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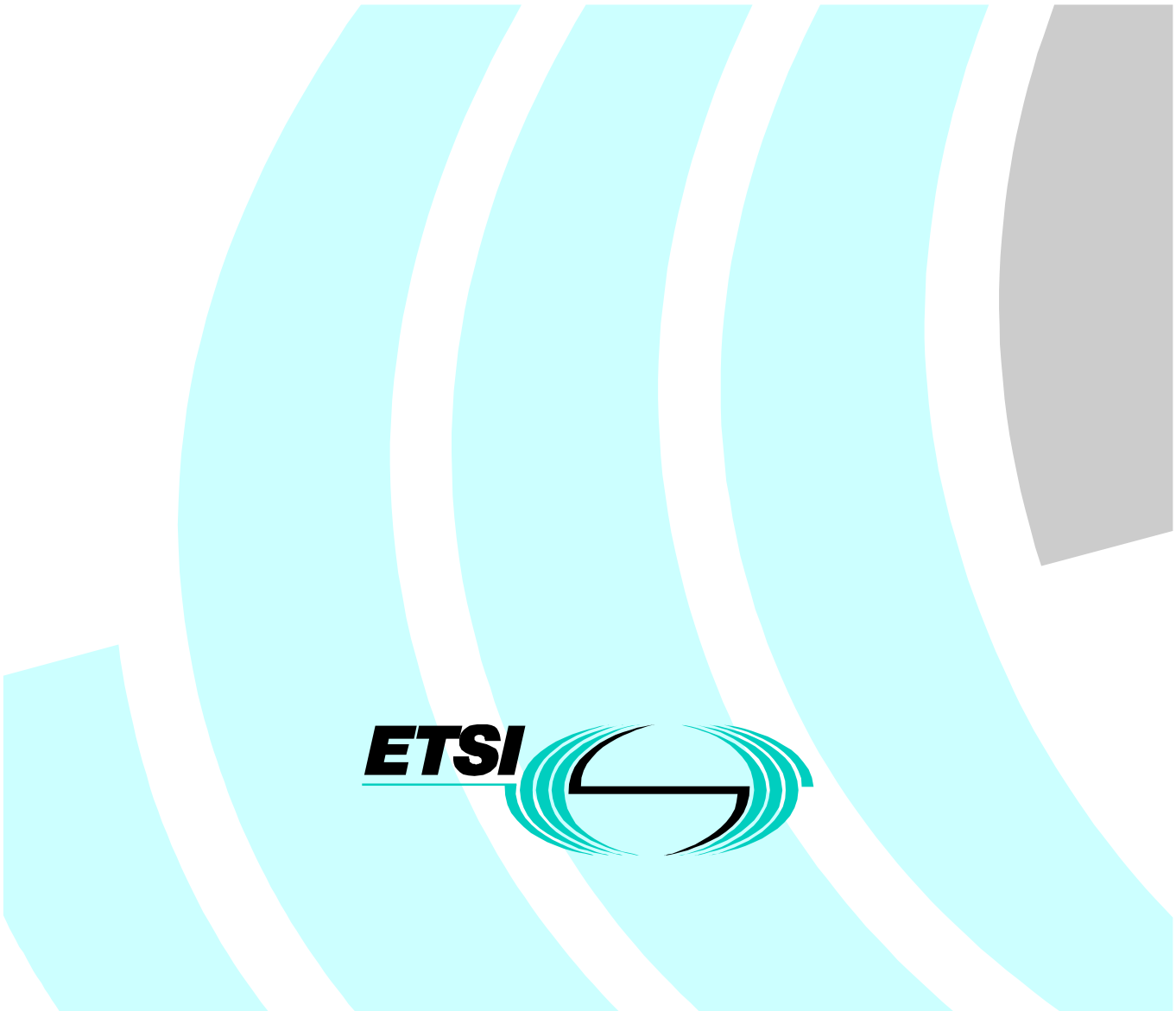
Network Aspects (NA); Number Portability Task Force (NPTF); Consequences of mobile number portability on the PSTN/ISDN and synergy between geographic and mobile number portability



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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Network Aspects (NA).

