# SMS Roaming Service and SMS Interworking Service

*Takuya Shinozaki, Etsuko Matsubara,*
*Masahiro Kadono and Mayumi Takahashi*

*DoCoMo's SMS Roaming Service and SMS Interworking Service have been launched. It now became possible to make use of SMS in roaming environments and message transmission between DoCoMo and overseas operators.*

## 1. Introduction

DoCoMo's Short Message Service (SMS) Roaming Service (outbound roaming and packet outbound roaming) and SMS Interworking Service were launched in December 2004 and February 2005, respectively, as new services of the international roaming services, WORLD WING [1][2] and WORLD WALKER PLUS/G-CARD [2].

With the launch of the SMS Roaming Service, it has become possible for outbound roaming users in overseas locations to receive and transmit SMS in addition to conventional voice call-based roaming. SMS is widely used in Europe, Asian countries and other parts of the world, and is a basic service provided by the majority of overseas operators; the environment required for SMS roaming has thus been mostly ready. Moreover, the demand for text-based communication is high in Japan as well, which lead us to launch SMS Roaming Service. Since only the receiver's telephone number needs to be specified for the address in the same way as within Japan, the user convenience to send SMS from abroad is maintained. Also, the roaming services that allow users of overseas operators to use DoCoMo networks were already launched in May 2004. Roaming users can thus use both voice and SMS services within DoCoMo networks.

The SMS Interworking Service made the SMS service available to users of overseas operators as well, which used to be provided among FOMA users only. Currently, voice and video phone calls to overseas locations are provided via the WORLD CALL service. With this new additional service, we promote further globalization and aim to improve the user convenience. An SMS is sent from a FOMA terminal supporting the service

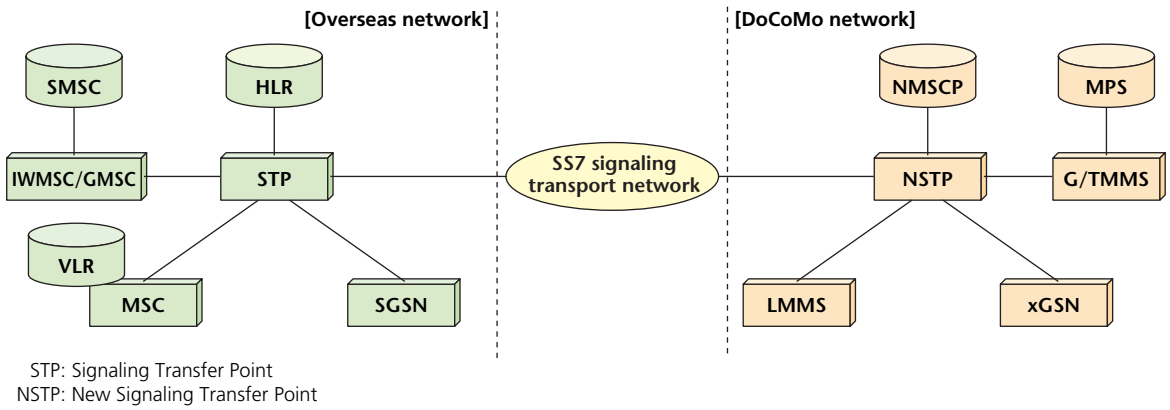


**Figure 1 Network configuration in SMS roaming service**

by entering "+" first, which is the international call identifier, followed by "country code" and then "telephone number." A very simple transmission procedure is adopted in order to provide services that are easy to use for users.

No special subscription is required to use the SMS Interworking Service, and FOMA users can use it freely. Moreover, SMS Roaming Service is automatically made available for users who have subscribed to the international roaming service.

This article provides an overview of the controls adopted within the DoCoMo networks and explains how the operation is coordinated with overseas networks in SMS Roaming Service and the SMS Interworking Service. Note that the same control is used for WORLD WALKER PLUS/G-CARD users as well in terms of SMS outbound roaming.

