

Dual Network Service

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NTT DoCoMo launched Freedom Of Mobile multimedia Access (FOMA) on a full scale in 2001, and it has been expanding its service area ever since then. However, it will take a long time to expand and catch up with the Personal Digital Cellular (PDC) service area. In the meantime, NTT DoCoMo will provide the Dual Network Service in light of user convenience.

This article describes the Dual Network Service and provides a detailed description of the control method.

1. Introduction

The Dual Network Service enables users to access both Personal Digital Cellular (PDC) and Freedom of Mobile multimedia Access (FOMA) using the same phone number. Dual network control is diverse, spanning the PDC network, the PDC mobile Packet data communication system (PDC-P) network and the FOMA network. The following sections focus on providing a detailed description of how these networks are coordinated, the approach to optional services control, and the method of preventing simultaneous communications.

2. Service Overview

The Dual Network Service, which is an optional service for FOMA subscribers, was developed assuming that a person using a FOMA terminal may also use a PDC terminal, and the subscriber may simultaneously possess both terminals. As there is only one subscriber involved, only one of the networks should be accessible at a time. The Dual Network Service subscriber (hereinafter referred to as "Dual Subscriber") has an activation status, and the accessible network switches from network to network according to his/her activation status. Also, location registration, handover and service control are network-dependent (i.e. PDC executes them independently of FOMA and vice versa).

2.1 FOMA Activation

When FOMA is active, call origination and termination are

performed only in the FOMA network. As for other services, only those provided by FOMA can be used.

2.2 PDC Activation

When PDC is active, call origination and termination are only performed in the PDC network or the PDC-P network. As for other services, PDC services equivalent to those contracted under FOMA and basic FOMA services can be used.* However, PDC operates these services independently of FOMA and vice versa (i.e. the service settings are network-dependent).

3. Network Control

3.1 Activation Switching Procedures and Status

Confirmation Procedures

The Dual Subscriber can switch and use the active network by operating the terminal. There are two ways for the user to switch the active network: by entering a special number (1540), or by menu operation (which is only available on FOMA terminals). The user can also confirm the activation status of each terminal by operating the terminal.

The terminal operation procedures to be performed by the user are shown below.

* Example of available PDC services: Voice mail, call forwarding, short mail, i-mode, (number display request service), quick dial, business quick dial, caller number display, D mode, call waiting, English guidance, remote access control, WORLDCALL, selection of functions during call, automated call charge information service and mobiler's check.

- (1) Operation to Switch Active Network (**Figure 1**)
 - ① Special number (1540) call origination, and menu operation.
 - ② Listen to guidance "Please enter your password."
 - ③ Enter the password.
 - ④ Listen to guidance "Switching has completed successfully."
- (2) Operation to Confirm Status
 - ① Special number (1516) call origination
 - ② Listen to the guidance.
 - If the status is active: "The network is currently accessible."
 - If the status is inactive: "The network is currently inaccessible."

3.2 Activation Switching Control

(1) Concept of Switching

For dual network switching, the operation of the terminal by the Dual Subscriber is preferred. Measures to deal with simultaneous communications are discussed in detail in Chapter 4.

(2) Administration Method at Network Level

When a user subscribes to the Dual Network Service, his/her subscriber profile for both PDC and FOMA is set up in the New Mobile Service Control Point (NMSCP), which enables him/her to use services in both PDC and FOMA networks depending on the conditions of the active network. The subscriber profile contains dual network contract information (existence/non-existence of contract)

and dual network activation status (PDC activation/FOMA activation), which are treated as information for controlling the Dual Network Service.

In the Dual Network Service, activation switching control and activation status administration are performed by the NMSCP, which administers the subscriber profile for both PDC and FOMA as well as the location information.

The FOMA network adopts the Visitor Location Register (VLR) system: as there is no access to the NMSCP at the time of call origination, the FOMA profile is held in the visited VLR