1 Scope

The scope of the present document is to describe the consequences of mobile number portability in GSM networks on PSTN/ISDN networks, and to describe how these consequences can be handled such that the PSTN/ISDN and GSM users can be provided with the same services as before the introduction of number portability. The present document also discusses possibilities for synergy between solutions employed in GSM networks for mobile number portability, and solutions employed in PSTN/ISDN networks for geographic number portability.

The present document is limited to the aspects of geographic and/or mobile number portability that affect PSTN/ISDN networks. Aspects that concern GSM networks only are not dealt with. The scope of the present document is limited to the network aspects. Service management and inter-operator procedures are outside the scope of the present document. The present document only treats service provider portability. Service portability between telephone service (fixed) and mobile telephone service (PLMN) is excluded from consideration.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

TR 101 119: "Network Aspects (NA); High level description of number portability".

TR 101 118: "Network Aspects (NA); High level network architecture and solutions to support number portability".

TR 101 122: "Network Aspects (NA); Numbering and addressing for Number Portability".

EG 201 367: "Intelligent Network (IN); Number Portability Task Force (NPTF); IN and Intelligence Support for Service Provider Number Portability".

3 Definitions and abbreviations

3.1 Definitions

NOTE: Definitions used in the present document are the definitions for number portability in the PSTN/ISDN (TR 101 119) (with the exception of the definition of mobile number portability). The definitions for number portability in the PSTN/ISDN differ from the definitions for number portability in GSM networks (DTS/SMG-010266Q7, see Bibliography). To avoid any confusion this subclause specifically repeats the definitions from (TR 101 119) that are different from GSM NP Service description (DTS/SMG-010266Q7, see Bibliography).

For definitions the reader is referred to (TR 101 119). In this subclause only definitions are included that are of particular interest in the context of the present document.

Entities

Network Operator: An entity that operates a network in order to route calls.

Service Provider: An entity that offers services to users involving the use of network resources. The "Service Provider" is understood in the present document in a generic way and may have different status according to the service provided. For example, "Service Provider" refers to a local loop operator in the case of Geographic Numbers, or to a mobile operator in the case of Mobile Numbers, or to a service operator / reseller in the case of Service Numbers.

Service Provider Portability

Donor Service Provider: The Service Provider from whom the number was initially ported.

Recipient Service Provider: The Service Provider to whom the number is ported.

Service Provider Portability for Geographic Numbers (SPPGN): A service that enables a customer to resign their subscription with a Service Provider and to contract another subscription with another Service Provider without changing their Geographic Number, without changing their location, and without changing the nature of the service offered.

Mobile Number Portability (MNP): The ability for a mobile subscriber to change within the same country the GSM network with which his Service Provider has a contract to implement his services for a specific MSISDN, whilst retaining the original MSISDN(s) (see also DTS/SMG-010266Q7).

Networks

Donor Network: The initial network where a number was allocated by the NPA before ever being ported.

Recipient Network: The network where a number is located after being ported.

Transit Network: A network between two networks, e.g. the recipient network and the donor network.

Originating Network: The network serving the calling end-user.

For most incoming international calls, the originating network is effectively the network containing the international gateway.

For carrier selection, the first exchange of the selected carrier effectively becomes the originating network for routeing purposes.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CCBS	Call Completion to Busy Subscriber
CCNR	Call Completion in case of No Response
DN	Directory Number
GMSC	Gateway Mobile Switching Centre
GSM	Global System for Mobile communication
HLR	Home Location Register
IN	Intelligent Network
ISDN	Integrated Services Digital Network
MAP	Mobile Application Part
MNP	Mobile Number Portability
MSISDN	Mobile Station ISDN Number
MSRN	Mobile Subscriber Roaming Number
MT-SMS	Mobile-Terminated SMS
NP	Number Portability
NPA	Numbering Plan Administrator
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
SCCP	Signalling Connection Control Part

SMS	Short Message Service
SOR	Support of Optimal Routeing
SPPGN	Service Provider Portability for Geographic Numbers
SRI	Send Routing Information
SSP	Service Switching Point
VLR	Visitor Location Register

4 Calls to ported mobile numbers

4.1 Introduction

After the introduction of mobile number portability, the DN (i.e. the MSISDN) no longer indicates the service provider from whom the user has a subscription. This means that the DN by itself can no longer be used for routeing the calls to the recipient network.

