

Mobile Number Portability

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Foreword

This NICC Document (ND) has been produced by NICC Naming Numbering and Addressing Working Group

Introduction.

Under OFCOM regulatory General condition 18 [ref] , Communication Providers are required to provide number portability. The present document sets out the interoperability requirements for the provision of mobile number portability.

1 Scope

A feasibility study on Mobile Number Portability (MNP) [1] produced by the UK telecommunications industry concluded that of the proposed technical solutions the method based on Signalling Relay Functionality (SRF) was preferred for the UK. This is a non-circuit related signalling technique and is a different approach to that taken for fixed number portability.

The purpose of this document is to describe the operation of UK MNP based on a SRF implementation.

This service description places requirements on participating MNP originating, transit and recipient networks. The service description does not place any requirements on the implementation adopted within a participating MNP network except to the extent that the implementation supports the requirements of the interconnect.

The MNP service covers numbers allocated to GSM 900, GSM 1800 and, 3G UMTS network operators as well as the numbers allocated to MVNOs, Wi-Fi providers and DECT guard-band communications providers.

Items not covered by this service description are:

- Billing and administration system requirements
- Porting process requirements
- CDR transfer process requirements
- Roaming information transfer requirements

This service description deals only with mobile terminating transactions. This is because mobile originated transactions initiated by the ported subscriber do not involve the ported number.

This service description does not deal with transactions based on International Mobile Subscriber Identities (IMSI) since IMSIs are not ported and once allocated by the Recipient network operate as normal. An example IMSI based transaction is Location Updating.

This service description describes a model for the implementation of MNP using generic terms to denote functionality in Qualifying Networks in order to ease understanding.

The implementation of functional entities described in section 5 of this document is a matter for the Qualifying Networks and is not mandated.

2 References

2.1 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] MNPTG CP(97)022 MNPTG Interim Report Issue 1, MNPTG.
- [2] ND1107:2001/10 PNO ISC/INFO/007 - UK Interconnect Use of SCCP
- [3] The National Telephony Numbering Scheme (<http://www.ofcom.org.uk/telecoms/ioi/numbers/>)

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Donor network : The network losing the terminating customer and ported directory number in the Porting process.

Global Title : A form of SCCP addressing.

Intermediate Routeing Number : A number used to force a ported call into the recipient network for call processing treatment. This number is conveyed in the MSRN field within the MAP layer.

Interrogating Network : Network that interrogates the SRF to determine the routeing of a Call or message

MNP Solution : Standard method by which the UK industry manages and operates services for mobile subscriptions with ported numbers.

Native number : A number inside the NNG range allocated to the operator from Ofcom

Originating network : The network originating a call or service request.

Ported Call : A call to a ported number.

Porting data : The data in the network responsible for routeing signals to the appropriate recipient network.

Ported Number : The directory number originally allocated by the Range Holding network to the ported subscriber.

Porting process : The process of moving a number from the donor network/SP to the recipient network/SP.

Qualifying Network : A network that has requested portability from another network and is able to provide portability to that network.

Range Holding network : The holder of the NNG range to which a ported directory number belongs

Recipient network : The network receiving a new subscription with a ported number.

Service Provider : The entity contracted to provide retail air time to the subscriber.

Subscriber : User of a mobile phone responsible for payment of the subscription account.

3.2 Abbreviations

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

A Party	Calling party
B Party	Called party
CAMEL	Customised Applications for Mobile network Enhanced Logic
CAP	CAMEL Application Part
CCBS	Completion of Calls to Busy Subscribers
CDR	Call Detail Record
CdPA	SCCP Called Party Address
CgPA	SCCP Calling Party Address
CND	Calling Number Display
DECT	Digital Enhanced Cordless Telecommunications
GMSC	Gateway MSC
HLR	Home Location Register
IMSI	International Mobile Subscriber Identity
IRN	Intermediate Routeing Number
MAP	Mobile Application Part
MNP	Mobile Number Portability
MRC	MNP Rerouteing Code
MSISDN	Mobile Subscriber ISDN Number
MSRN	Mobile Subscriber Roaming Number
MVNO	Mobile Virtual Network Provider
NICC	Network Interoperability Consultative Committee
NNG	National Number Group
OR	Optimal Routeing
SCCP	Signalling Connection Control Part
SIM	Subscriber Identity Module
SMS	Short Message Service
SRF	Signalling Relay Function
SRI	MAP Send Routeing Information
SRI-SM	MAP Send Routeing Information for Short Message
TSG	Technical Steering Group
UMTS	Universal Mobile Telecommunications System
Wi-Fi	Wireless Fidelity

4 Service Description - Mobile Number Portability

MNP is the ability for a mobile subscriber to change network operator whilst retaining their original directory number for each service used in the new network. The move may, or may not, include a change in service provider.

MNP is not service portability, i.e. if a service supported in the old network is not available on the new network then number porting mechanisms will not provide that service for the porting subscriber.

Number porting involving GSM or UMTS subscriptions does not include porting the IMSI. When porting to a GSM or UMTS subscription a new SIM and IMSI are provided by the recipient network.

The service described in this specification relies on the SRF which is populated with data regarding ported numbers. This is usually populated with data on exported and imported numbers for the CP's own network.

5 MNP Solution – Signalling Relay Function

This section uses generic terms to denote functionality in Qualifying Networks. The implementation of functional entities described in this section is a matter for the Qualifying Networks in order to meet the MNP Interface requirements in section 7.

5.1 Background – Mobile terminated calls

In mobile networks, calls cannot be delivered to mobile subscribers simply by means of analysing the digits dialled because the mobile can be anywhere in the mobile network or even roaming. To deliver a call a Routeing Enquiry is made to a Home Location Register (HLR) to determine where the called subscriber is located and to obtain a routeing number, see Figure 1. The Routeing Enquiry is a C7 based signal. The routeing number is temporarily allocated to the called subscriber and relates to the visited switch.

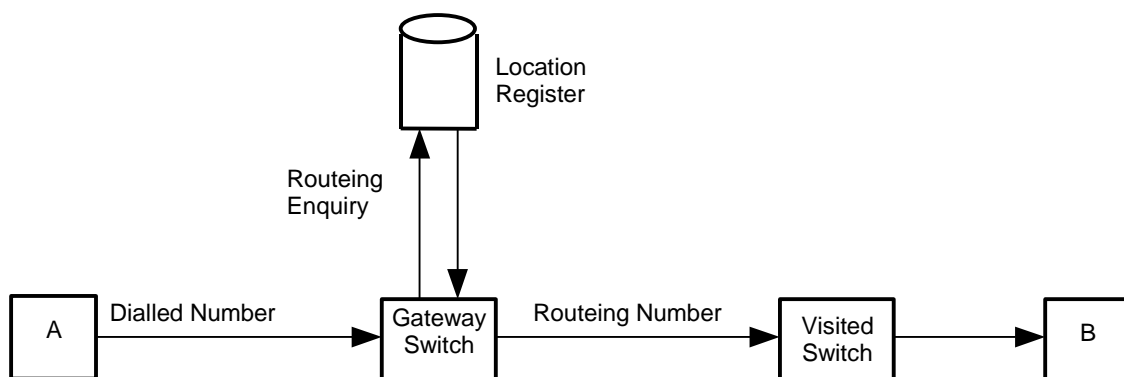


Figure 1 - Generic Mobile Terminated Call.