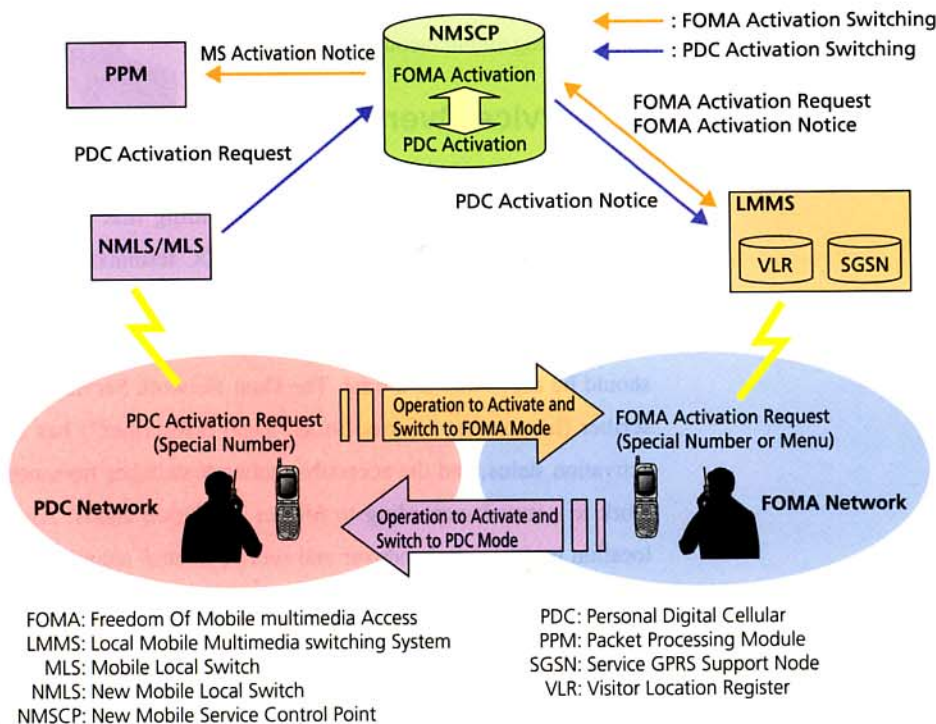


Figure 1 Dual Network Activation Switching Control

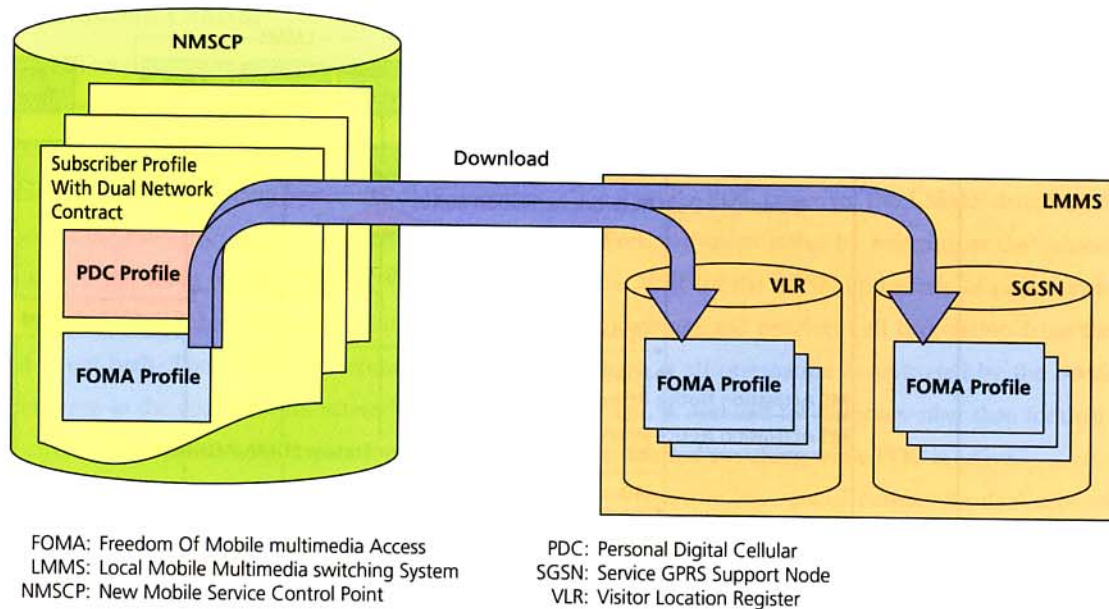


Figure 2 Subscriber Profile

and, assuming that there is a packet-switching contract, in the Service GPRS Support Node (SGSN) (**Figure 2**). The Local Mobile Multimedia switching System (LMMS) can identify the activation status by referring to the dual network control information in the VLR (SGSN) set up when the FOMA profile was downloaded.

(3) FOMA Activation Switching Control

Figure 3 shows the special-number operation procedures performed from a FOMA terminal (FOMA activation sequence section). An activation switching request from the FOMA terminal is received by the LMMS, and the subscriber's contract status and activation status are determined by referring to the subscriber profile in the VLR, followed by the execution of switching control. The NMSCP determines the communication status of the PDC terminal by referring to the Line Memory (LM) in the PDC subscriber profile, and rewrites the status in the dual network control information, from PDC activation to FOMA activation. Furthermore, at this point, the NMSCP informs the Packet Processing Module (PPM) and VLR (as well as SGSN if there is a packet-switching contract) of the change in the dual network activation status, from PDC activation to FOMA activation. The VLR (SGSN) rewrites the dual network activation status in the subscriber profile, from PDC activation to FOMA activation. Subsequently, the NMSCP informs the LMMS of the completion of the process, and the LMMS transmits guidance to inform the user of the successful completion of the activation of and switching to the FOMA terminal. Communication by the FOMA terminal is now enabled. FOMA