Mobile number portability may affect PSTN/ISDN networks, if a call to a mobile, ported number is originated in or routed through a PSTN/ISDN. Because the DN no longer indicates the user's service provider the effect may be that routeing, and thereby use of network resources might not be as efficient as before the introduction of number portability.

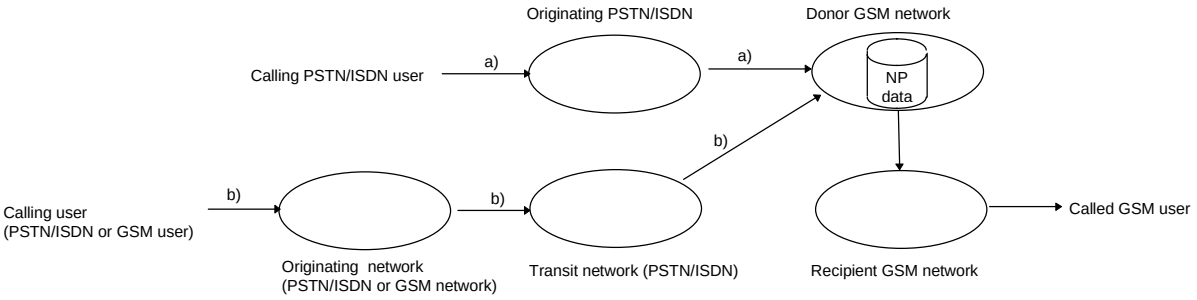
4.2 High-level Network models

This subclause discusses high-level network models that can be applied in the case that calls are routed to ported mobile numbers through the PSTN/ISDN. These models concern both initial (i.e. first time) and subsequent porting of numbers, as from the point of view of the network architecture there is no distinction between these cases.

It should be noted that for mobile number portability to function correctly in an fixed network environment where number portability is also present, the Routeing Information schemes should be devised so that they are mutually exclusive, i.e. do not interfere with one another. This means that the Routeing Information that identifies a recipient entity in the mobile network domain should not be the same as that which identifies a recipient entity in the fixed network domain. Additionally, if portability in the fixed network uses a different approach to that in the mobile network for conveying the Routeing Information, e.g. concatenated addressing versus separated addressing, exchanges shall be able to accommodate both methods of conveyance.

4.2.1 Onward routeing model

If a mobile user ports his number from one mobile network to another (mobile number portability), and if the PSTN/ISDN is not aware that service provider portability may have been applied to this number, the PSTN/ISDN will route the call to the donor GSM network. The donor GSM network shall be aware of the possibility that number portability has been applied. It therefore detects the number portability, consult the NP database, and retrieves routeing information for the call. With this routeing information the call is routed onward to the recipient network. There the call may be delivered to the called user if the user is roaming in the home network. If the user is roaming in another network the recipient network may route the call further, according to normal call handling procedures, to the visited GSM network, where the call is then delivered to the called user. This involves retrieval of information from the location register. This scenario is illustrated in Figure 4.1. For the sake of simplicity in the figure it is assumed that the called party is roaming in the home GSM network. However, if the called party would be roaming in another network, this would not alter the fact that donor mobile network is responsible for the detection of the number portability, and for the rerouting of the call.



a) PSTN/ISDN is originating network
b) PSTN/ISDN is transit network

Figure 4.1: Routeing of calls to ported mobile numbers, where PSTN/ISDN networks are not aware of mobile number portability

