

## **Number Portability in Sweden – Network solutions for Service Provider Portability for public digital mobile telephony services – Technical prestudy**

*Nummerportabilitet i Sverige – Nätlösningar för digital mobiltelefonitjänst – Teknisk förstudie*

A technical prestudy for handling number portability for public digital mobile telephony services between public telecommunications networks

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## Preface

This report is structured in the following way:

**Introduction** is a general introduction to the document.

**Clause 1** describes the scope of the document.

**Clause 2** lists reference documents.

**Clause 3** lists terms and definitions used in the document.

**Clause 4** explains abbreviations used in the document.

**Clause 5** describes the preconditions for mobile number portability.

**Clause 6** analyses the methods for mobile number portability.

**Clause 7** analyses the network interface.

**Clause 8** analyses the portability and routing domain.

**Clause 9** analyses the administrative interface.

**Clause 10** analyses the fault handling.

**Clause 11** analyses the interworking between public telecommunications networks.

**Clause 12** identifies related working groups.

**Clause 13** analyses the structure of a Guide/Swedish Standard for MNP

**Annex A** describes the differences between terms used in SS 63 63 90 and ETSI draft MNP standards.

The preconditions for the administrative interface and the reference database for the support of mobile number portability is analysed in Report ITS 13, *Number portability in Sweden – Administrative process for public digital mobile telephony services, including the administrative interface and the central reference database – Technical prestudy* [24].

This report is produced by Working Group 15, AG15 of Information Technology Standardization, ITS. Members of the group have been interested parties representing the telecommunications operators and industry.

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## Introduction

This report analyses and recommends a solution for service provider portability for public digital mobile telephony services provided in a PLMN (GSM) to be specified as a Guide or Swedish Standard.

## 1 Scope

This report addresses mobile number portability defined as service provider portability for public digital mobile telephony within a country. The report focuses on areas that will have an impact on the choice of a technical solution for service provider portability for public digital mobile telephony services provided in a PLMN and especially on the network interface, shown in figure 1.1 below.

In this report, Mobile Number Portability is used in the sense of Service Provider Portability.

NOTE 1: In the ETSI MNP-standard [7] MNP is defined as the ability for a mobile subscriber to change GSM subscription network within the same country whilst retaining their original MSISDN(s).

NOTE 2: The IMSI shall not be ported.

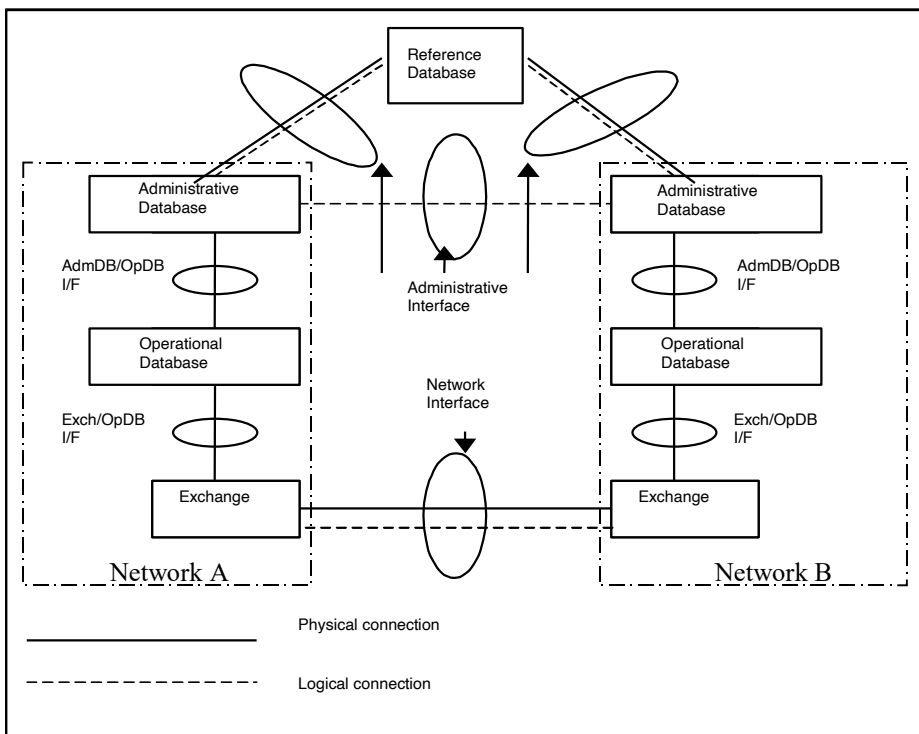


Figure 1:1

NOTE: The figure (that is generic) shall be seen in the context of mobile number portability, where Network designate PLMN.