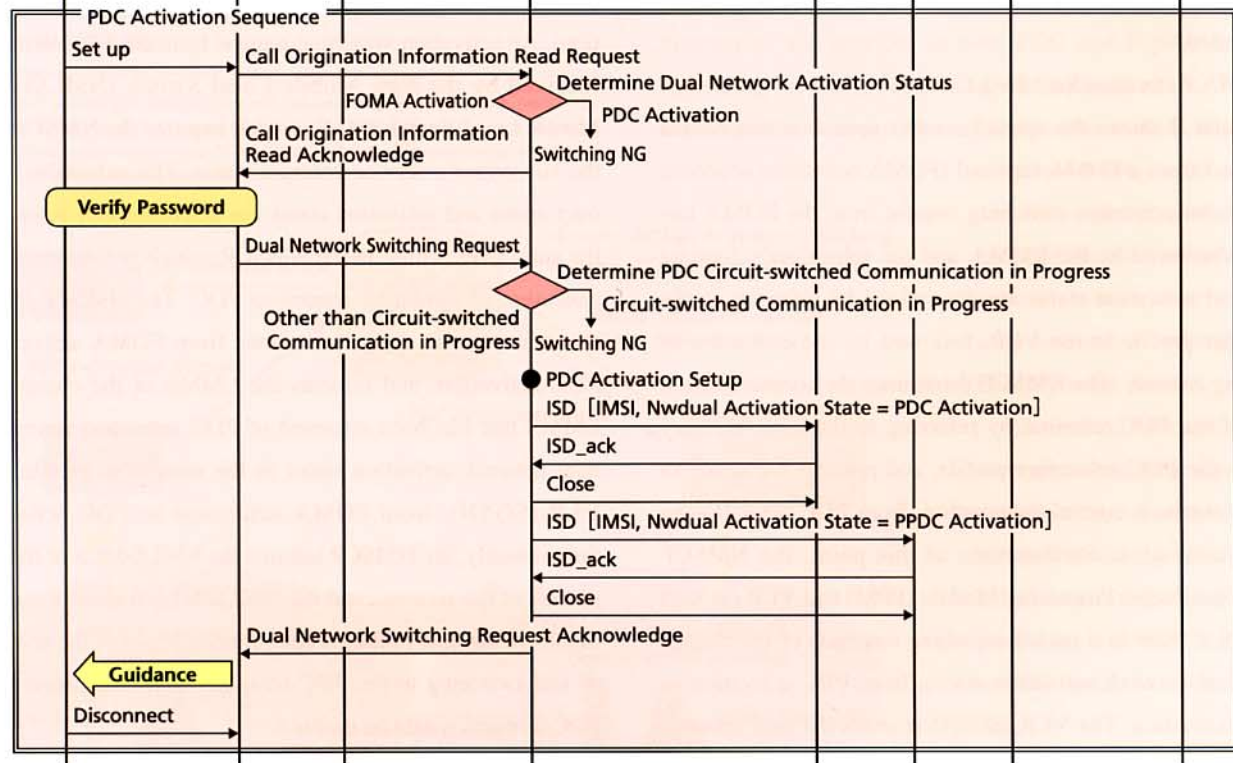
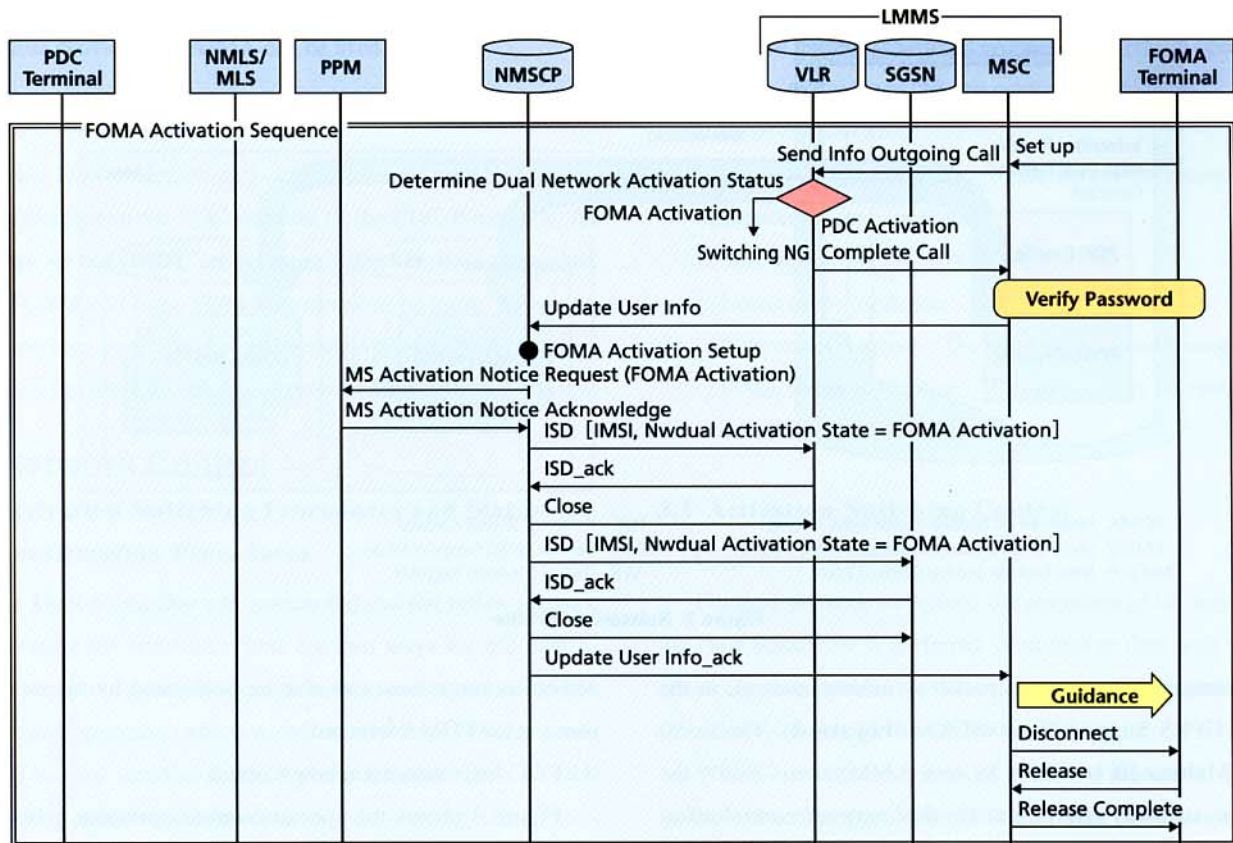
activation procedures can also be performed by operating the menu in the FOMA terminal.

(4) PDC Activation Switching Control

Figure 3 shows the special-number operation procedures performed from a PDC terminal (PDC activation sequence section). An activation switching request from the PDC terminal is received by the New Mobile Local Switch (NMLS) or the Mobile Local Switch (MLS), which inquires the NMSCP about the subscriber's service contract status. The subscriber's contract status and activation status are determined by referring to the subscriber profile in the NMSCP, which is followed by the execution of switching control to PDC. The NMSCP changes the dual network activation status, from FOMA activation to PDC activation, and informs the LMMS of the change. The LMMS that has been informed of PDC activation rewrites the dual network activation status in the subscriber profile in the VLR (SGSN), from FOMA activation to PDC activation. Subsequently, the NMSCP informs the NMLS/MLS of the completion of the process, and the NMLS/MLS transmits guidance to inform the user of the successful completion of the activation of and switching to the PDC terminal. Communication by the PDC terminal would be enabled.