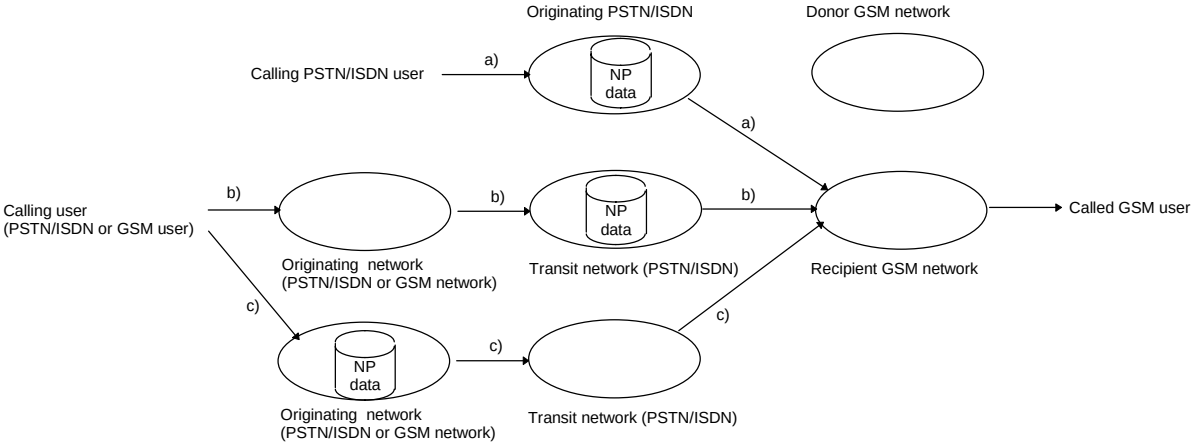
In this model responsibility is placed on the GSM networks to handle the number portability aspects of the call. However, as the PSTN/ISDN networks are not involved, these responsibilities are outside the scope of the present document.

The routeing of the call via the donor GSM network corresponds to the high-level network models for SPPGN, where calls are rerouted by Onward routeing principles (TR 101 118). The same disadvantages and advantages of the network models for SPPGN apply. Other network models for SPPGN, discussed in (TR 101 118), could however be applied in the case that calls to ported, mobile numbers are routed through the PSTN/ISDN. Other network models give a different set of disadvantages and advantages, which could better suit the preferences of the involved network operators. Below it is explained how these models could be applied and which responsibilities would be imposed on PSTN/ISDN networks and on GSM networks.

4.2.2 All Call Query model

This subclause describes how a call to ported, mobile number routed through the PSTN/ISDN, would be handled according to the all call query model.

On reception of calls to mobile numbers the PSTN/ISDN queries a database that contains the number portability data for the mobile numbers. From this database routeing information is obtained to reroute the call towards the recipient GSM network, instead of the donor GSM network. The model is illustrated in Figure 4.2 (for simplicity it is again assumed that the mobile user is roaming in the home network).



a) PSTN/ISDN is originating network
b) PSTN/ISDN is transit network which makes an NP database query
c) PSTN/ISDN is transit network which does not make an NP database query

NOTE: The figure does not exclude the possibility that multiple networks make queries to NP databases.

Figure 4.2: Rerouteing of calls to ported mobile numbers by PSTN/ISDN networks

In this model responsibility is placed on the PSTN/ISDN to detect any calls to ported, mobile numbers, to retrieve routeing information for those calls, and to reroute them. The donor GSM network is not involved in call handling, and therefore has no responsibilities in this respect. The recipient GSM network has the responsibility to detect that calls are addressed to ported numbers (the recipient network would otherwise route those calls to the donor GSM network). The recipient GSM network shall also complete the calls, which involves retrieval of information from the location register, but this task is outside the scope of the present document.

4.2.3 Call dropback model

This subclause describes how a call to ported, mobile number routed through the PSTN/ISDN, would be handled according to the call dropback model.

The PSTN/ISDN routes the call to the donor GSM network. It provides, with the call, an indication that it is capable of handling a call dropback. The donor GSM network detects that number portability has been applied, consults the NP database, and retrieves routeing information for the call. The donor GSM network then releases the call back to the PSTN/ISDN with the routeing information. The donor GSM network knows that the PSTN/ISDN can handle call dropback because an indication was provided. On reception of the release message with the routeing information the PSTN/ISDN reroutes the call to the recipient GSM network. The model is illustrated in Figure 4.3 (for simplicity it is again assumed that the mobile user is roaming in the home network).

