public telephones.
- ⑦ During the conversation, the remaining units shall be checked whether it has become 6 or not.
- ⑧ If, as a result of the checking of the above ⑦, the remaining units turns out to be 6, MLS shall indicate to send the alarm to the MS. After allowing the conversation to be made for the time worth a unit, it shall repeat the processes from ⑤ onward.

Also, if the remaining units is other than 6, MLS shall allow the conversation to be made for the time worth a unit, and repeat the processes from ⑤ onward without sending the alarm to the MS.

- ⑨ When the conversation is finished, MLS shall notify M-SCP of the used units (regular clearing process) and then notify MS of the unit validity period and the remaining units.

(2) Connection procedure of terminating call

Figure 5 shows the connection procedure of a terminating call to an available MS.

- ① Once a call is originated to a Pre-Call user's MS, the call

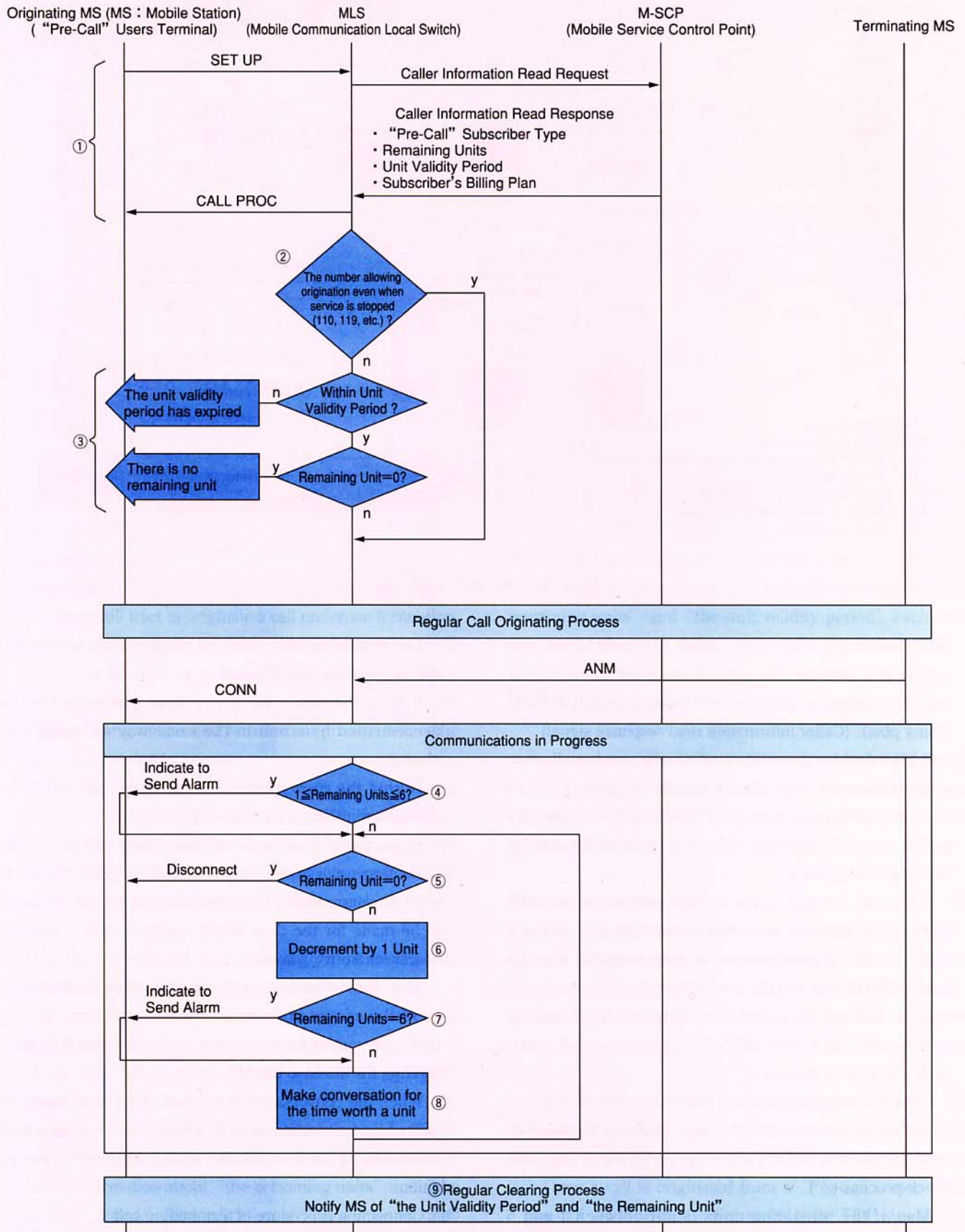


Figure 4 Connection Procedure of Originating Call

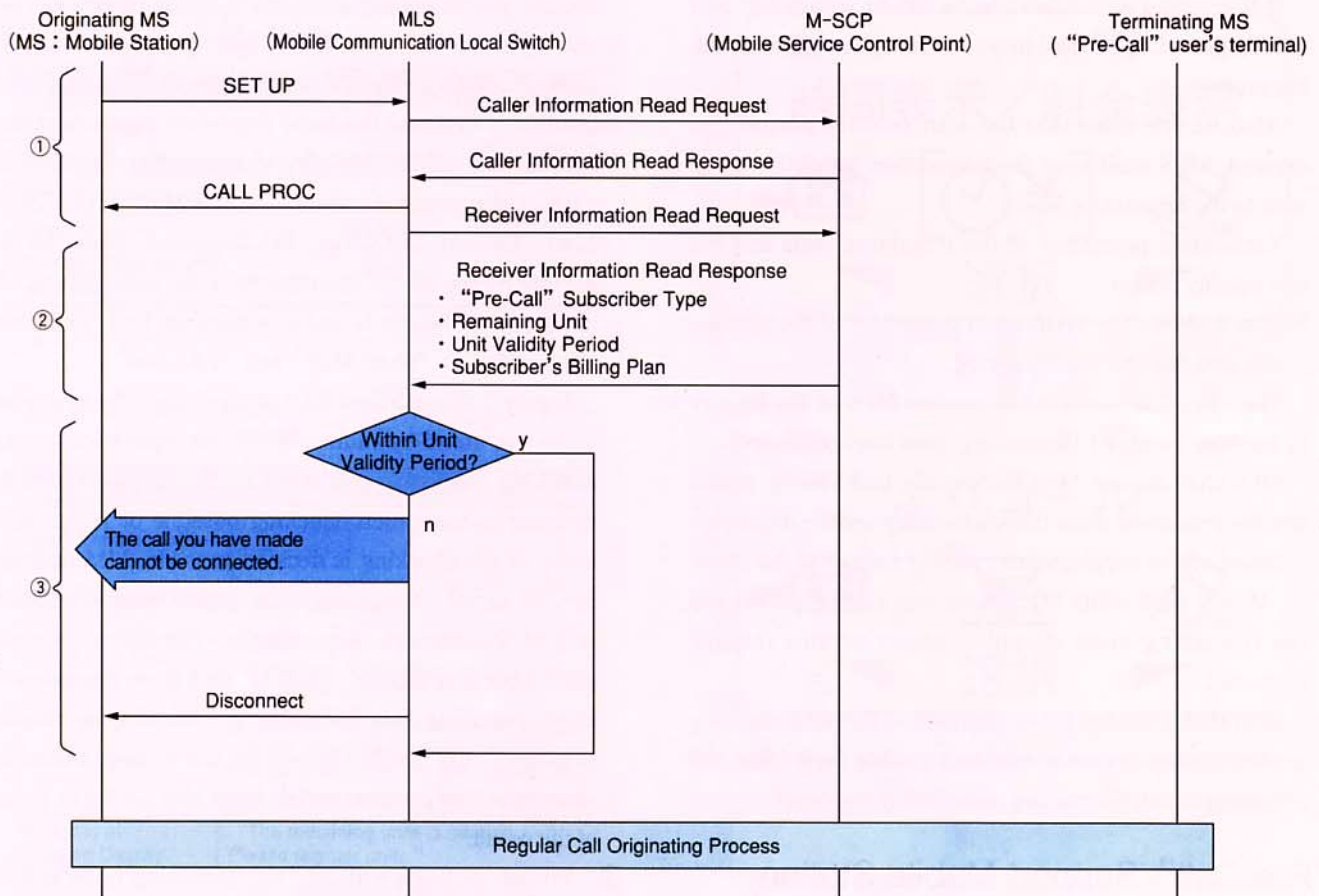


Figure 5 Connection Procedure of Terminating Call

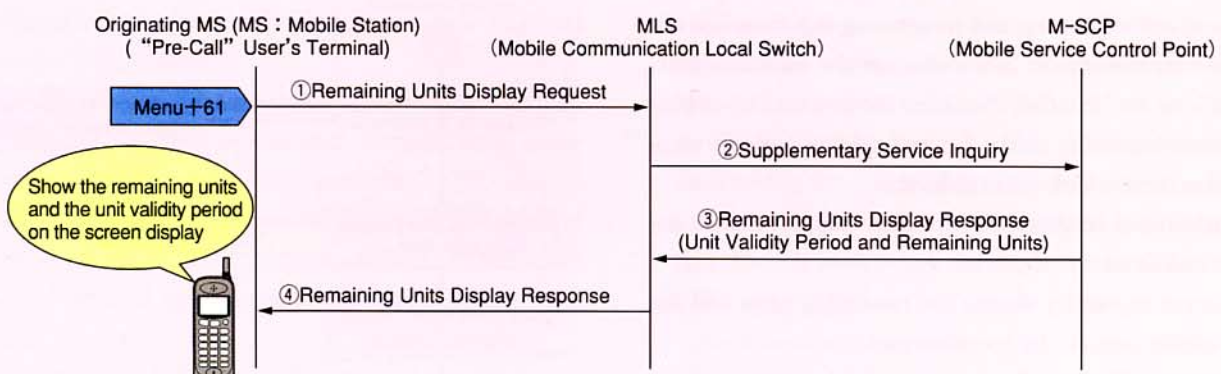