3.3 Location Registration Control

Location registration is performed regardless of the activation status, according to changes in the current location of the PDC terminal or the FOMA terminal.



FOMA: Freedom Of Mobile multimedia Access
 IMSI: International Mobile Subscriber Identity
 ISD: Insert Subscriber Data
 LMMs: Local Mobile Multimedia switching System
 MLS: Mobile Local Switch
 MSC: Mobile Switching Center
 NMLS: New Mobile Local Switch
 NMSCP: New Mobile Service Control Point
 PDC: Personal Digital Cellular
 PPM: Packet Processing Module
 SGSN: Service GPRS Support Node
 VLR: Visitor Location Register

Figure 3 Activation and Switching Sequence

3.4 Call Termination Control

If there is a call termination request to a Dual Subscriber for circuit-switched communications, the New Mobile Gateway Switch (NMGS), the Mobile Gateway Switch (MGS) or the Gateway Mobile Multimedia switching System (GMMS) inquires the NMSCP about the subscriber's status and executes call termination control in the same manner as calls are terminated with respect to a non-Dual Subscriber who subscribes to either PDC or FOMA, not both. The NMSCP determines the active network by referring to the dual network activation status, and executes call termination control with respect to the active network. If there is a call-termination request for packet-switched communications, the network that is capable of terminating the call is selected depending on the service.

3.5 Call Origination Control

If a Dual Subscriber originates a call, the terminal for the active network executes call origination control according to the service conditions of the active network (Figure 4).

If there is a call origination request from a PDC terminal while FOMA is active, the NMSCP determines the activation

status and notifies the NMLS/MLS/PPM receiving the call origination request that FOMA is currently active in order to restrict call origination from the PDC/PDC-P network. On the other hand, if there is a call origination request from a FOMA terminal while PDC is active, the LMMS determines the dual network activation status by referring to the subscriber profile in the VLR (or the SGSN in the case of packet-switched communications) and restricts call origination from the FOMA network. Call origination is restricted by the NMSCP when the menu is operated for purposes other than for dual network activation and switching while PDC is active.

However, the special number for dual network switching is permitted to originate calls only when the status is inactive. The special number for status confirmation can be used regardless of the activation status.

4. Measures to Restrict Simultaneous Communications

In the Dual Network Service, it is necessary to restrict simultaneous communications by a PDC terminal and a FOMA terminal according to the service conditions. This Chapter dis-

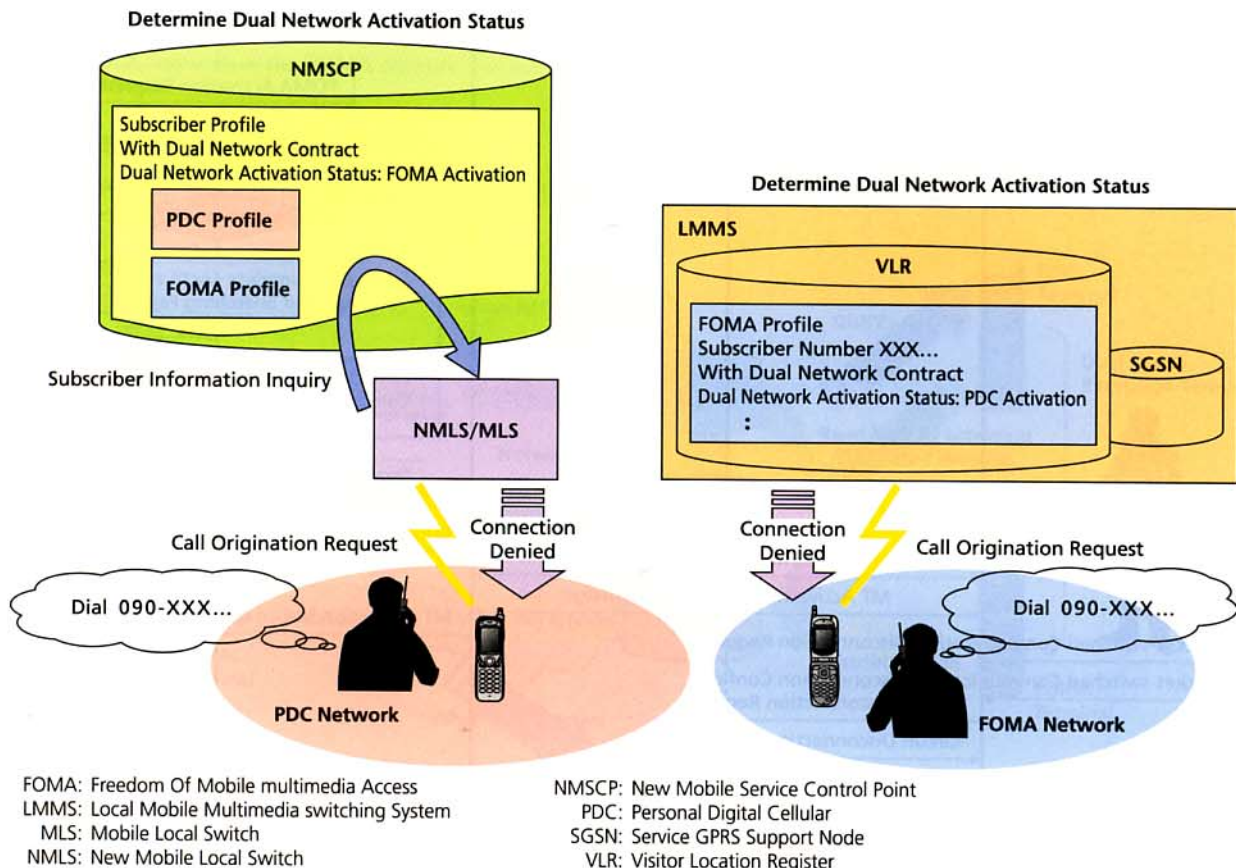


Figure 4 Dual Network Call Origination Restriction Control

cusses the distinctive functions for restricting simultaneous communications.