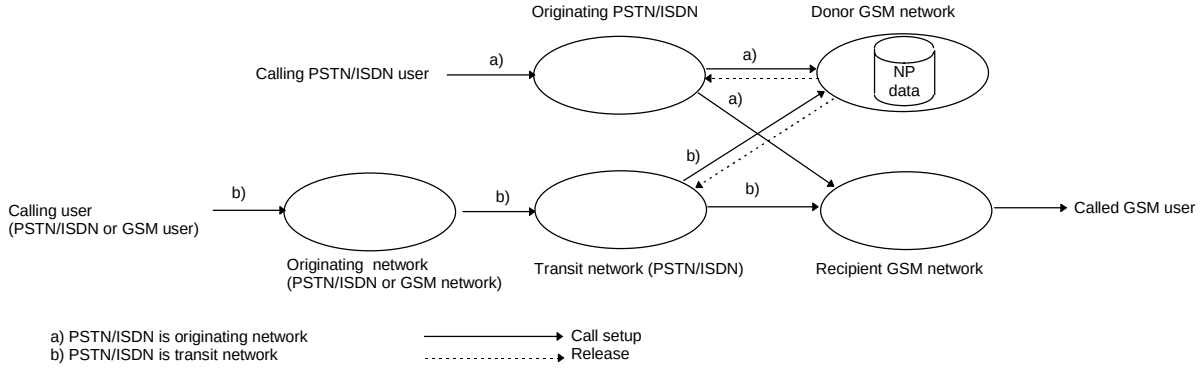


Figure 4.3

Depending on the network capability the call may be released back to the transit network or even further, i.e. to the originating network.

The originating network may be a GSM network. This would mean that a donor GSM network releases a call back through a transit PSTN/ISDN network to an originating GSM network. The originating GSM network would reroute the call with the routeing information that was provided with the call by the donor GSM network. In the present document we assume that such a call dropback would take place similar as between a transit PSTN/ISDN and an originating PSTN/ISDN.

In this model responsibility is placed on the donor GSM network to detect that the call involves a ported number. The donor GSM network further has the responsibility to retrieve routeing information that tells the PSTN/ISDN how to reroute the call, and to release the call back to the PSTN/ISDN with the routeing information. The PSTN/ISDN has the responsibility to detect that the release message concerns a call dropback, and to reroute the call according to routeing information provided by the donor GSM network. The recipient GSM network has the responsibility to detect that the call is addressed to a ported number (the recipient network would otherwise route the calls to the donor GSM network). The recipient GSM network shall also complete the calls, which involves retrieval of information from the location register, but this task is outside the scope of the present document.

4.2.4 Query on Release model

This subclause describes how a call to ported, mobile number routed through the PSTN/ISDN, would be handled according to the query on release model.

The PSTN/ISDN routes the call to the donor GSM network. It provides, with the call, an indication that it is capable of doing a query on release. The donor GSM network detects that number portability has been applied. The donor GSM network then releases the call back to the PSTN/ISDN with an indication that the call involves a ported, mobile number. The donor GSM network knows that the PSTN/ISDN is capable of query on release because an indication was provided earlier. On reception of the release message the PSTN/ISDN reroutes the call to the recipient GSM network. The model is illustrated in Figure 4.4 (for simplicity it is again assumed that the mobile user is roaming in the home network).

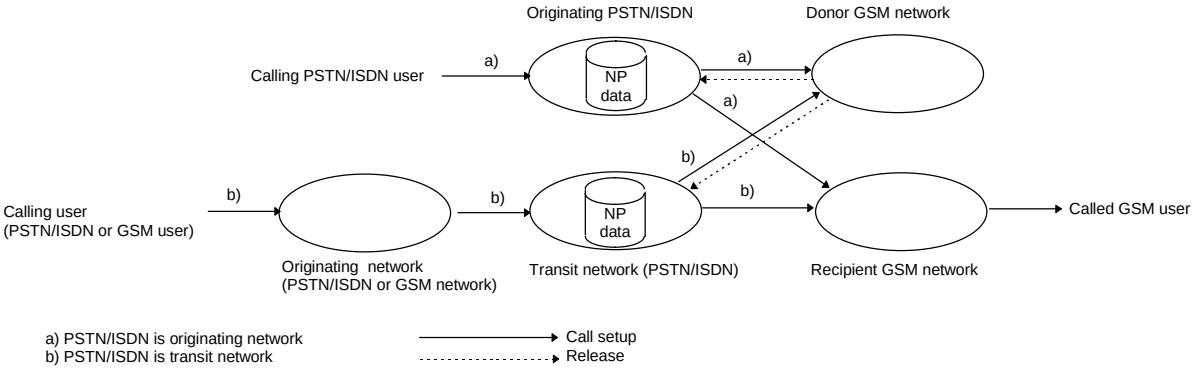


Figure 4.4

Depending on the network capability the call may be released back to the transit network or even further, i.e. to the originating network.