## 2. SMS Roaming Service

**Figure 1** shows the network configuration for providing SMS Roaming Service.

A DoCoMo network and an overseas network are connected via SS7 signaling transport network. The specific controls are explained below.

### 2.1 Controlling SMS Transmission/Reception of Outbound Roaming Users

1) Location Registration Control

**Figure 2** shows an overview of the processing performed when a FOMA user registers his/her location in an overseas network.

A location registration request is sent from the mobile terminal to a Serving General packet radio service Support Node (SGSN) of the overseas network (1).

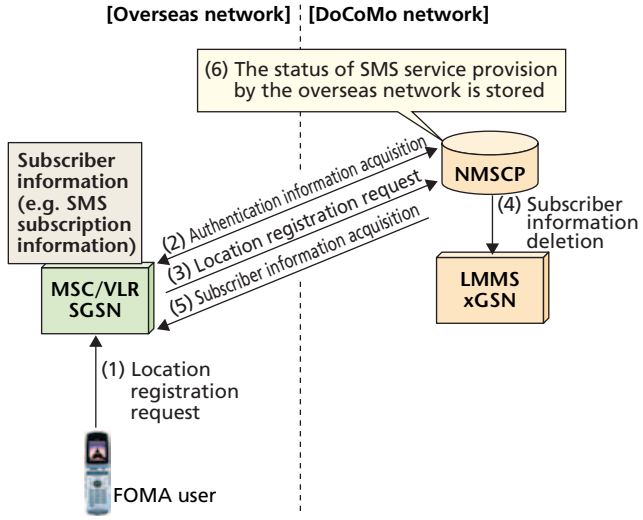


**Figure 2 Overview of processing at location registration (FOMA user in range of overseas network)**

After authenticating the request, the SGSN/the Visitor Location Register (VLR) of the overseas network sends a location registration request to a New Mobile Service Control Point (NMSCP) (2), (3). The NMSCP, upon receiving the location registration request, recognizes that the subscriber has roamed out to the overseas network based on their SGSN/VLR numbers of the registered network, and deletes the subscriber information in the previously registered network (4). Next, it judges whether or not the network that the roaming user is connected to is part of the Circuit Switching (CS) service/Packet Switching (PS) service roaming agreement, whether or not the user is a roaming service subscriber, and whether or not any roaming restrictions apply to the user. If all these requirements are satisfied, the NMSCP downloads the subscriber information, including the SMS subscription information, to the SGSN/VLR of the overseas network and completes the location registration (5). If DoCoMo has only made a roaming agreement for CS services

with the overseas operator, only the CS service location registration is completed. This allows the user to use SMS at the roaming destination.

Not all overseas networks provide SMS services. If an overseas network does not support SMS services, it is notified to the NMSCP in response to the authentication information acquisition. Based on the information, the NMSCP stores the status of SMS service provision for the overseas network, making it possible to avoid unnecessary call reception control (6). The details of this call reception avoidance processing are explained in 2).

2) SMS Transmission/Reception Control

**Figure 3** shows an overview of the processing involved in SMS transmission/reception between outbound roaming users.

If an outbound roaming user sends an SMS to a FOMA user, an SMS transmission request is sent from the mobile terminal to a Mobile Switching Center (MSC) of the overseas network (or an SGSN in the overseas network) (1). The MSC in the overseas network judges whether or not the caller is an SMS subscriber and, if he/she is a subscriber, sends an SMS transmission request to the representative Message Processing System (MPS) number stored in the User Identity Module (UIM). This signal is tentatively received by a representative Gateway/Transit Mobile Multimedia switching System (G/TMMS) via the SS7 signaling transport network (2). This is necessary because the representative MPS number is in fact a non-existing switching system number, and it is hence necessary to terminate the signal at the G/TMMS and relay it after determining the actual MPS number of the SMS registration destination and the number of the G/TMMS that handles the MPS in question (3). The representative G/TMMS sends the SMS transmission request to the G/TMMS handling the MPS (4) and the SMS is stored in the MPS (5).