5.2 Signalling relay principle

The signalling relay principle takes advantage of the routing enquiry signal to provide number portability. The principle is that the Interrogating Network sends the routing enquiry signal or other signal addressed to a ported number to the appropriate recipient network for treatment, see Figures 2, 3, 4 and 5. In this way the recipient network can provide the routing number or other result to complete the routing of the call or transaction.

Note : The figures below are largely logical diagrams only showing the source and the destination of signals not the physical path. Detailed call flows are given in Section 7.

A Signalling Relay Function (SRF) is required in the Interrogating mobile network to provide this functionality. The SRF shall include the functionality to:

1. Determine for which directory numbers relaying is applicable
2. Determine to which network relaying should be directed
3. Modify SCCP addressing to relay signals to the recipient network

The SRF is provisioned with at least the MSISDNs exported from the Rangeholder.

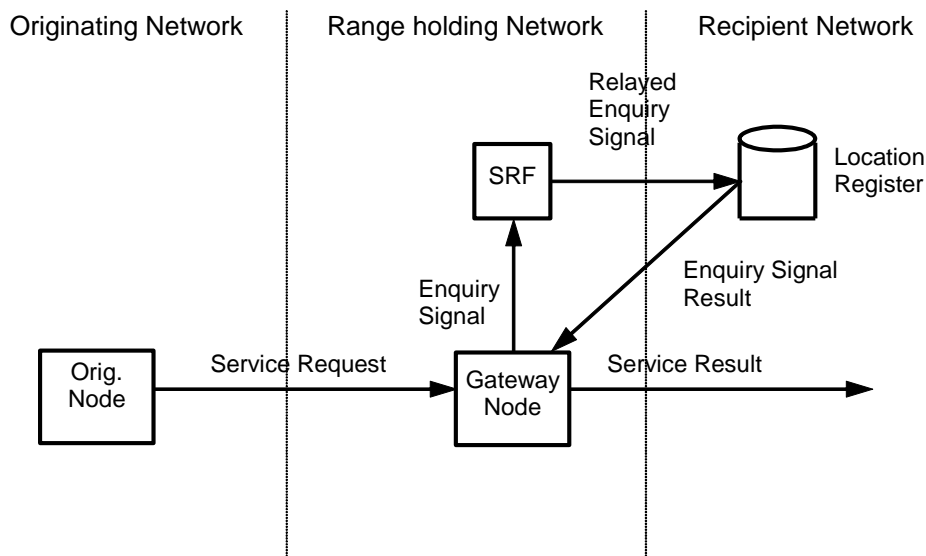


Figure 2 - Signaling Relay Operation - Circuit Related Call routing enquiry

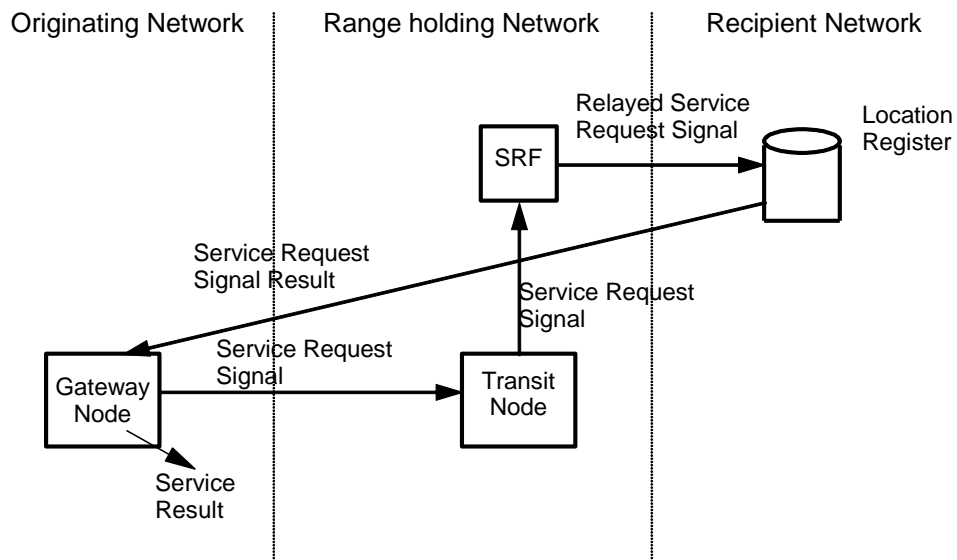


Figure 3 - Signaling Relay Operation - Signals other than circuit related call routing enquiries

5.3 Exception handling for circuit-switched calls

Call handling is achieved by sending an Intermediate Routing Number to the gateway node in the Interrogating network, as before, except that the SRF generates the enquiry result rather than the recipient network, see Figure 5. Once in the Recipient network, the call enters the standard routing enquiry stage.

This exception handling is only applicable to routing enquiries for circuit related calls. All other signals are relayed to the recipient location register function.

Figure 4 below shows the action of the handling for routing enquiries for circuit related calls that have entered the Range holding network operator from the originating network.

Figure 5 below shows the action for the routing of signals other than routing enquiries for circuit related calls.

Note : The figures below are logical diagrams only showing the source and the destination of signals not the physical path. The numbers on each signal indicate the sequence of signals.