Figure 6 Verification Procedure of the Remaining Units and the Unit Validity Period

shall be connected to MLS (SETUP signal) and inquire M-SCP about caller's information. (Caller information read request signal)

Based on the caller information read request signal, M-SCP shall notify MLS of the result of checking the subscriber data. (Caller information read response signal)

② MLS shall inquire M-SCP about the subscriber informa-

tion of the terminating MS. (Receiver information read request signal)

Based on the receiver information read request signal, M-SCP shall notify MLS of the result of checking the subscriber data (whether the receiver is receiving this service or not, the remaining units, the unit validity period and the billing plan). (Receiver information read response signal)

- ③ If the “Pre-Call” subscriber’s MS is within the unit validity period, MLS shall move to the regular call originating process.

Also, in the case that the unit validity period has expired, MLS shall send the connection restriction guidance to the originating MS.

- (3) Verification procedure of the remaining units and the unit validity period

Figure 6 shows the verification procedure of the remaining units and the unit validity period.

- ① The “Pre-Call” user’s MS notifies MLS of the inquiry by pushing menu+61 (Remaining units display request).
- ② MLS shall inquire M-SCP about the unit validity period and the remaining units (Supplementary service inquiry).
- ③ Based on the supplementary service inquiry of the above ②, M-SCP shall notify MLS of the unit validity period and the remaining units (Supplementary service inquiry response).
- ④ MLS shall notify the MS of the result of the Supplementary service inquiry response (the unit validity period and the remaining units). (Remaining units display response)

“Pre-Call” Support Mobile Station

As previously mentioned, “Pre-Call” is a network-driven prepaid service so “the remaining units” and “the unit validity period” are not controlled and the controlling process of call originating and terminating is not carried out inside the mobile station. In this chapter, the additional functions unique to “Pre-Call” such as the function to display “the remaining units” and “the unit validity period” accumulated in the network are explained.