The originating network may be a GSM network. This would mean that a donor GSM network releases a call back through a transit PSTN/ISDN network to an originating GSM network. The originating GSM network would reroute the call with routeing information obtained by querying an NP database. In the present document we assume that such a query on release procedure would take place similar as between a transit PSTN/ISDN and an originating PSTN/ISDN.

In this model responsibility is placed on the donor GSM network to detect that the call involves a ported number. The donor GSM network further has the responsibility to release the call back to the PSTN/ISDN with an indication that it concerns a call to a ported number. The PSTN/ISDN has the responsibility to detect that the release message concerns a request for query on release, to retrieve routeing information from the NP database, and to reroute the call. The recipient GSM network has the responsibility to detect that the call is addressed to a ported number (the recipient network would otherwise route the call to the donor GSM network). The recipient GSM network shall also complete the calls, which involves retrieval of information from the location register, but this task is outside the scope of the present document.

4.2.5 Discussion

4.2.5.1 Comparison of Models with respect to Operator Responsibilities

Comparing the various network models it can be seen that at the one end of the spectrum in the onward routeing model (the situation described in subclause 4.1) the GSM network handles the number portability all by at itself, whereas at the other end of the spectrum in the all call query model the PSTN/ISDN handles the routeing of calls towards the recipient GSM network. Going from onward routeing, to call dropback, to query on release, to all call query responsibilities move from the GSM network to the PSTN/ISDN network.

Routeing of calls towards the recipient GSM network is a function that the transit or originating PSTN/ISDN network can offer to the GSM networks. It will depend on agreement at national level between GSM and PSTN/ISDN operators, and/or on the regulatory environment whether the GSM networks make use of this function. Nonetheless the standards should support that PSTN/ISDN networks can offer such a function.

Considering that GSM networks apply an onward routeing model, the all call query model may be used at the same time in PSTN/ISDN networks without any problems. The use of call dropback or query on release models require agreement with the GSM network that it will not apply onward routeing. PSTN/ISDN networks indicate to the GSM networks via an indication in the forward direction if they support the query on release or call dropback.

4.2.5.2 Access of PSTN/ISDN to Mobile Number Portability Data

The query on release and all call query model require that number portability data for mobile numbers has to be available to PSTN/ISDN networks. The PSTN/ISDN network operators can store a copy of the number portability data for mobile numbers in the databases already available for service provider portability for geographic numbers.

To share number portability data for mobile numbers with the PSTN/ISDN network operators the GSM operators can use an administrative interface. The administrative procedures are outside the scope of the present document.

4.3 PSTN/ISDN-GSM network interface

4.3.1 Backward direction

In the call dropback model routeing information is sent in the backward direction with a release message from the GSM network to the PSTN/ISDN. The routeing information could be conveyed in various formats described in (TR 101 122). The PSTN/ISDN network operator and GSM network operator need to agree in which format routeing information should be transferred.

In the query on release model an indication is sent in the backward direction with a release message from the GSM network to the PSTN/ISDN. This indication tells that the call involves a ported mobile number.

4.3.2 Forward direction

In the all call query, call dropback, and query on release models the PSTN/ISDN reroutes the call. For this purpose, routeing information is sent with the call in the forward direction. For the call dropback and query on release models an indication is also sent with the call in the forward direction which tells that dropback or query on release is supported.

The routeing information of the PSTN/ISDN does not have much use in the recipient GSM network, as the call enters the GSM network at the GMSC, and the further routeing of the call depends on the routeing information (MSRN) that the GMSC retrieves from the HLR/VLR. To allow for independence of the PSTN/ISDN network operators and the GSM network operators, the routeing information may not be needed to be transferred to the recipient GSM network. Independence of number portability solutions for PSTN/ISDN and GSM networks also means that the networks can follow separate evolution paths. The routeing number obtained by the PSTN/ISDN may be useful to GSM networks if it would be structured such that it can be used to route immediately to the correct HLR.