Upon receiving an SMS transfer request from the MPS (6), the G/TMMS sends a reception information read request to the NMSCP in order to acquire the information of the network to which the receiving user is registered (the SGSN and MSC numbers of the registered network) (7). If the receiving user is also outbound roaming, the NMSCP checks the status of SMS service provision of the overseas network (8). If the overseas network does not provide SMS services, the NMSCP does not return the registered network information to the G/TMMS and the SMS is not sent to the receiving user. If, on the other hand, the overseas network does provide SMS services, the NMSCP returns a reception information read response containing the registered network information to the G/TMMS (9). The G/TMMS then sends an SMS transfer request based on the registered network information and the mobile terminal receives the SMS (10), (11).

## 2.2 Controlling SMS Transmission/Reception of Inbound Roaming Users

1) Location Registration Control

**Figure 4** shows an overview of the processing performed when a user of an overseas network registers his/her location to a DoCoMo network.

A location registration request is sent from the mobile termi-

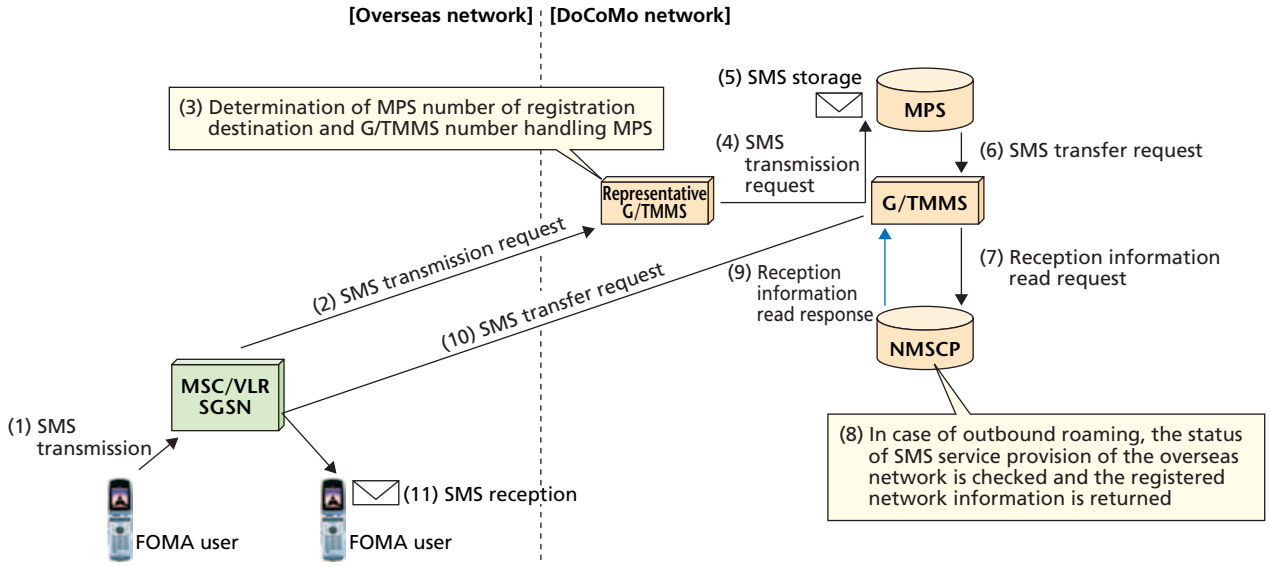


**Figure 3 Overview of processing at SMS transmission/reception (between outbound roaming users)**

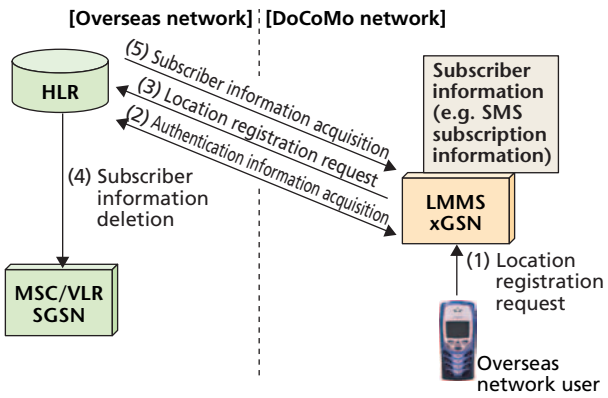


**Figure 4 Overview of processing at location registration (overseas network user in range of DoCoMo network)**

nal to the Local Mobile Multimedia switching System (LMMS)/serving/gateway GPRS Support Node (xGSN) of the DoCoMo network (1). The LMMS/xGSN authenticates the request and judges whether or not the caller is a subscriber of a network that is part of the roaming agreement (2). If the network is part of the roaming agreement, the LMMS/xGSN sends the location registration information to a Home Location Register (HLR) of the overseas network (3). Subscriber information including the SMS subscription information is then downloaded from the HLR of the overseas network to the LMMS/xGSN. The location registration is completed when the LMMS/xGSN retains this information (4), (5).