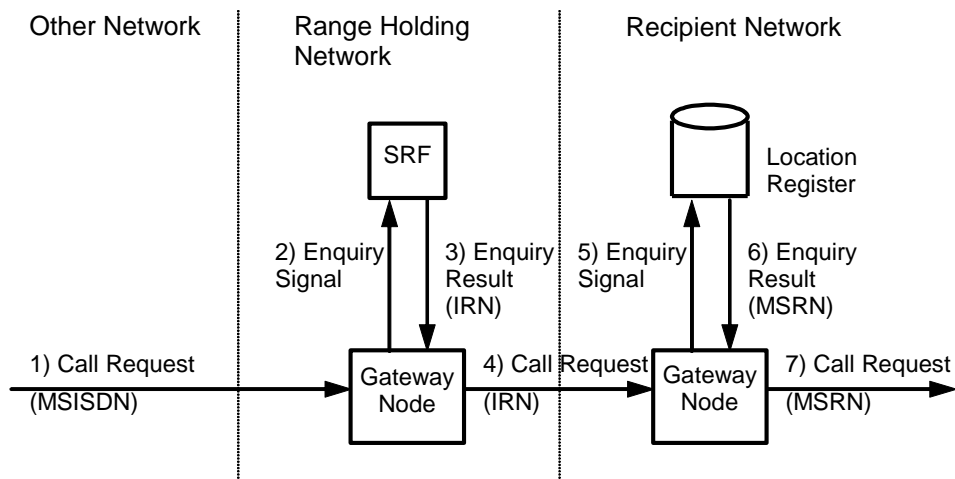


Figure 4 - Call Routed via range holder

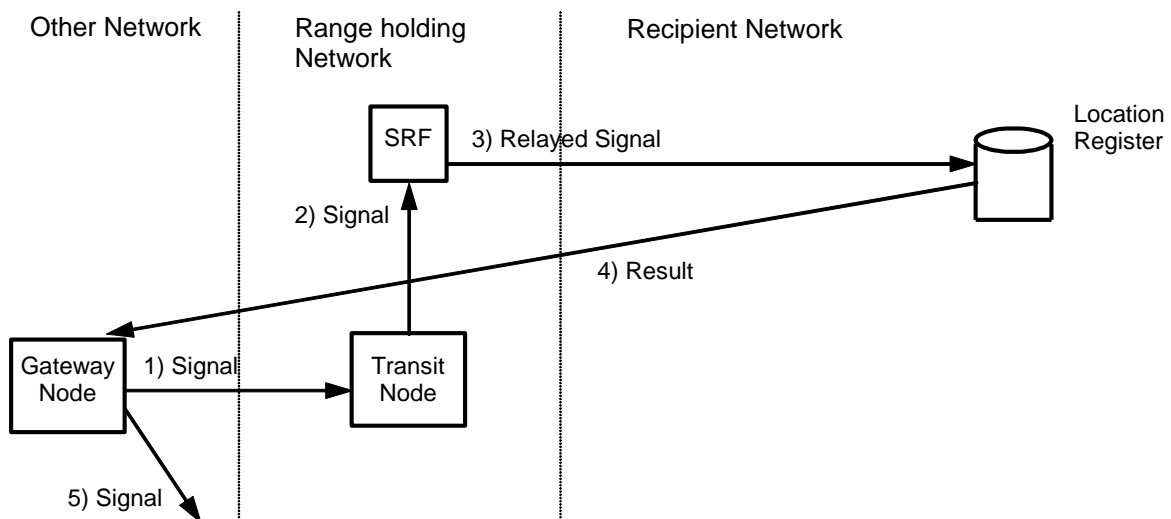


Figure 5 - Signals other than circuit related routing enquiries indirectly routed

Functionality is required in the Interrogating network to invoke circuit switched call handling at the appropriate times. The Interrogating network contains:

1. proprietary criteria defined by the Interrogating network for invoke proper call handling

2. functionality to determine which signals are applicable.
3. functionality to return an IRN for signals which are applicable.
4. Signalling Relay Functionality for signals which must be sent to the Recipient network.

If the Interrogating network is the Recipient network for the terminating number, the call is handled in a manner determined by the network. This is outside the scope of this specification.

6 MNP Interface Requirements

This section defines the MNP interface between Qualifying Networks and is a mandatory requirement for MNP.

6.1 Network Interfaces

A ported call uses a dialled directory number from the number range of a network but the call must be delivered to the Recipient network of the called subscriber. To support this requirement an MNP interface is required between the Interrogating and Recipient network. The interface may be direct or indirect (via a transit operator), therefore the mandatory requirements of the interface must be supported by Originating, Interrogating, Recipient and Transit networks, see Figure 6.

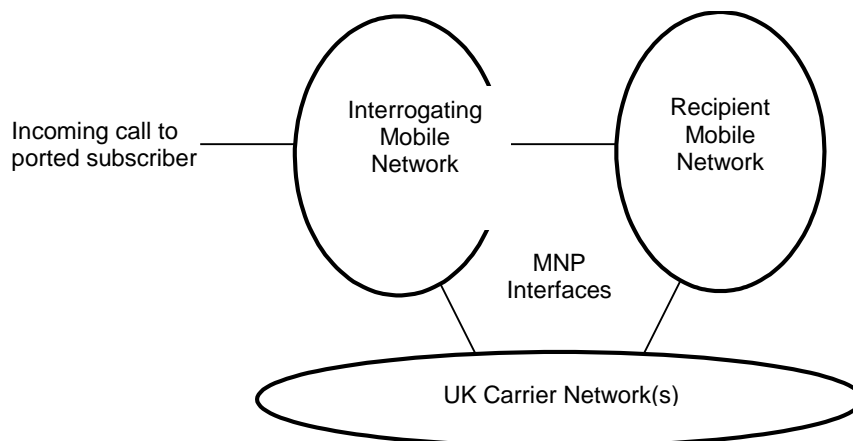


Figure 6 - MNP Interfaces.

6.2 Signalling Interfaces

6.2.1 Signalling operations affected by MNP

The signalling systems operating across the MNP interconnect shall be the C7 based Mobile Application Part and ISDN Supplementary Services ASEs as applicable. These application parts shall be supported by the C7 signalling layers, MTP, SCCP and TCAP.

The operations affected by MNP are those addressed at the SCCP layer on the MSISDN of a ported subscriber. The current standardised messages routed on MSISDN are shown in the table below:

Table 6.2.1.a - Operations subject to the MNP SRF

Operation	Name	Protocol	Exception handling applicable
sendRouteingInformation	SRI	MAP	Yes
sendRouteingInformation (OR)	SRI(with OR parameters)	MAP	No (NOTE)
sendRouteingInfoForSM	SRI-SM	MAP	No
setMessageWaitingData	SMWD	MAP	No
reportSM-DeliveryStatus	Report SM Delivery Status	MAP	No
CcbsRequest	CCBS Request	CCBS ASE	No
CcbsSuspension	CCBS Suspension	CCBS ASE	No
CcbsResume	CCBS Resume	CCBS ASE	No
CcbsCancel	CCBS Cancel	CCBS ASE	No
Other MSISDN based non circuit related signals destined for the HLR as defined by 3GPP	As defined in 3GPP TS29.002	MAP	No

NOTE: If optimal routing is not allowed, the Recipient network may either return an 'OR not allowed' error (in which case the call will be routed to the Range holding network) or (preferably) return an IRN in the MSRN field of the acknowledgement, thus causing the call to be routed directly to the recipient network. In order to allow OR the Range holding network should relay SRIs transparently to the recipient network.

Version differences of MAP operation shall be dealt with by MAP version negotiation mechanisms between the Interrogating node and the HLR (Recipient network). Since the SRF and the circuit switched interrogating node are in the same network the SRF shall recognise the SRI for circuit switched calls and handle it according to this specification.

6.2.2 MTP Addressing

Non circuit related messages routed from the interrogating network to Recipient networks should be addressed to a node which will perform Global Title Translation to determine the final destination of the message. In this way Interrogating networks will not require knowledge of all Recipient network HLRs.

6.2.3 SCCP Addressing

MAP operations are routed on Global Title in the SCCP layer. A re-routing code is required to relay the signal to the recipient network. This is inserted by the Interrogating network from the ported subscribers provisioned data. The SCCP Called Party Address is the modified field.

A standard signalling re-routeing number plan is required for SCCP interconnect to allow signal relaying, see following section. Where interconnect is achieved through transit networks the transit network is required to support the signalling re-routeing number plan. The addressing of SCCP messages between the Interrogating and recipient networks is as follows (please refer to [2] for details of SCCP parameters):

Table 6.2.3.a - MNP SCCP Addressing

Protocol Layer	Field	Number
MAP	MSISDN	7abc SN 447abc SN
SCCP	CdPA Address Indicator	RI=GT, GTI=0100, SSNI =1, PCI=0
SCCP	CdPA	SSN=6 (HLR) or 11 (ISDN ASE) TT=0, NPI=E164, NAI=International, GT=447XYZ abc SN
SCCP	CgPA	Originating Node Address

Responses to the relayed operations are addressed in the standard way using the received calling party address.