4.1 Measures against Simultaneous Communications on activation switching to FOMA from PDC

In PDC-P communications, temporary discrepancies may arise between the LM information status in the NMSCP and the actual communication status in the PDC-P network due to NMSCP reboot, etc. Taking such situations into account, NTT DoCoMo has realized a function to sever PDC-P communications with certainty and prevent simultaneous communications with FOMA on activation switching to FOMA from PDC (Figure 5).

If an activation switching request is made to FOMA during PDC-P communications, the NMSCP sets “LM: Communication not in progress” and “Communication Type: Default” in the PDC subscriber profile, switches the dual network activation status to FOMA activation, and transmits the mobile terminal (MT) activation notice (activation change type = FOMA) in the Packet Mobile Application Part (PMAP) signal to the Packet GateWay module (PGW). This signal is relayed to the PPM,

which forces the call to be disconnected if the Dual Subscriber is communicating in its node, and executes the disconnection process with respect to the terminal engaged in communications and the PGW/Mobile message-Packet GateWay module (M-PGW) as well.

In particular, even if the terminal engaged in PDC-P communications attempts to execute handover to an area governed by another PPM after the dual network activation status is switched to FOMA activation by the NMSCP, such an attempt is regarded impermissible by the NMSCP. Accordingly, the MS activation notice signal is transmitted to the visited PPM with certainty, enabling forced call disconnection.

4.2 Measures against Simultaneous Communications on activation switching to PDC from FOMA

When operation for activation is performed in the PDC network, it means that the user is requesting the activation of the PDC terminal. Therefore, switching the status to PDC activation must be permitted regardless of whether or not communication is in progress on the FOMA side. However, if communication is in progress on the FOMA side, the process to disconnect the

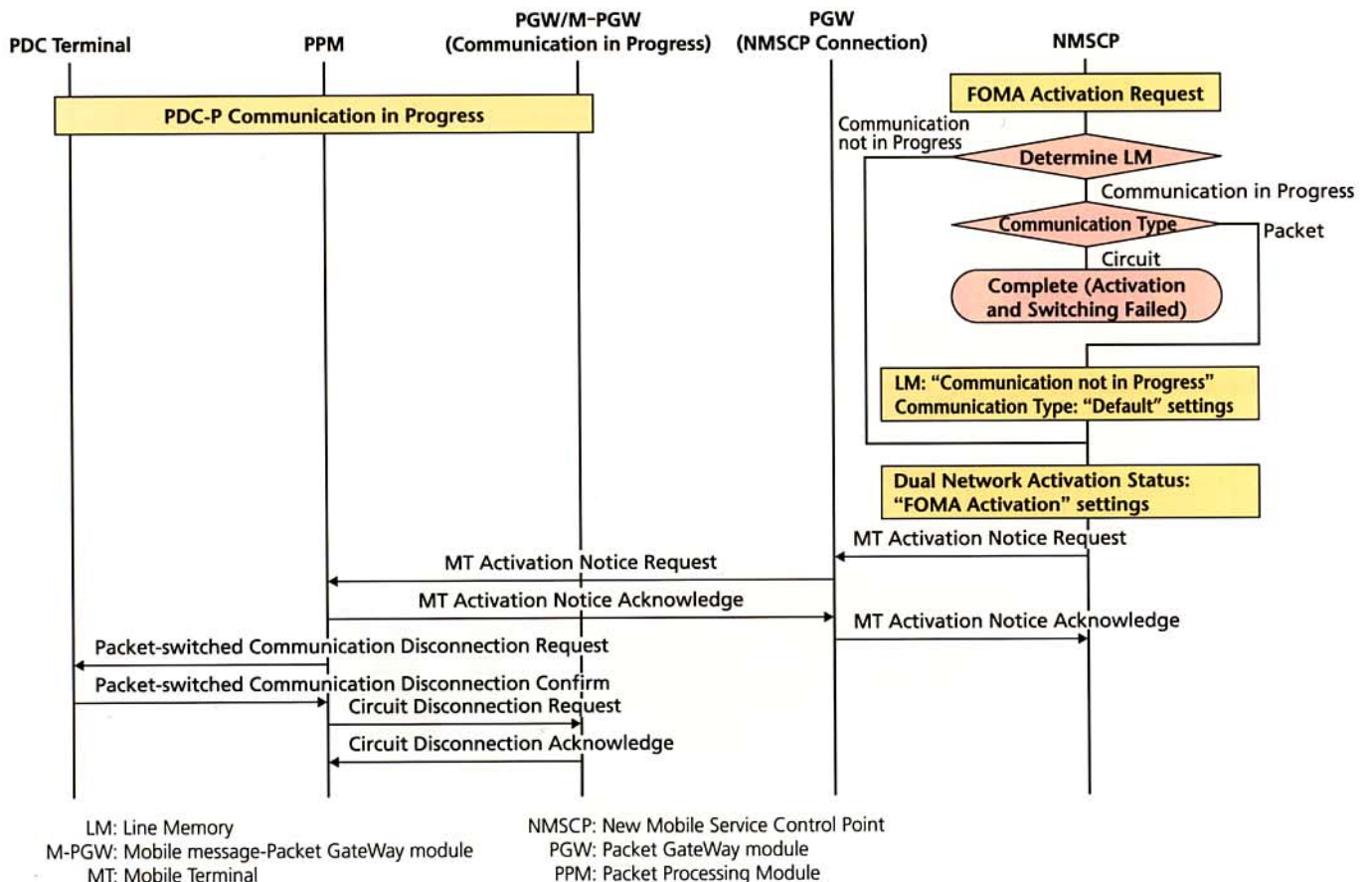


Figure 5 Activation of and Switching to FOMA during PDC-P Communications

call in progress on the FOMA side (both circuit-switched and packet-switched calls) is executed in order to restrict simultaneous communications when switching to PDC, because normal communication after switching to PDC will result in simultaneous communications.