2) SMS Transmission/Reception Control

**Figure 5** shows an overview of the processing involved in SMS transmission/reception between overseas network users.

If an overseas network user sends an SMS, an SMS transmission request is sent from the mobile terminal to an LMMS/xGSN (1). The LMMS/xGSN judges whether or not the overseas network user is an SMS subscriber and whether or not the SMS registration destination is part of the roaming agreement (2). The LMMS/xGSN maintains the overseas network's SMSC number and is thus able to judge whether or not the SMS registration destination is part of the roaming agreement. If the requirements are satisfied, the LMMS/xGSN sends an SMS transmission request to a Short Message Service Center (SMSC) of the overseas network via an InterWorking Mobile Switching Center (IWMSC) of the overseas network (3), and the SMS is stored in the SMSC of the overseas network (4).

Upon receiving an SMS transfer request from the SMSC of the overseas network (5), a Gateway Mobile Switching Center (GMSC) of the overseas network reads information of the network to which the receiving user is registered (the SGSN and MSC numbers of the registered network) from the HLR of the overseas network (6) and sends an SMS transfer request based on this information (7), whereupon the mobile terminal receives the SMS (8).

## 2.3 Billing Control

User billing and settlement among operators related to outbound roaming users are handled according to billing information created for individual roaming destinations, which is obtained via a clearing house*.

LMMS/xGSN nodes are equipped with detailed bill creation functions for handling billing of inbound roaming users in overseas networks and settlement among operators. In case of SMS transmission from an inbound roaming user, a detailed bill is created when an SMS is stored in an overseas network SMSC. In case of SMS transfer to an inbound roaming user, a detailed

* Clearing house: A third party organization that settles costs involved in international roaming, including network usage fees generated among mobile communication carriers.