## 2 References

### 2.1 Normative References

- ETSI TR 101 118** Network Aspects (NA) – High level network architectures and solutions to support number portability. V1.1.1 (1997-11) [1]
- ETSI TR 101 122** Network Aspects (NA) – Numbering and addressing for number portability, V1.1.1 (1997-11) [2]
- Svensk nummerplan för telefoni (E.164)** NPTA decision Hk 94-4621 and additional decisions, see PTS webpage <http://www.pts.se>. [3]
- SS 63 63 91:1999 Edition 1** Number Portability in Sweden – Administrative process for number portability, including the administrative interface and the central reference database [4]
- SS 63 63 90:1999 Edition 1** Number Portability in Sweden – Network solution for Service provider Portability for fixed public telecommunications services [5]
- ETSI EN 301 715 V7.0.1** Digital cellular telecommunications system (Phase2+), Support of Mobile Number Portability (MNP), Service description, Stage 1, (GSM 02.66 version 7.0.1 Release 1998) [6]
- ETSI EN 301 716 V7.1.0** Digital cellular telecommunications system (Phase2+), Support of Mobile Number Portability (MNP), Technical Realization, Stage 2 (GSM 03.66 Version 7.1.0 Release 1998) [7]
- ETSI TR 101 621 V1.1.1** Network Aspects, Number portability task force, Consequences of mobile number portability on the PSTN/ISDN and synergy between geographic and mobile number portability [8]
- ITU-T Rec. Q.769.1** Signalling System No. 7 – ISDN user part enhancements for the support of number portability [9]
- ITU-T Rec. I.210 (03/93)** Principles of telecommunication services supported by an ISDN and the means to describe them. [10]
- Draft SS 63 63 93:1999 Edition 1** PSTN-ISDN-PLMN ISUP signalling interface for Sweden [11]
- ITU-T Rec. Q.711 – Q.715 (07/96)** Specifications of Signalling System No.7 – Signalling Connection Control Part (SCCP). [12]

### 2.2 Informative References

- Regeringens proposition 1997/1998:126** Nummerfrågor [13]

<b>ETSI TR 101 119</b>	Network Aspects (NA) – High level description of number portability. V1.1.1 (1997-11) [14]
<b>EN 300 356-1</b>	Integrated Services Digital Network (ISDN) – Signalling System No.7 – ISDN User Part (ISUP) version 3 for the international interface – Part 1: Basic services – [ITU-T Recommendations Q.761 to Q.764 (1997), modified][15]
<b>ITU-T Rec. Q.761 – 764</b>	Integrated Services Digital Network User Part (ISUP), ISUP 2000 [16]
<b>OVUM – Number Portability in Sweden</b>	Ovum’s study (report and annexes) on the possible introduction of Number Portability (February 1997) [17]
<b>Oftel, Number portability functional specification</b>	Issue No: 3 – Geographic, non-geographic and mobile portability [18]
<b>PNO-IG/MNPTG, Technical Realization UK Mobile Number Portability</b>	Draft Issue 1, Version 11 [19]
<b>PNO-IG/MNPTG, Interim report, Technical feasibility study UK Mobile Number Portability</b>	Issue 1, Version 9 [20]
<b>PTSFS 1999:3</b>	Post- och telestyrelsens föreskrifter och allmänna råd om nummerportabilitet för fasta teletjänster [21]
<b>PTSFS 1999:4</b>	Föreskrifter om ändring i Post- och telestyrelsens föreskrifter (1994:15) om tilldelning och reservering av nummerkapacitet ur den svenska nummerplanen för telefoni (E.164) [22]
<b>Second interim report on Number Portability for mobile networks</b>	ETO, 24 September 1999 [23]
<b>Report ITS 13</b>	Number Portability in Sweden – Administrative process for public digital mobile telephony services, including the administrative interface and the central reference database – Technical pre-study [24]
<b>ITU-T Rec. E.212</b>	The international identification plan for mobile terminals and mobile users (11/98) [25]

### **3 Terms and definitions**

For the purpose of this report the following terms and definitions apply. Some of the terms and definitions in this report differ from the ones in the ETSI MNP-standard [7]. The differences are shown in Annex A of this report.