The disconnection process is executed as follows. When operation for activation is performed in PDC, NMSCP transmits to the Mobile Multimedia switching System (MMS) an Insert Subscriber Data (ISD) signal, which instructs MMS to rewrite the status to PDC activation. The reception of the ISD signal triggers the MMS to rewrite the status and execute the disconnection process with respect to the user's circuit-switched call and packet-switched call that is currently in progress (Figure 6).

5. Optional Services

This chapter reviews the distinctive conditions of optional services provided to Dual Subscribers.

5.1 Voice Mail Service

A subscriber to the Dual Network Service and the voice mail service can use a voice mailbox common to both networks. Accordingly, the subscriber can retrieve a voice mail message from both PDC and FOMA networks, regardless of whether it was stored when the PDC network or the FOMA network was active.

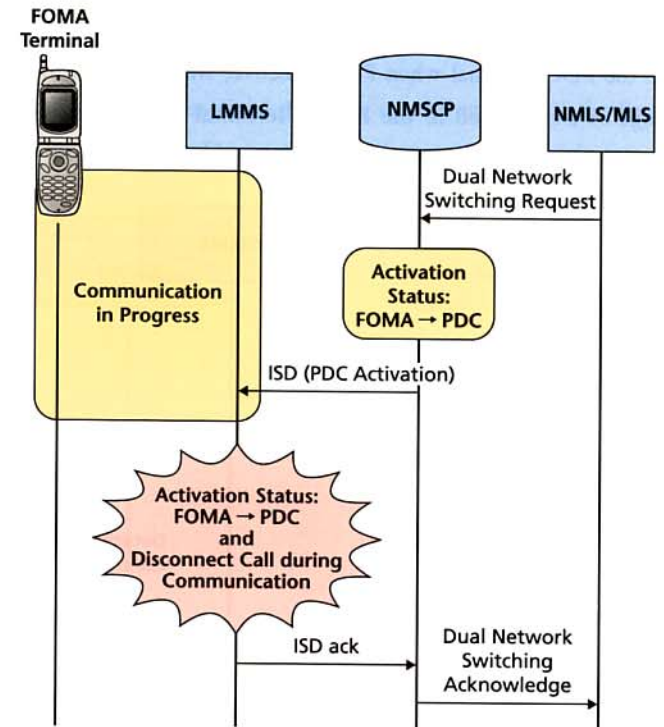
5.2 Mail Services

Conditions of mail services provided to Dual Subscribers

are illustrated in Figure 7, and the details are described below.

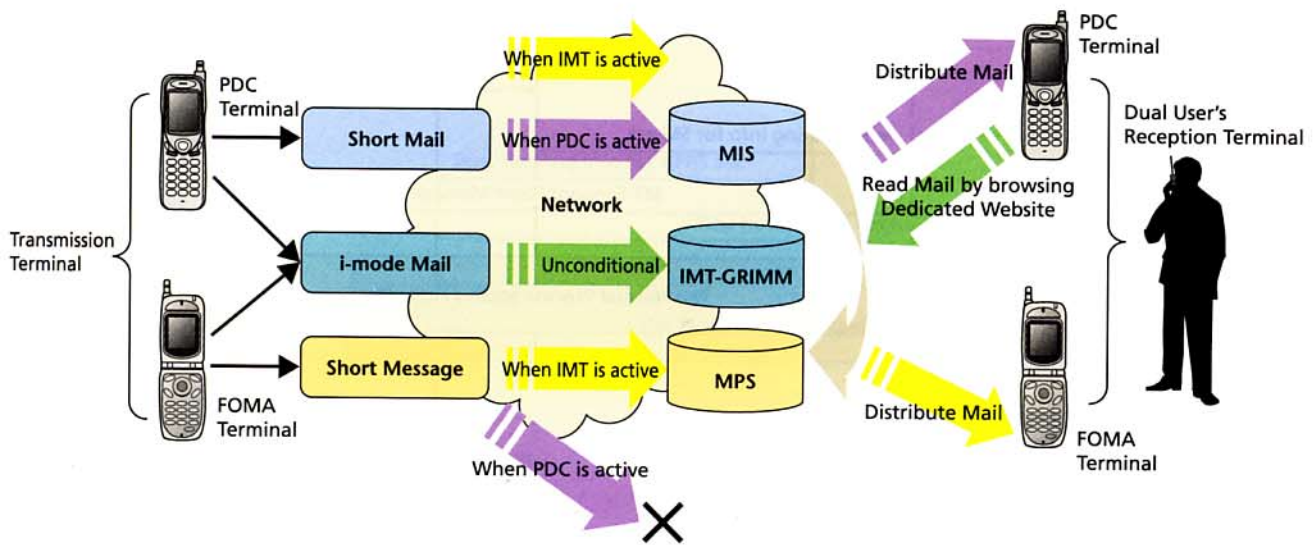
(1) Short Message and Short Mail

When the PDC network is active, the user can receive short



FOMA: Freedom Of Mobile multimedia Access
 ISD: Insert Subscriber Data
 LMMS: Local Mobile Multimedia switching System
 MLS: Mobile Local Switch
 NMLS: New Mobile Local Switch
 NMSCP: New Mobile Service Control Point
 PDC: Personal Digital Cellular