6.2.4 SCCP Number Plan for Signal Relaying

The SCCP MNP re-routeing number is defined as follows:

Table 6.2.4.a - MNP SCCP Called Party Address format

CC	MRC	abc	SN
----	-----	-----	----

Digit	Name	Value
CC	Country Code	44
MRC (NOTE 1)	MNP Re-routeing Code	7XYZ
Abc (NOTE 2)	NNG	ported number nng
SN	Subscriber Number	ported number

NOTE 1: The value of 'XYZ' is administered by Ofcom. For individual MRCs allocated to each mobile network operators, please refer to The National Telephony Numbering Scheme [3]

NOTE 2: The NNG will exclude the leading (mobile) service digit 7.

The Interrogating network shall ensure that the above addressing format is provided at interconnect interfaces.

6.2.5 IRN number plan for circuit switched call handling

The IRN is used for routing circuit switched calls from the Interrogating network to the Recipient network. At the Interrogating network it is carried in the MSRN field of the appropriate SRI response MAP message from the SRF to the Interrogating MSC. The format is the same as that described in Table 6.2.4.a above.

The IRN, when used in interconnect circuit-related signalling shall form of the called party address that is suited to the signalling system used on the interconnect, for example “07XYZ abc 123456”. The destination number used in interconnect circuit related signalling may also be formatted differently according to the relevant interconnect arrangements. The reasons for choosing one format or the other is outside the scope of this Specification.

6.3 Requirements on Qualifying Networks

6.3.1 Originating network requirements

Unless the network is also the range holding or recipient network, the Originating network shall route circuit switched calls to the Range Holding network using the MSISDN.

Non circuit related signalling shall be routed to the Range holder using the MSISDN.

6.3.2 Range Holding network requirements

Range Holding networks shall :

1. Relay the following signals addressed to a ported number as illustrated in section 6.2.1 towards the Recipient network using the MNP SCCP numbering plan specified in sections 6.2.3 and 6.2.4:
 - MAP SendRoutingInfoforSM
 - MAP ReportSM-DeliveryStatus
 - MAP SetMessageWaitingData
 - All CAP signals

Other signals addressed to a ported number may be blocked. At the request of the Recipient Network, the Range Holding network shall relay signals addressed to ported numbers for specific MAP Operation Codes and Calling Global Titles.

and

2. Route circuit switched calls arriving in the Range Holding network towards the Recipient network using the MNP IRN numbering plan specified in section 6.2.5. The range holding network shall not change any signalling parameters in the circuit related call control signalling (e.g. UK ISUP). The only change shall be that the IRN shall replace the MSISDN as the destination number. Where the incoming and outgoing signalling systems are different the appropriate interworking specification rules shall be applied.

For non-ported numbers, the network shall receive incoming calls and messages using the MSISDN in the SCCP Global Title (for non-circuit related services) or the Called party in ISUP signalling (for circuit switched calls).

6.3.3 Recipient network requirements

The recipient network shall receive incoming calls and messages for imported numbers using the IRN in the appropriate signalling fields.

The following rules apply in the recipient network.

- The call shall never be routed out of the recipient network using porting codes. This is to prevent calls endlessly being routed between networks if the SRF data in different networks are not in step. Where a call is received with the Recipient network's IRN (or equivalent destination group) but the number is not hosted on the Recipient network, the call shall be failed.
- No signalling message received using the IRN as SCCP Global Title should be rerouted. This is to prevent messages being routed endlessly between networks. Where a message is received with the Recipient network's IRN but the number is not hosted on the Recipient network, the message shall be rejected.
- The signalling for a mobile originating or diverted voice call from a mobile with an imported MSISDN shall be the same as the signalling from a mobile with a non-porting MSISDN. This is to make sure that the porting of mobile numbers has no impact on the downstream operators handling the calls.

6.3.4 Transit network requirements

Networks providing SCCP transit functionality between Interrogating and Recipient networks are required to support the MNP re-routeing numbering plan defined in section 6.2.3 and 6.2.4

Networks providing call routeing between Qualifying Networks shall support routeing of IRN numbers defined in section 6.2.5. Circuit switched calls may also be routed using any agreed called party address. However, this is the subject of commercial negotiation and therefore outside the scope of this specification.

6.4 Requirements on SRF

The table below shows the SRF actions on receiving SRI from GMSC (or GMSC type interrogating node) and a non-call related message (e.g. SRI for SMS from an SMS – SC)

Table 6.4.a SRF requirements

	SRI for Circuit switch calls (e.g. Voice) from own GMSC	Non circuit related signalling
Non-Ported MSISDN in own network number range	Route SRI to HLR	Route to HLR
Ported In MSISDN	Route SRI to HLR	Route to HLR
Ported Out MSISDN	Return IRN of recipient network as MSRN in SRI	Route to Recipient Network (NOTE 1)
MSISDN without individual entry in SRF in own network number range (NOTE 2)	Route SRI to HLR	Route to HLR

NOTE 1 - if the incoming signal had Called party address GT=IRN the signal shall not be routed. This is to prevent messages being routed endlessly in loops due to data mismatches in different networks.

NOTE 2 – This case is identified by the range in which the called MSISDN resides rather than an individual entry.

6.5 Requirements on GMSC

For voice and circuit switched calls the interrogation of the SRF is carried out in the Range holding network. The actions required are described in the following table.

Table 6.5.a GMSC requirements

	Terminating number is owned by interrogating network and SRI result is a real MSRN	Terminating number is not owned by interrogating network.
Mobile originating call to UK MSISDN.	Route according to MSRN	Route to Recipient operator using the IRN (for ported out numbers) or to range holder using the MSISDN (for numbers unknown to the operator)
Call from another network to an MSISDN in Network's own range (no IRN)	Route according to MSRN	Route to Recipient operator using the IRN for exported numbers (ported out number call case)
Call from another network using own network's IRN.	Route according to MSRN	Do not route as this situation represents a mismatch of provisioned porting information between SRFs!

7 Call Flows

The diagrams in the following sections describe only the relevant nodes, Messages and Parameters at the various protocol layers for each scenario.

7.1 Voice call: basic signalling relay operation

The following call flow is included for information to illustrate the handling of a non-ported number with the SRF in operation in the Range Holding network.