#### **3.1 Entities**

##### **3.1.1 network operator**

An entity operating a public telecommunications network in order to route calls.

NOTE: A network operator can also be the service provider.

### **3.1.2 public telecommunications operator (PTO)**

A telecommunications operator in Sweden offering public telecommunications services.

NOTE: This term includes both Service Provider and Network Operator.

### **3.1.3 service provider**

An entity offering public telecommunication services to subscribers and users involving the use of network resources.

NOTE: "Service Provider" is, in this standard, used in a generic sense, and may have a different status according to the service provided.

## **3.2 Numbers**

### **3.2.1 directory number (DN)**

An E.164 number in the national numbering plan assigned to a subscriber for a public telecommunications service.

NOTE: The Directory Number is assigned directly to subscribers by the public telecommunication operators from number ranges assigned by the NPA. The use of the Directory Number in this standard could be in either the national format (national (trunk) prefix +NDC + SN) or the international format (CC + NDC + SN). The latter is equal to MSISDN.

### **3.2.2 international mobile subscriber identity (IMSI)**

The IMSI is a string of decimal digits, up to a maximum of 15 digits, that identifies a unique mobile terminal or mobile subscriber internationally.

### **3.2.3 national (significant) number**

The portion of the number that follows the national (trunk) prefix. The national (significant) number consists of the National Destination Code (NDC) followed by the Subscriber Number (SN).

### **3.2.4 ported number**

A Directory Number subject to mobile number portability.

### **3.2.5 routing number**

A specific number which is part of the routing information, used by the networks to route the call and the non-call related signalling message.

NOTE: The Routing Number conveys information for use by the network. If the digits dialled by the user matches the digits of a Routing Number, the dialled digits shall not be interpreted as a Routing Number.

## **3.3 Networks**

### **3.3.1 donor network**

The network from which a number is ported.

### **3.3.2 initial donor network**

The initial network to which a number range was allocated by the NPA.

NOTE: The corresponding term used in ETSI MNP standards [7] is number range owner network.

### **3.3.3 originating network**

The network where the calling party is located.

NOTE 1: For incoming calls to the routing domain, the originating network is effectively the first network receiving the call within the routing domain. For example, for incoming international calls, the originating network is effectively the network containing the international switching centre (ISC). In a PLMN, the equivalent function is contained in the Gateway Mobile-services Switching Centre (GMSC)

NOTE 2: For carrier selection, the network containing the first exchange of the selected carrier, becomes effectively the originating network for routing purposes as regards mobile number portability.

#### **3.3.4 recipient network**

The network where a number is located after being ported.

NOTE: In ETSI MNP standards [7] the term recipient network is used during the porting process. The recipient network becomes the subscription network after the completion of the porting process..

#### **3.3.5 terminating network**

The network where the called party is located at the moment.

#### **3.3.6 transit network**

A network switching calls and conveying non-call related signalling messages between two other networks.

### **3.4 Other definitions**

#### **3.4.1 administrative database (AdmDB)**

The Service Provider's database, not call-related or with any similar function in charge of the storage and updating of the Operational Database of ported Directory Numbers necessary for the Service Provider's correct routing of calls and non-call related signalling messages.

#### **3.4.2 administrative interface**

The interface between Service Providers' Administrative Databases, and between the Service Providers' Administrative Databases and the Reference Database, if implemented.

NOTE: See Figure 1:1.

#### **3.4.3 mobile number portability**

Service provider portability for public digital mobile telephony services within the same country.

#### **3.4.4 national numbering plan**

A national numbering plan provides a structure for the numbers used and the number space available in a country.

NOTE: See ref. [3] for the structure of the Swedish numbering plan for telephony.

#### **3.4.5 network interface**

The interface between public telecommunications operators supporting Mobile Number Portability.

NOTE: See Figure 1:1.

#### **3.4.6 non-call related signalling message**

All signalling messages where the Directory Number is used to route the message on SCCP level except MAP SRI without Optimal Routing parameter set.