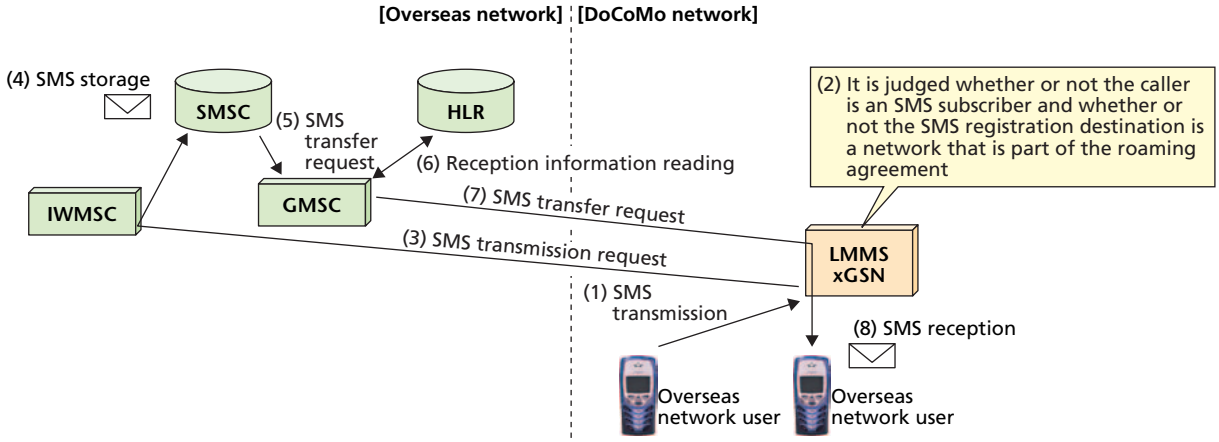


**Figure 5 Overview of processing at SMS transmission/reception (between overseas network users)**

bill is created when an SMS is stored in the mobile terminal.

## 3. SMS Interworking Service

The configuration of the connected networks for providing the SMS Interworking Service is the same as for SMS Roaming Service (Fig. 1). The specific controls are explained below.

### 3.1 SMS Transmission/Reception Control (From a FOMA User to an Overseas Network User)

**Figure 6** shows an overview of the processing involved in SMS transmission/reception from a FOMA user in range of a DoCoMo network to an overseas network user in the range of his/her own network.

If a FOMA user in range of a DoCoMo network sends an SMS to an overseas network user, an SMS transmission request is sent from the mobile terminal to an LMMS/xGSN (1). The LMMS/xGSN determines the MPS number of the SMS registration destination and the number of the G/TMMS handling the MPS in question, and sends an SMS transmission request to the G/TMMS handling the MPS (2). Upon receiving the SMS transmission request, the G/TMMS judges whether or not the telephone number of the SMS transmission destination belongs to the overseas network and whether or not the number is a telephone number of a network that is part of the international SMS agreement (3). If it is a telephone number belonging to a network that is part of the international SMS agreement, the G/TMMS sends an SMS transmission request to the MPS (5) and the SMS is stored in the MPS (6).

If the operator belongs to a network that is part of the international SMS agreement and is situated in a country that conforms to Mobile Number Portability (MNP), it is not possible to identify whether or not the number is a telephone number of a network that is part of the international SMS agreement based on the telephone number alone, and one of the following cases may occur.

- An SMS is sent to a user who moved out from a network that is part of the international SMS agreement in a country supporting MNP to a network not part of the international SMS agreement.
- An SMS cannot be sent to a user who moved into a network that is part of the international SMS agreement from a network not part of the international SMS agreement in a country supporting MNP.

In order to deal with these problems, if a G/TMMS receiving an SMS transmission request (2) recognizes a telephone number of an overseas network from the number, it judges whether it is a telephone number of a country conforming to MNP or not (3). If it is a telephone number of a country conforming to MNP, it acquires the reception information from an HLR of the overseas network and obtains the user's International Mobile Subscriber Identity (IMSI) in order to identify the operator (4). If, on the other hand, the caller is a subscriber of a network that is part of the international SMS agreement, the G/TMMS sends an SMS transmission request to the MPS (5) and the SMS is stored in the MPS (6). In order to implement this procedure, the G/TMMS manages information about MNP conformity for each telephone number and interna-