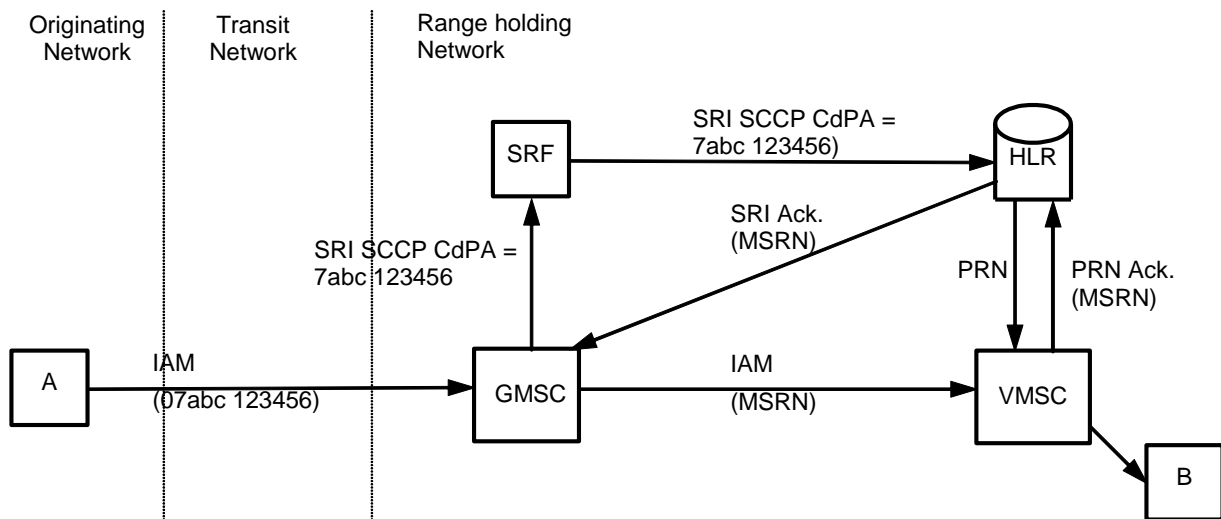


Figure 7 - Signalling Relay Operation - Non-Ported Number

7.2 Call to Ported number via Range holder

The following call flow illustrates the handling of a ported number with the SRF in operation in the Range Holding network.

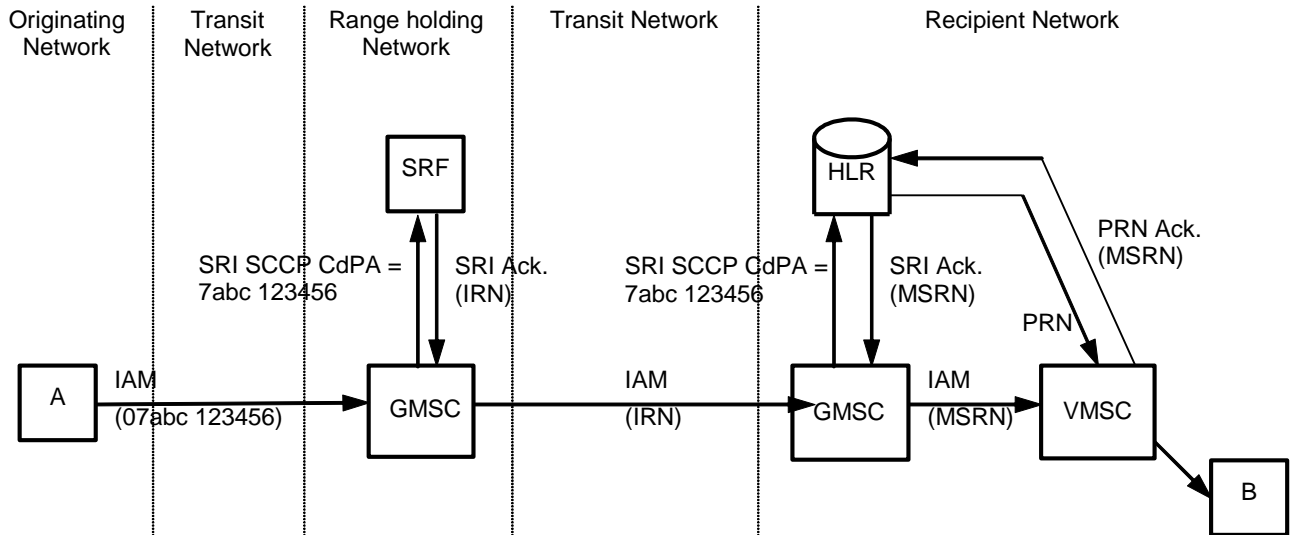


Figure 8 – Call to ported number via Range Holder.

7.3 Optimal routeing

The following message flow illustrates the handling of a circuit switched call to a roaming handset with the SRF in operation in the Range Holding network.

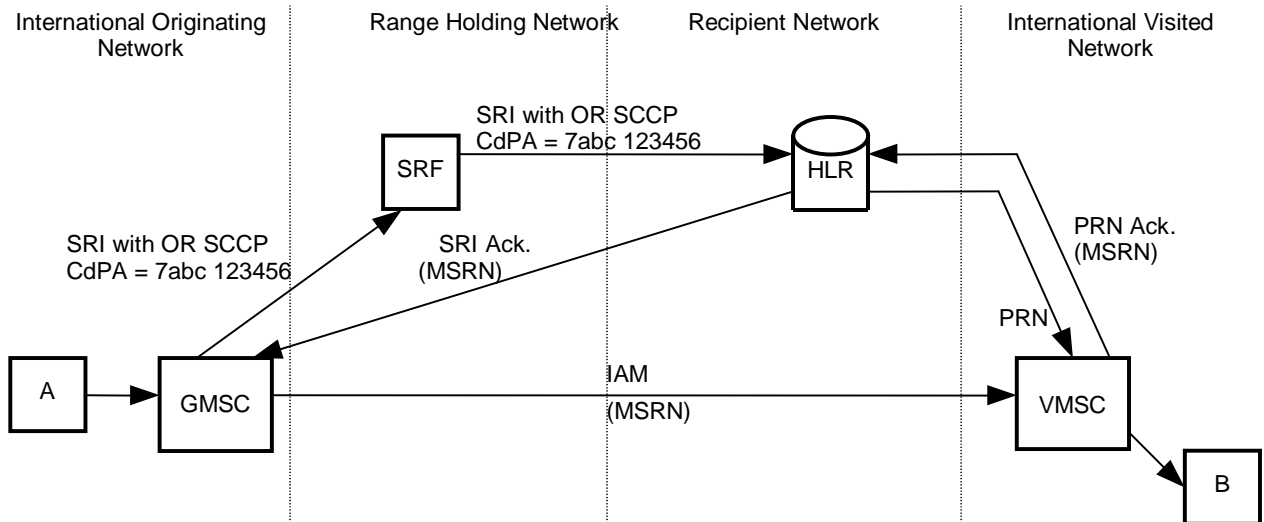


Figure 9 – Signalling Relay Interaction with Optimal Routeing

7.4 Range holding network originated call

This call case exists when the originating mobile network is also the rangeholder. The call to the ported number is routed using the IRN.