Figure 6 Disconnecting FOMA Call on Activation Switching to PDC from FOMA



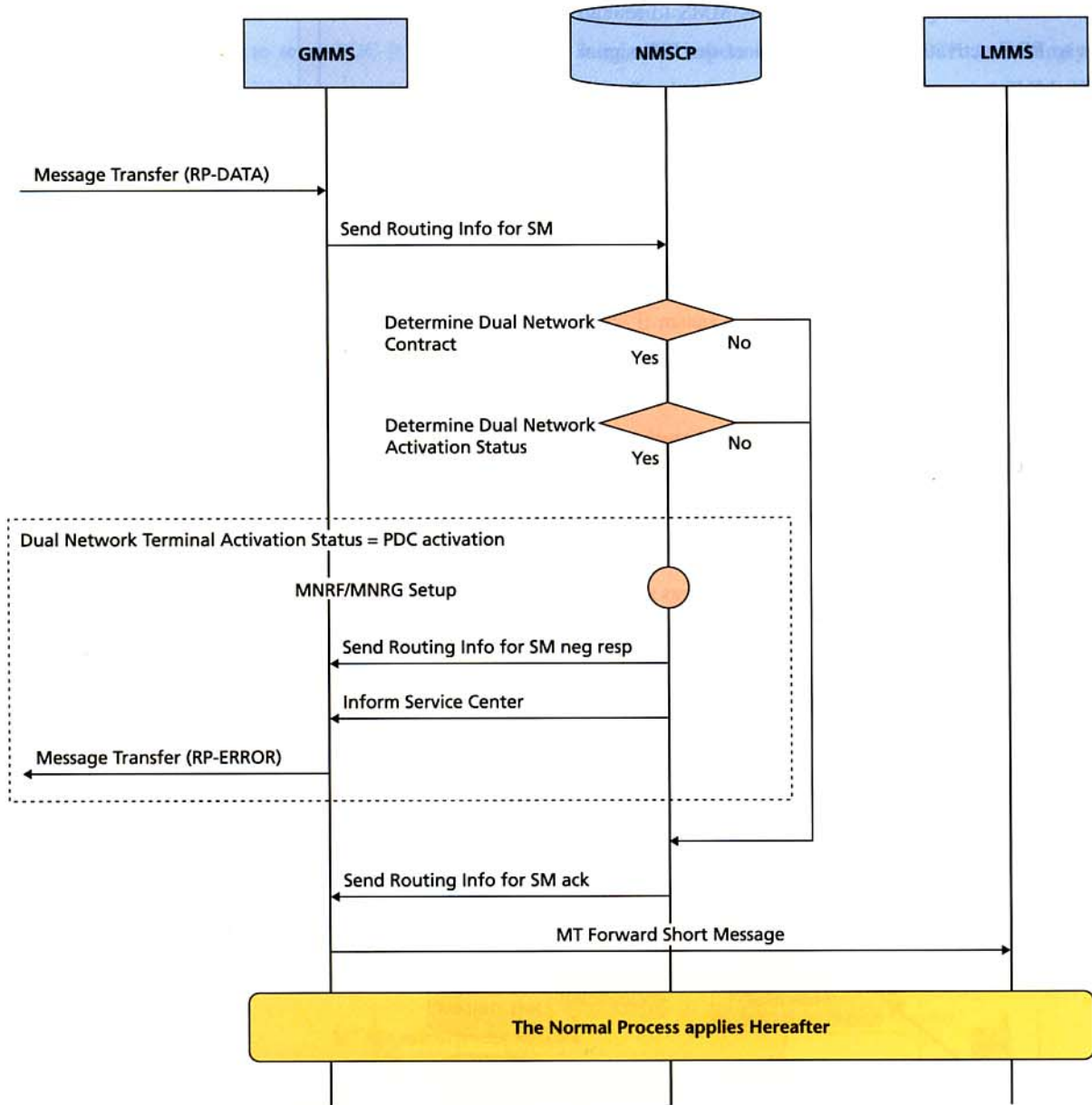
FOMA: Freedom Of Mobile multimedia Access
 GRIMM: Gateway service Representative Internet Market Mobile access exchange
 IMT: International Mobile Telecommunications
 MIS: Mobile communications Information Storage system
 MPS: Message Processing System
 PDC: Personal Digital Cellular

Figure 7 Conditions of Mail Services provided to Dual Users

mail (assuming that he/she is not an i-mode subscriber). When the FOMA network is active, the user can receive short messages. If a PDC subscriber transmits a short mail to a Dual Subscriber, the Dual Subscriber at the receiving end determines the active network at the network level; short mail is transmitted to the PDC terminal when PDC is active, whereas short message is transmitted to the FOMA terminal when FOMA is

active. If a FOMA subscriber transmits a short message to a Dual Subscriber, a short message is transmitted only when FOMA is active (**Figure 8**).

As for mail transmitted from the Dual Subscriber, short message transmission from a FOMA terminal is permitted when FOMA is active, whereas short mail transmission from a PDC terminal is allowed when PDC is active.



- GMMS: Gateway Mobile Multimedia switching System
- LMMS: Local Mobile Multimedia switching System
- MNRF: Mobile station Not-Reachable Flag
- MNRG: Mobile station Not-Reachable for GPRS Flag
- MT: Mobile Terminal
- NMSCP: New Mobile Service Control Point
- PDC: Personal Digital Cellular
- RP: Relay Protocol
- SM: Short Message