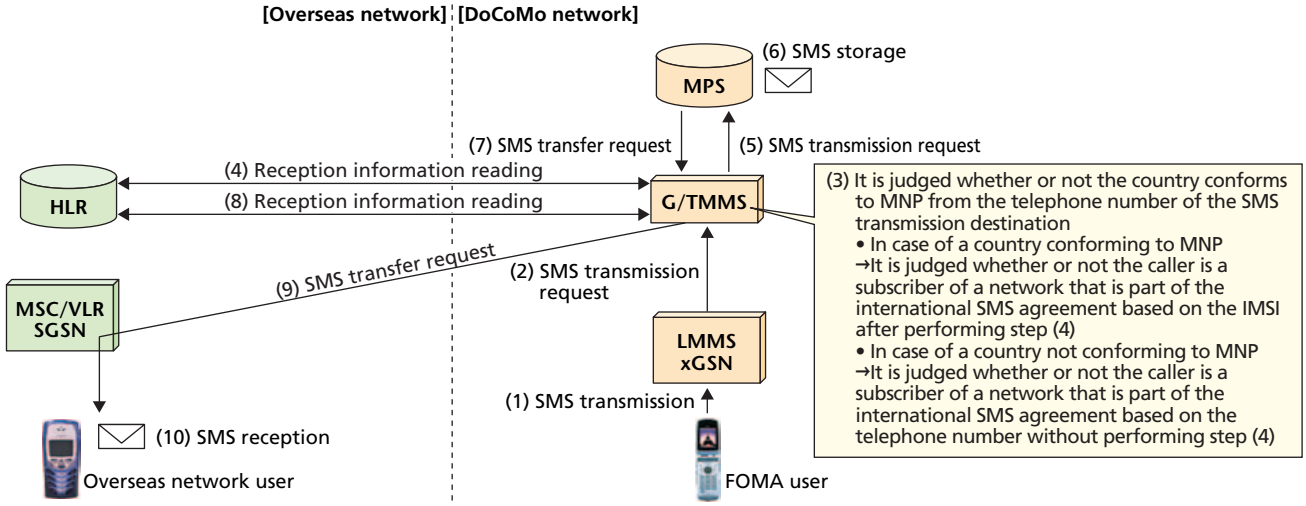


**Figure 6 Overview of processing at SMS transmission/reception (from FOMA user to overseas network user)**

tional SMS agreement status for each operator.

By implementing these procedures, we managed to solve the problems above and achieved correct SMS transmission to users in countries conforming to MNP.

Based on the telephone number of the SMS transmission destination, the G/TMMS receiving an SMS transfer request from the MPS (7) recognizes that the receiving user is a subscriber of an overseas network and reads the reception information from an HLR of the overseas network in order to obtain information of the network to which the receiving user is registered (the SGSN and MSC numbers of the registered network) (8) by acquiring the reception information. The G/TMMS then sends an SMS transmission request based on the registered network information obtained from the HLR of the overseas network (9) and the mobile terminal receives the SMS (10).

### 3.2 SMS Transmission/Reception Control (From an Overseas Network User to a FOMA User)

**Figure 7** shows an overview of the processing involved in SMS transmission from an overseas network user in range of his/her network to a FOMA user.

If an overseas network user sends an SMS to a FOMA user (1), the SMS is stored in an SMSC of the overseas network via an IWMSC of the overseas network (2), (3).

The SMSC of the overseas network then sends an SMS transfer request to a GMSC of the overseas network (4), which in turn sends a reception information read request to an NMSCP on the FOMA side in order to acquire the information of the network to which the receiving user is registered (the SGSN and MSC numbers of the registered network) (5). The NMSCP judges whether or not the network is part of the international SMS agreement based on the SMSC number stored in the reception information read request (6). In the case where the network is part of the international SMS agreement, the NMSCP returns a reception information read response containing the registered network information to the GMSC of the overseas network (7). The GMSC of the overseas network then sends an SMS transfer request based on the registered network information acquired from the NMSCP (8) and the mobile terminal receives the SMS (9).

The same reception control is performed regardless of whether the sender of the SMS is in a country conforming to MNP or a country not conforming to MNP, because the judgment of networks taking part in the international SMS is performed based on SMSC numbers.