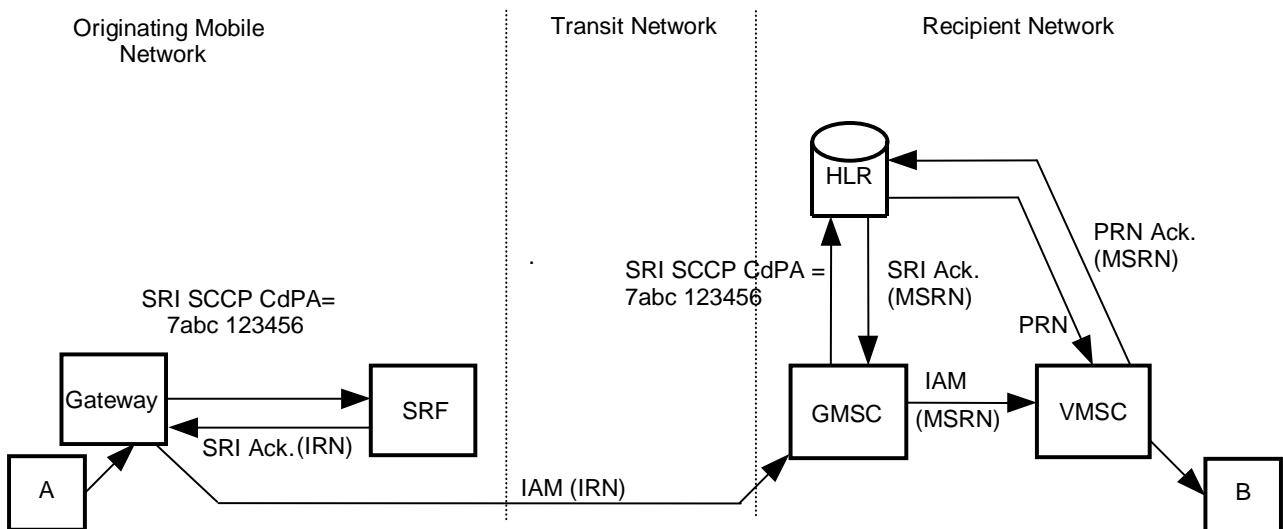


Figure 10 – Mobile Originated call

7.5 SMS Delivery

In order to illustrate the most complex scenario conceivable, the message flow below assumes that SMS conveyance is in operation between the Originating and Range holding networks. Figure 11 illustrates the case where the Originating network is not the rangeholder, while Figure 12 illustrates the case where the Originating network is the rangeholder.

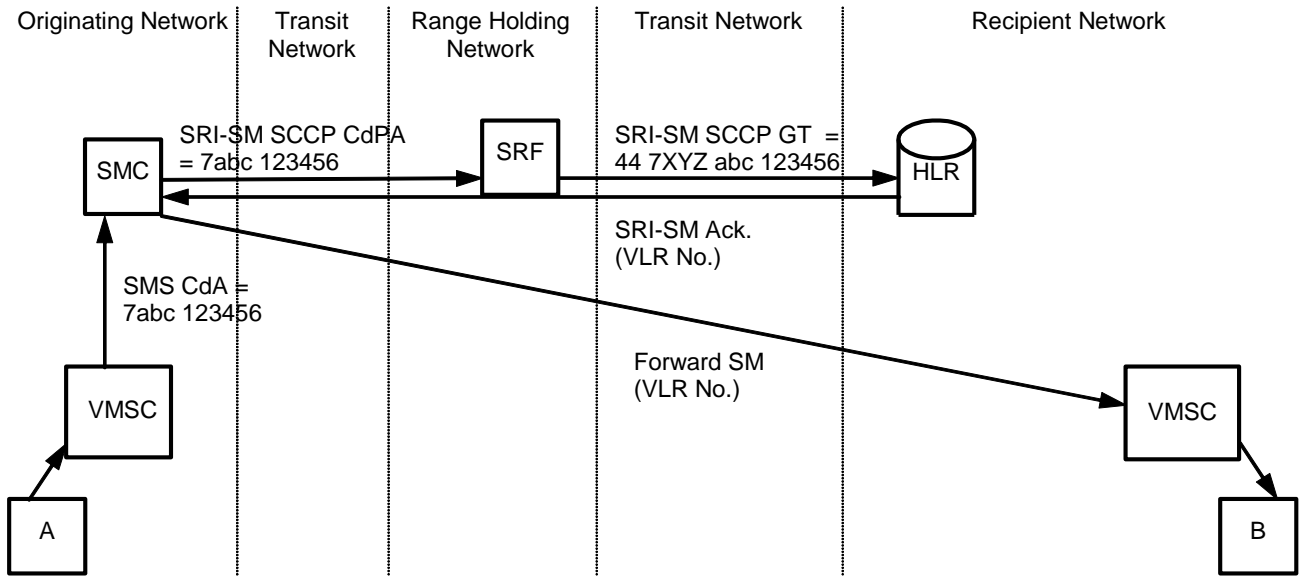


Figure 11 – SMS separate originating and rangeholding networks

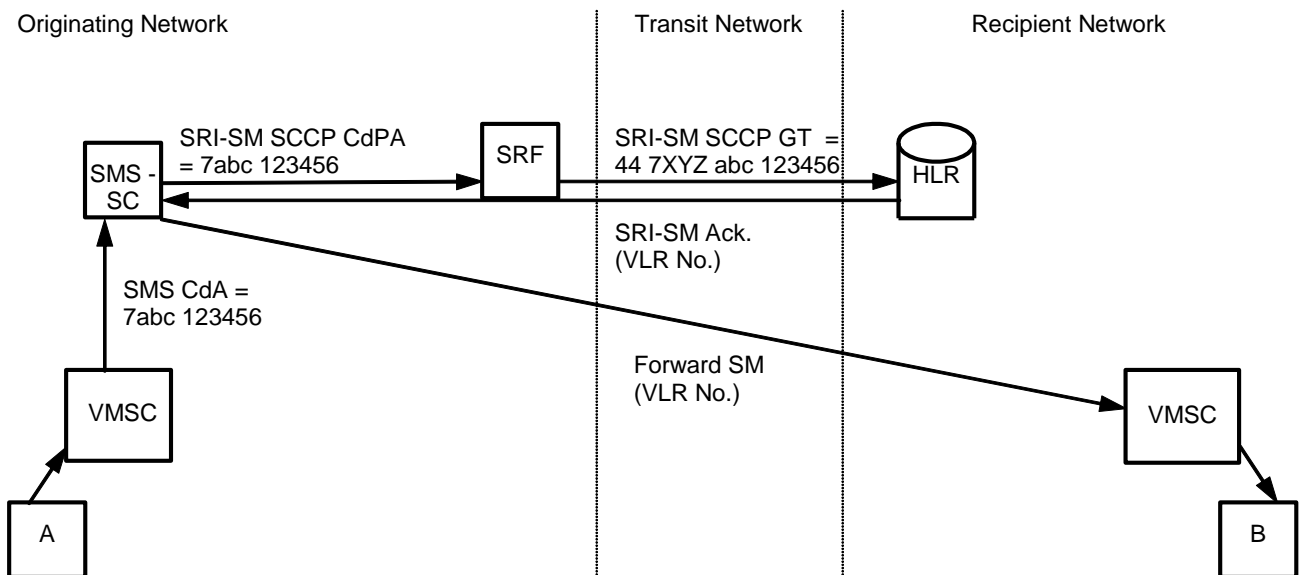


Figure 12 - SMS from rangeholding network

7.6 SMS Message Waiting

In order to illustrate the most complex scenario conceivable, the message flow below assumes that SMS conveyance is in operation between the Originating and Range Holding networks. Figure 13 illustrates the case where the Originating network is not the rangeholder, while Figure 14 illustrates the case where the Originating network is the rangeholder.