The additional functions of “Pre-Call” support mobile station are as follows :

- ① Process of inquiry about “the remaining units and the unit validity period” by operation part
- ② Process of inquiry about “the remaining units and the unit validity period” by making a call
- ③ Remaining units alarm sounding function
- ④ Switching of the display menu according to whether the user is receiving “Pre-Call” service or not
- ⑤ Addition of serial signals

In the following, each of the above items is briefly explained.

- ① Process of inquiry about “the remaining units and the unit validity period” by operation part

This process is made to send inquiries to the network

about “the remaining units and the unit validity period” and to display the result by the user operation in stand-by mode (including external serial request). This process is conducted by using the same procedure signal (operator-specific data of MM (Mobility Management) signal) as the case of the inquiries about “Voice Mail” [1], “Short Mail” [2] and “FAX-ban” [3]. However, since the sub message type of the operator-specific data differs, the inquiry itself has to be made separately from that about “Voice Mail” , “Short Mail” and “FAX-ban” .

Figure 7 shows a flowchart of checking “the remaining units” in stand-by mode. When the operation for the checking process is conducted at the operation part, the decision to have such checking possible or not shall be made. If the checking is decided possible, MM operator-specific signal, “remaining units display request” shall be sent to the network. Accordingly, “remaining units display request response” shall be sent from the network. Upon receiving this “remaining units display request response,” the result is shown on the display, and at the same time, the external serial signal also produces output of the result.

- ② Process of inquiry about “the remaining units and the unit validity period” by making a call

This process is made to have users recognize of the

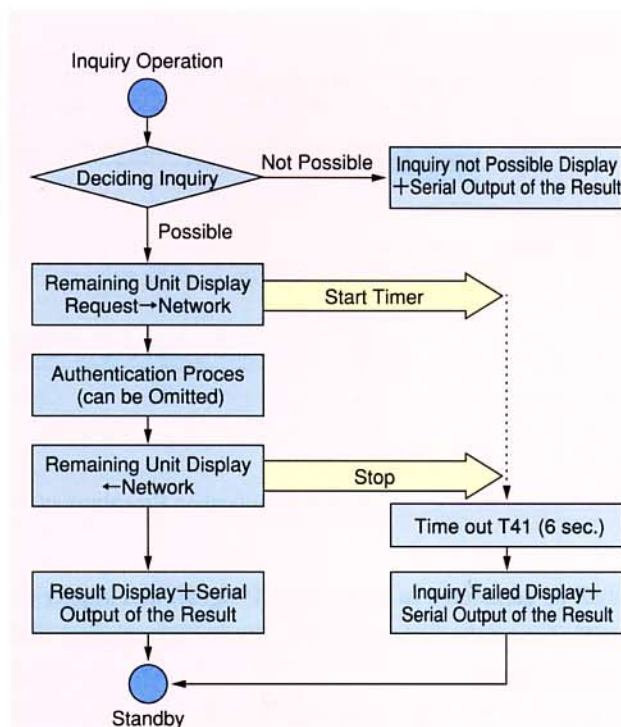


Figure 7 Flowchart of Checking Remaining Call Units in Standby Mode

Table 3 Requirements for Checking of Call Units in Standby Mode

Conditions for Decision	Operation Part Checking	Order
Home Network	DoCoMo Network	1
Broadcasting Information	DoCoMo Network	2
Pre-Call Subscription	Yes	3
Stand-by Mode	Standby	4
Location Register Under Restriction	No	5

Table 4 Terminal Specifications of Remaining Units Alarm and Warning Display

Item	Specification
Alarm Pattern	At user's option from 2 or more alarm types
Alarm Sounding Time	3 sec. upon receiving "Remaining unit warning alarm request"
Output Equipment of Alarm	Receiving speaker (under voice connection) / External sounder (under data connection)
Alarm Volume	In case of receiving speaker : Interlocks with the receiving volume In case of external sounder : Interlocks with the termination ringing
Contents of Warning Display	"The remaining units is nearing zero. Please register units."
Display Time of Warning	From reception of "remaining units warning alarm request" until the completion of a conversation

remaining units and the unit validity period at the start and the end of a conversation.