### 3.3 Countermeasures against Spam Mails

After the launch of the SMS Interworking Service, there is a risk that spam mails may be sent from overseas networks via the Internet. As a countermeasure against this, NMSCPs regulate SMS transmission from overseas network users to FOMA users in excess of a certain amount. Since an NMSCP is the first device to receive transmissions from an overseas network user to a FOMA user, it serves as a guard function for the entire DoCoMo network by implementing this function.

## 4. Conclusion

This article explained the control processing carried out within the DoCoMo networks and the interworking with overseas networks in SMS Roaming Service and the SMS

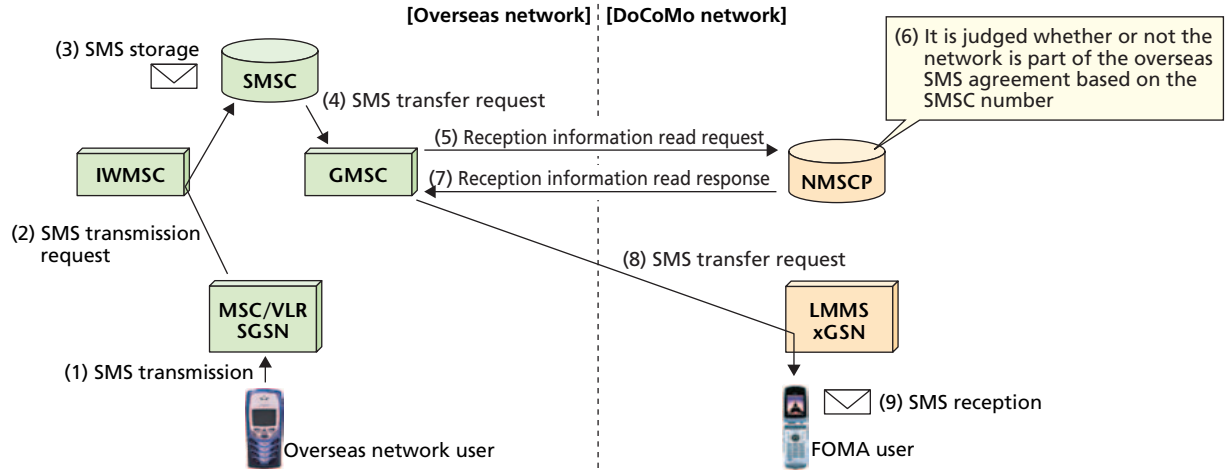


**Figure 7 Overview of processing at SMS transmission/reception (from overseas network user to FOMA user)**

Interworking Service.

Both services play important roles in supporting DoCoMo's international services. For this reason, we will aggressively promote expansion of the countries and regions where these services are available and make efforts to improve the convenience for DoCoMo users to upgrade DoCoMo's international services.

## REFERENCES

[1] M. Kikkawa et al.: "FOMA International Roaming Service," NTT DoCoMo Technical Journal, Vol. 5, No. 2, pp. 55–62, Sep. 2003.

[2] DoCoMo World Service Website: "How to use the roaming service"; http://www.nttdocomo.co.jp/english/p_s/world/roaming/howto/index.html

## ABBREVIATIONS

CS: Circuit Switching
GMMS: Gateway Mobile Multimedia switching System
GMSC: Gateway Mobile Switching Center
HLR: Home Location Register
IMSI: International Mobile Subscriber Identity
IWMSC: InterWorking Mobile Switching Center
LMMS: Local Mobile Multimedia switching System
MNP: Mobile Number Portability
MPS: Message Processing System
MSC: Mobile Switching Center
NMSCP: New Mobile Service Control Point
NSTP: New Signaling Tranfer Point
PS: Packet Switching
SGSN: Serving General packet radio service Support Node
SMS: Short Message Service
SMSC: Short Message Service Center
STP: Signaling Tranfer Point
TMMS: Transit Mobile Multimedia switching System
UIM: User Identity Module
VLR: Visitor Location Register
xGSN: serving/gateway GPRS Support Node