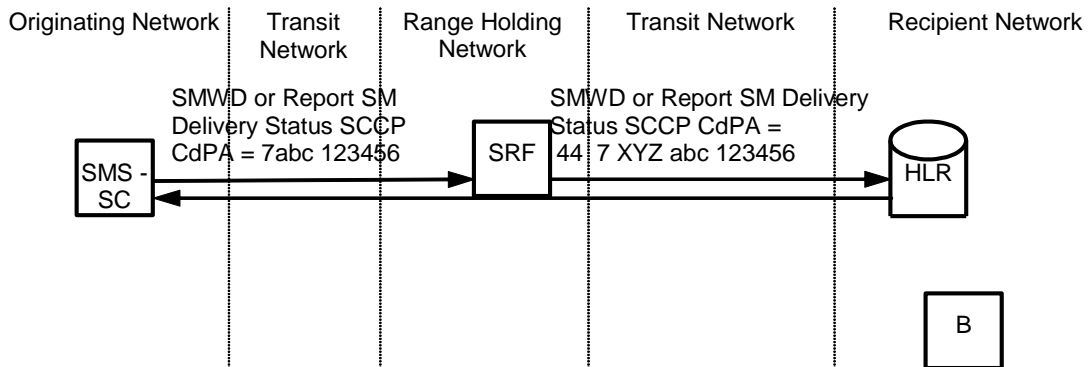


Figure 13 – SMS set message waiting – originating and rangeholder are different networks

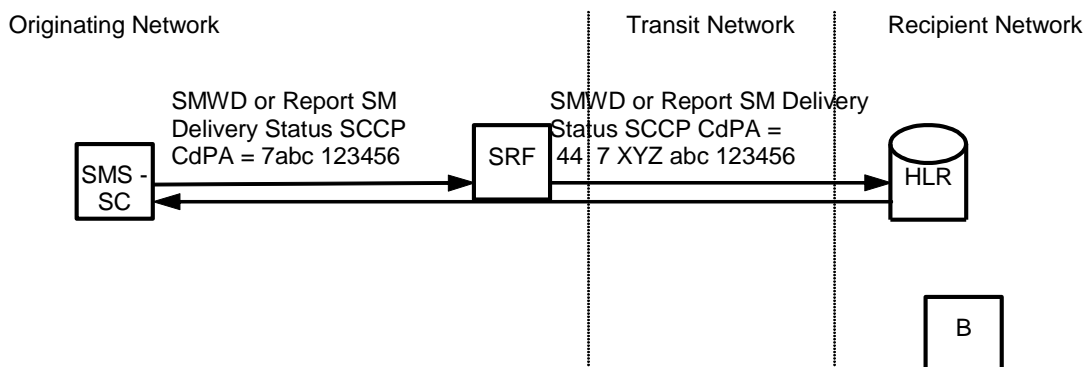


Figure 14 – SMS set message waiting – originating and rangeholder are same network

7.7 CCBS

The Activation, Suspension and Resume signals which are transferred from the Originating side to the Recipient network are relayed by the SRF. The Remote User Free signal, which is transferred in the opposite direction, is sent direct from Recipient to Originating networks using the C7 SCCP calling party address provided earlier. The final CCBS call is handled as another ported call.

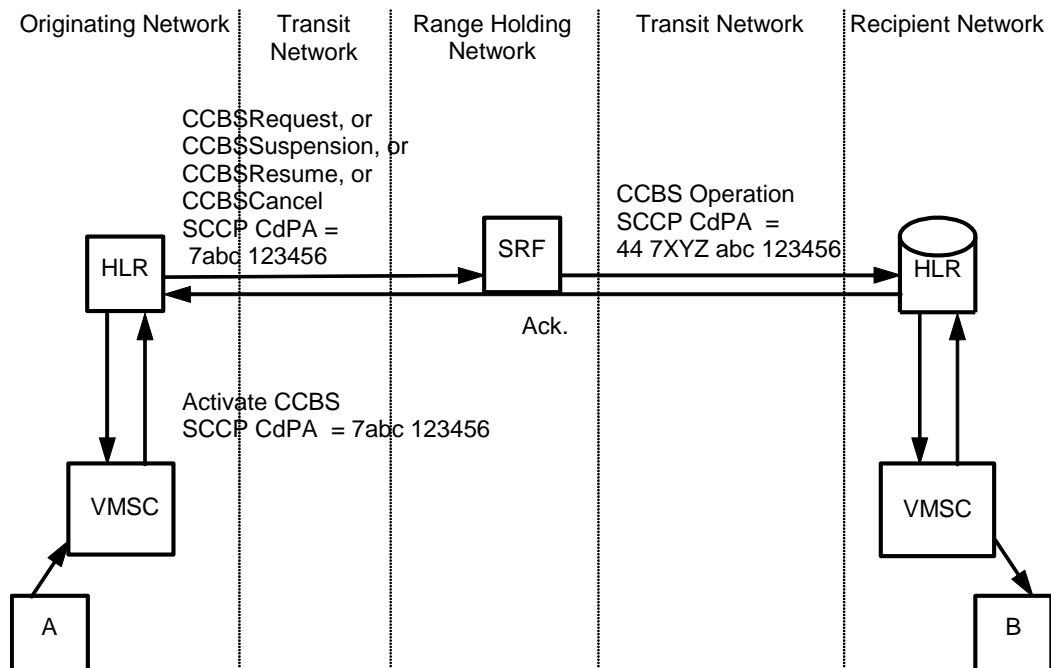


Figure 15 – Activation/Suspension/Resume/Cancel CCBS on ported subscriber – originating and range holding networks separate

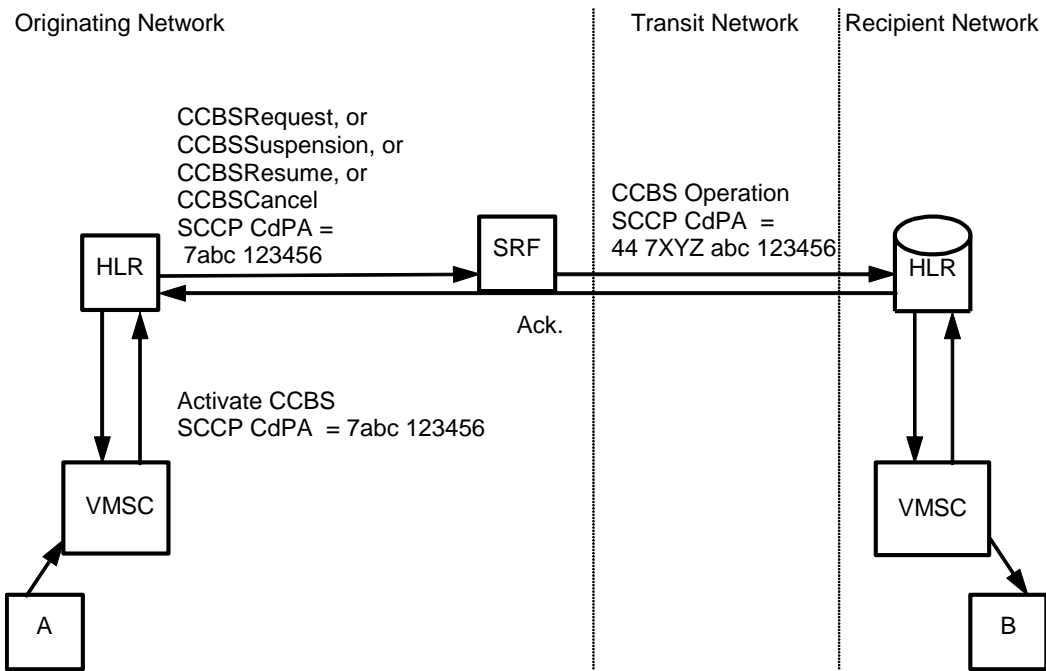


Figure 16 – Activation/Suspension/Resume/Cancel CCBS on ported subscriber – originating and range holding networks are the same

7.8 Send IMSI

In order to illustrate the most complex scenario conceivable, the originating network shown below is a VPLMN for the subscriber who has ported from Range holding to recipient networks. (i.e. the ported subscriber has roamed onto a foreign network).