The MS receives "the remaining units display" notified by information element locking shift (Code group 6) of the downlink frequency conversion part (CC : Call Control) signal and shows the result on the display for 3 seconds at the start and the end of the conversation. At the same time, the external serial signal also produces output of the result.

③ Remaining units alarm sounding function

Once the network receives "remaining units warning alarm request" notified by the locking shift (code group 6) of response (CONN) or additional information (INFO) signal when the remaining units became less than the given value, the MS shall sound or display the warning, establish the "remaining units alarm response" to the information element/locking shift (code group 6) of the uplink INFO signal and send it to the network. Terminal specifications of the remaining units alarm and warning display are shown in Table 4.

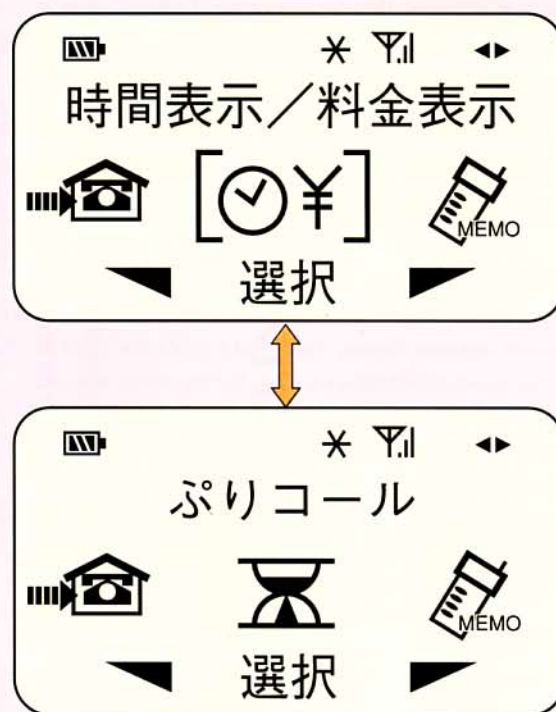


Figure 8 Display Example depending on Pre-Call Subscription

④ Switching display menu according to whether the user is receiving "Pre-Call" service or not

Assuming the case to use Pre-Call compatible MS for regular subscription, the MS switches its display menu according to whether it is receiving "Pre-Call" service or not. Figure 8 shows display example of N601ps depending on "Pre-Call" subscription. The MS shall decide whether "Pre-Call" service is being subscribed or not by "Pre-Call service subscriber display" which is an information element within the "remaining units display response" notified from the network upon inquiry from the operation part. Then, it shall switch the display menu between "Pre-Call" and "Talk time/Call charge" display.

⑤ Addition of serial signals

Following serial signals are added : "Remaining units inquiry request" as an uplink serial, "service display information (addition of information element), "remaining units inquiry result," and "tone type of remaining units warning alarm" as a downlink serial.

Closing

There are various types of prepaid methods in the prepaid type cellular phone services provided by the European operators. Examples are a system that issues a scratch card which

enables unit registration from a prepaid mobile station, a system similar to this but using credit card, and systems that use Internet and bank transfer for the registration.

We will continue to work to let the future "Pre-Call" have wider variety of the unit registration methods, taking account of users' purposes of using "Pre-Call" .

References

- [1] Hanaoka, Kanazawa, Inokuma, Sakai : NTT DoCoMo Technical Journal Japanese Version Vol.3, Nol.1, Apr.1995, pp.24-26, "New mobile communications service / 4. Storing system service" .
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- [3] Onoue, Fukushima, Tokohara : NTT DoCoMo Technical Journal Japanese Version Vol.6, Nol.2, Jul.1998, pp.46-51, "Special issue for new services - FAX Ban Service" .