Consequently calls to ported mobile numbers are transferred as ordinary calls across the PSTN/ISDN-GSM network interface , but an indication may be provided to the recipient GSM network that the call is to a ported number.

5 Non-circuit related signalling

5.1 General description

In GSM the MAP protocol is used to retrieve information for routeing of calls or short messages. MAP messages are carried by the SCCP layer. In cases where one GSM network retrieves information from another GSM network, MAP messages are sent between GSM networks. PSTN/ISDN networks may be used as transit networks between the GSM networks, and may therefore transport SCCP messages, containing MAP messages, for the GSM (although this is not generally the case).

In this respect two GSM features, the Support of Optimal Routeing (SOR) and the mobile-terminated Short Message Service (MT-SMS), are of particular interest. The MAP messages for SOR and MT-SMS are addressed from the originating GSM network to the HLR in the recipient GSM network. For the destination of the MAP messages the mobile number is used as address. The mobile number is also used for routing towards the destination of the SCCP message which carries the MAP message. Figure 5.1 shows MT-SMS as an example.

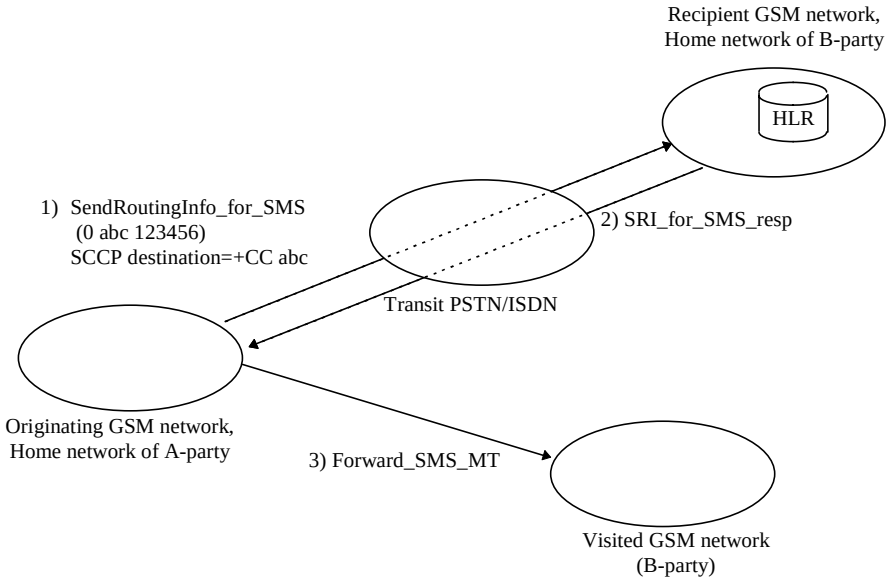


Figure 5.1: Exchange of MAP messages for MT-SMS

The introduction of MNP causes the addressing of these SCCP messages to become incorrect. Therefore in GSM networks a Signalling Relay function is introduced (SMG12 Tdoc 98S455). The Signalling Relay function intercepts the SCCP messages, and modifies the destination of the SCCP messages.

The format of the destination address of the SCCP messages, used by the Signalling Relay function, affects the PSTN/ISDN transit networks, because the PSTN/ISDN transit networks have to route the SCCP messages on the destination address. The routeing of SCCP messages, in which DNs are used as destination address is also related with the provisioning of supplementary services based on non-circuit related signalling, such as CCBS, CCNR, after the introduction of number portability. Solutions in the PSTN/ISDN for these supplementary services for number portability should be aligned with the solutions in GSM networks applied in the Signalling Relay function.

5.2 Network architecture

5.2.1 Introduction

The routeing of SCCP messages from the mobile network follows the following scenario. In this scenario, several options can be chosen. These options will be discussed in the following paragraphs.