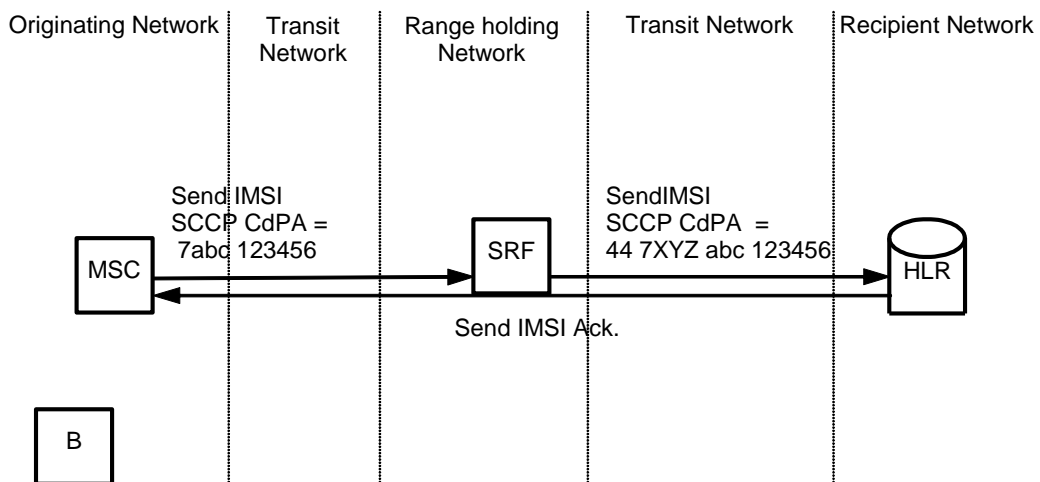


Figure 17 – Send IMSI – separate originating and range holding networks

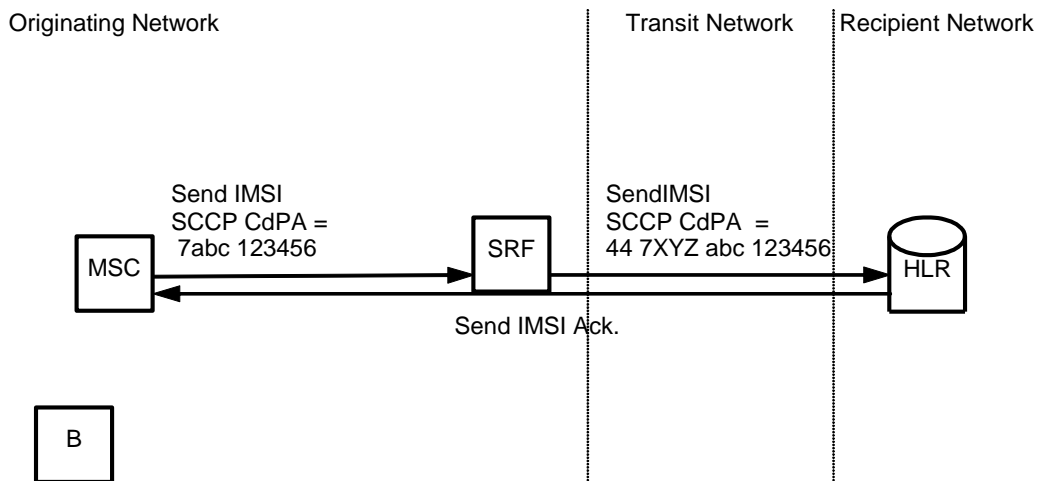


Figure 18 – Send IMSI – originating network is range holder.

8 Service Interactions

In general, services based on circuit switched calls are under the control of the Recipient network because calls to ported subscribers are routed to the Recipient network.

8.1 Line identity presentation services

The ported number shall be stored in the location registers of the Recipient network. In this way the ported number is provided as the line identity of the subscriber during mobile originated calls.

8.2 Emergency calls

When a mobile originated emergency call is made by a ported subscriber, the Recipient network shall provide the emergency authorities with sufficient information to identify the serving network's identity.

8.3 CAMEL

The CAMEL Any Time Interrogation Request operation will be routed on MSISDN and is therefore applicable for relaying by the SRF in the Range Holding Network as described in Table 6.2.1.a in Section 6.2.1.

8.4 Echo cancellers

Range holding networks are not obliged to provide echo cancellers, but if they do, they must support the normal echo canceller control protocols.

9 Call Trap

Call Trap is the ability of a Recipient network to ‘trap’ calls to numbers which have been ported into the recipient network and which originated in the recipient network. This avoids routing of the call to the Range holding network and then back to the recipient (originating) network.

Call Trap can apply to both circuit-related calls and non-circuit related signalling (e.g. SMS messages, CCBS messages).

Call Trap is a matter entirely for the Recipient network and its implementation, although beneficial is not mandatory.

10 Error Handling

10.1 MTP/SCCP/TC errors

With MNP in use MTP/SCCP/TC errors will be passed across UK interconnects. The handling of these errors is described in the relevant ITU-T and UK NICC specifications. There are no additional requirements for the handling of these errors placed on UK operators by MNP.

10.2 Unsuccessful call completion or application errors

As circuit switched calls to ported subscribers are routed to the Recipient network, any announcements and tones generated as a result of call/service failure, call forwarding etc will be generated by the Recipient network. No further action is needed for MNP.

History

Document history		
<Version>	<Date>	<Milestone>
Issue 1	March 2000	Editorial changes to conform with BSI format Note: Published with the document number PNO-ISC/SER/008
Issue 2	June 2005	Editorial changes, Addition of new PLMN IRNs, Addition of Direct routeing method options; modification of figures 11, 12, & 13 to use 'gateway' rather than GMSC, and use STP rather than MSC; new 3.3.3. Addition of new section 3.4. Modified 4.5 to allow IRN's to be used as well as MSISDNs for SRI enquires to donor operators; modified 3.4 table
Issue 3	February 2007	Editorial changes for the new MRC ranges allocated by Ofcom for the new mobile voice providers.
Issue 1.4.1	April 2008	Changes to incorporate the OFCOM requirement to handle traffic without using the Range Holder. Removal of recipient DROF functionality. Note : As this incorporates new NICC template, Section numbers changed
Issue 1.4.2	October 2008	Warning added to front sheet following decision to set aside Ofcom requirement to handle traffic without using the Rangeholder
Issue 1.5.1	June 2010	Changes resulting from abandonment of OFCOM 2008 announcement
Issue 2.1.1	November 2020	Changes to Section 6.3.2 to reflect that rangeholder networks may block messaging which could be used for fraudulent purposes; to update the Registered Office; rectify various typos.