Figure 8 Termination of Short Message

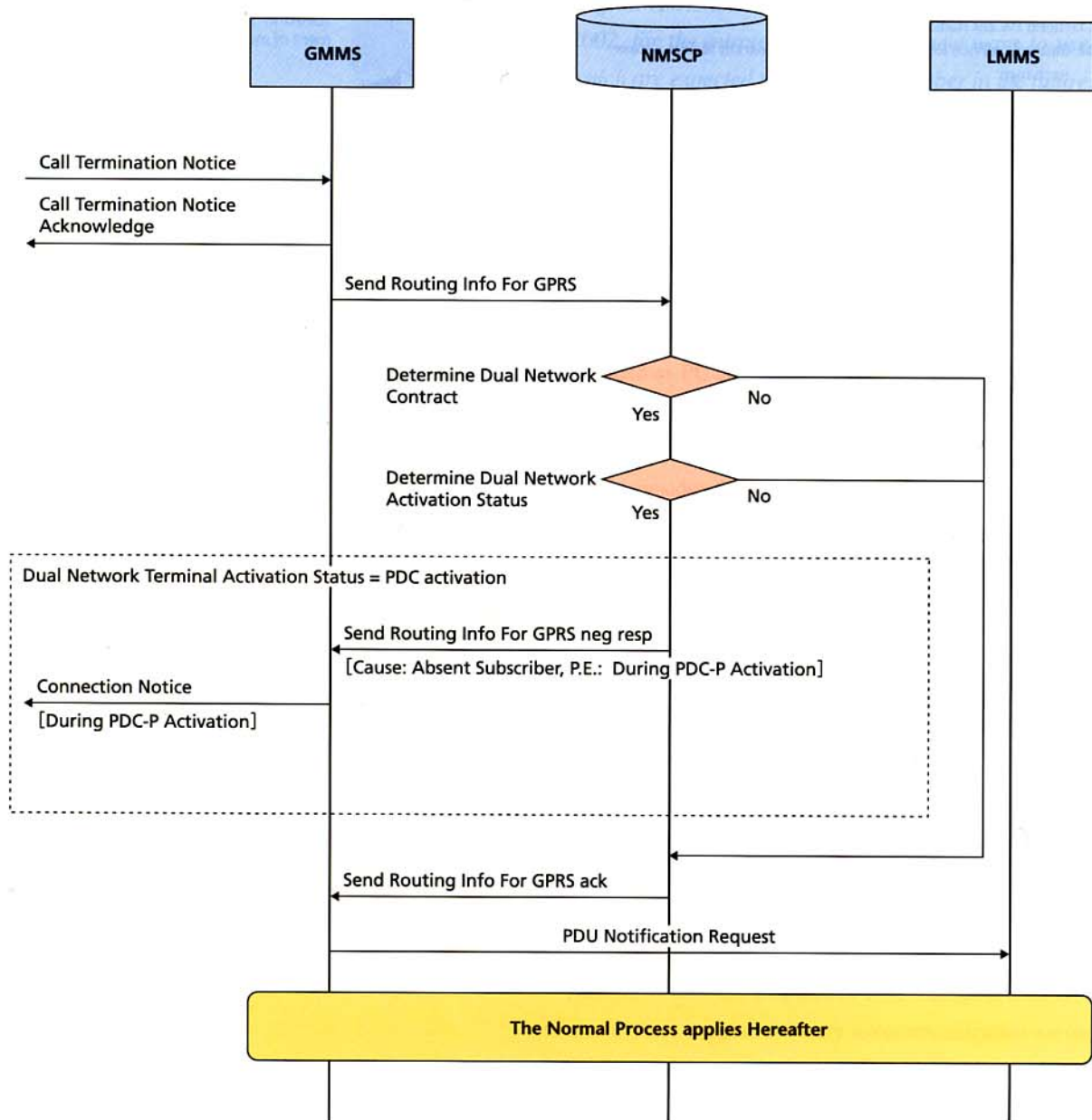
(2) i-mode mail

As optional services are provided under conditions depending on the active network, short messages and short mail are stored in the respective servers according to the Dual Subscriber's active network. However, i-mode mail is unconditionally stored in the mailbox on the FOMA side provided that the user is a Dual Subscriber, because the mail may be too large for the PDC terminal to receive. The stored mail can only be

received when FOMA is active: the mail is not transmitted to the FOMA terminal when PDC is active. Although the PDC terminal cannot receive i-mode mail, it can read the mail by browsing a dedicated website (Figure 9).

6. Conclusion

This article described the basic control method of the Dual Network Service. Dual networks accommodate multiple termi-



- GMMS: Gateway Mobile Multimedia switching System
- GPRS: General Packet Radio Service
- LMMS: Local Mobile Multimedia switching System
- NMSCP: New Mobile Service Control Point
- PDC: Personal Digital Cellular
- PDC-P: PDC mobile Packet data communication system
- PDU: Protocol Data Unit

Figure 9 Termination of i-mode Mail

nals as a whole—one terminal in each network—and there are restrictions in that these terminals cannot be used simultaneously. In order to mitigate this drawback, various creative efforts were made on the control front. It is hoped that these creative efforts will enable customers to use the service safely and conveniently.

GLOSSARY

FOMA: Freedom Of Mobile multimedia Access
GMMS: Gateway Mobile Multimedia switching System
GPRS: General Packet Radio Service
GRIMM: Gateway service Representative Internet Market Mobile access exchange
IMSI: International Mobile Subscriber Identity
IMT: International Mobile Telecommunications
ISD: Insert Subscriber Data
LM: Line Memory
LMMS: Local Mobile Multimedia switching System
M-PGW: Mobile message-Packet GateWay module
MGS: Mobile Gateway Switch
MIS: Mobile communications Information Storage system
MLS: Mobile Local Switch
MMS: Mobile Multimedia switching System
MNRF: Mobile station Not-Reachable Flag
MNRG: Mobile station Not-Reachable for GPRS Flag
MPS: Message Processing System
MSC: Mobile Switching Center
MT: Mobile Terminal
NMGS: New Mobile Gateway Switch
NMLS: New Mobile Local Switch
NMSCP: New Mobile Service Control Point
PDC: Personal Digital Cellular
PDC-P: PDC mobile Packet data communication system
PDU: Protocol Data Unit
PGW: Packet GateWay module
PMAP: Packet Mobile Application Part
PPM: Packet Processing Module
RP: Relay Protocol
SGSN: Service GPRS Support Node
SM: Short Message
VLR: Visitor Location Register