SCCP messages, carrying MAP messages, directed to the HLR in the home network of the B-party, may be routed as before the introduction of number portability, i.e. to the donor GSM network. This is the case for all not-mobile originating messages, and all international incoming messages. In those cases the SCCP messages are send to the home network (i.e. the donor network), and there the messages are intercepted by the Signalling Relay. The signalling relay modifies the destination of the SCCP message to allow the SCCP messages to be rerouted. To this purpose the Signalling Relay of the donor GSM network has access to a database containing routeing information for ported mobile numbers. The SCCP messages are subsequently routed through the transit PSTN/ISDN network to the recipient GSM network.

5.2.2 Addressing scenarios

The Signalling Relay of the donor network can modify the destination of the SCCP message to indicate:

1) a Signalling Relay in the recipient network;

2) an HLR in the recipient network;

3) the transit PSTN/ISDN.

In case 1 the Signalling Relay in the recipient network further determines the destination (i.e. HLR) of the SCCP message. If transit PSTN/ISDN networks are involved in the routeing of the message from the donor GSM network to the recipient GSM network, the PSTN/ISDN networks have to handle the routeing information provided by the donor GSM network. The implications of this are discussed in subclause 5.2.3.

In case 2 the Signalling Relay in the donor GSM network indicates the final destination of the SCCP message. In comparison with case 1, the recipient GSM network needs to provide more detailed information about its imported customers for the number portability database in the donor GSM network. If transit PSTN/ISDN networks are involved in the routeing of the message from the donor GSM network to the recipient GSM network, the PSTN/ISDN networks have to handle the routeing information provided by the donor GSM network. The implications of this are discussed in subclause 5.2.3. From the point of view of the transit PSTN/ISDN case 1 and 2 are comparable.

In case 3 the routeing information retrieved in the donor GSM network is only used for routeing inside the GSM network. In this case the transit PSTN/ISDN network retrieves its own routeing information. This means that it has to be able to perform a function similar to the Signalling Relay of the donor GSM network.

For the provisioning of supplementary services based on non-circuit related signalling, such as CCBS, CCNR, after the introduction of number portability, similar mechanisms as used for SCCP messages from GSM networks may be employed. A solution for the PSTN/ISDN could be based on a Signalling Relay function.

5.2.3 Address formats for SCCP

Solutions where SCCP messages are routed between GSM networks through PSTN/ISDN transit networks on the routeing information provided by the GSM (case 1 and 2 of subclause 5.2.2), bring the implication that the PSTN/ISDN shall be able to handle the format in which the routeing information is provided. The addressing for SCCP in the PSTN/ISDN is then linked to the addressing in the GSM.

As a short term solution the Signalling Relay of the donor network could add a prefix to the SCCP destination address. This means that a concatenated address is used to provide the routeing information.

In the longer term a separated address approach may also be considered for SCCP messages, analogous to the separated address approach for routeing of calls to ported numbers. The benefit of such an approach would be the increased address space, allowing more generically a numbering plan for routeing numbers independent from the numbering plan for directory numbers. This would require a change in the SCCP protocol.

Another possibility would be that the directory number is transferred only at the application level and not at the SCCP level. In this case the SCCP messages only contain a routeing number.

In any solution however where the directory number is transferred, the recipient GSM network can obtain the DN (MSISDN) from the message.

6 Number portability databases

In the context of interaction between PSTN/ISDN networks and GSM networks four different sets of number portability data can be distinguished. On the one hand there is the distinction between number portability data for routeing of SCCP messages and for routeing of calls. On the other hand there is the distinction between the PSTN/ISDN and GSM domains. These two distinctions lead to potentially four different sets of number portability data.

Depending on the network architecture options that are chosen, databases may be shared. In this case it is useful to have the same address formats in the database for the sets of number portability data that are to be shared.

The different databases for the different sets of number portability data could use the same, generic mechanisms to access the data, if databases are consulted that are external to the exchanges. One possibility for a generic access to the database is the use of IN techniques. In particular the nodes that reroute the SCCP messages, e.g. the Signalling Relay function of the GSM networks, could be enhanced with SSP functionality, allowing similar access to IN databases as for IN-based number portability solutions for PSTN/ISDN networks (EG 201 367).

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

Tdoc 98S455: "Solutions for supporting Mobile Number Portability".

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History

Document history		
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