#### **3.4.7 operational database (OpDB)**

A database used in real-time by the network operator or service provider for the correct routing of calls and non-call related signalling messages to ported Directory Numbers.

NOTE: The Operational Database could form part of an IN implementation, could be embedded within the exchange or could be some other type of on-line database.



### 3.4.8 operator identity

Identity of a Public Telecommunications Operator.

### 3.4.9 portability check

The function whereby a network, e.g. the serving network, performs a check of whether a Directory Number is ported.

### 3.4.10 portability domain

The part of the number ranges of the national numbering plan where number portability is supported for a certain type of public telecommunications services.

NOTE 1: A Portability Domain may represent e.g. specified fixed subscriber number ranges, another number ranges for public digital mobile telephony services.

NOTE 2: The corresponding term used in ETSI MNP standards [7] is portability cluster.

### 3.4.11 porting process

A description of the transfer of a number between network operators.

### 3.4.12 reference database (RefDB)

The database in charge of the storage and updating of the Administrative Databases of the Service Providers' ported Directory Numbers.

NOTE: The data stored is necessary for correct routing of calls and non-call related signalling messages by all PTOs in the Routing Domain using the All Call Query (call related) and Direct routing (non-call related) methods. The Reference Database can be centralised (CrefDB) or distributed (DrefDB).

### 3.4.13 routing domain

The part of the national public telecommunications network obliged to perform a portability check and to route the call and the non-call related signalling message accordingly.

NOTE: The Routing Domain includes the Portability Domain.

### 3.4.14 service provider portability

A function enabling the subscribers to cancel their subscriptions with a Service Provider and to contract another subscription with another Service Provider, without changing their Directory Numbers and the nature of the service offered.

## 4 Abbreviations

ACQ	All Call Query method
AdmDB	Administrative Database
CCBS	Completion of Calls to Busy Subscriber supplementary service
CdPA	Called Party Address
CdPN	Called Party Number
CrefDB	Centralised Reference Database
DN	Directory Number
DPC	Destination Point Code
DrefDB	Distributed Reference Database
ETSI	European Telecommunications Standards Institute
GMSC	Gateway Mobile-services Switching Centre
GSM	Global System for Mobile communications
GT	Global Title
HLR	Home Location Register
IAM	Initial Address Message. The message sent to set up a speech path through the network
IMSI	International Mobile Subscriber Identity
IN	Intelligent Network
ITS	Information Technology Standardisation

ISC	International Switching Centre
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
MAP	Mobile Application Part
MNP	Mobile Number Portability
MNP-SRF	Signalling Relay Function for support of MNP
MSA	Mobile Station of the A subscriber
MSC	Mobile-services Switching Centre
MSISDN	Mobile Station International ISDN Number
MSRN	Mobile Station Roaming Number
NDC	National Destination Code
N(S)N	National (Significant) Number
NP	Number Portability
NPA	Numbering Plan Administration
NPTA	National Post & Telecom Agency, the national regulatory authority for the telecommunications sector
OpDB	Operational Database
OQoD	Originating call Query on Digit Analysis
OR	Onward Routing method
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
PTO	Public Telecommunications Operator
QoHR	Query on HLR Release
RefDB	Reference Database
RN	Routing Number
SCCP	Signalling Connection Control Part
SMS	Short Message Service
SN	Subscriber Number
SRI	Send Routing Information
SSN	Sub-System Number
TCAP	Transaction Capabilities Application Part
TQoD	Terminating call Query on Digit Analysis
VLR	Visitor Location Register
VMSC	Visited MSC

## **5 Preconditions for Mobile Number Portability**

### **5.1 General preconditions**

- The solution shall be non-discriminatory.

### **5.2 Regulatory preconditions**

The obligation regarding number portability for digital mobile telephony services entered into force on 1 July 1999 (amendment 1999:578 to the Telecommunications Act (1993:597)).

Neither the Telecommunications Act nor the Telecommunications Bill (1997/98:126 – Numbering) specifies a time plan for mobile number portability. The Bill states that the National Regulatory Authority (NRA) shall decide upon an implementation date after consulting the public telecommunications operators. Such a consultation was held during 1998, where 1 July 2001 was proposed as an implementation date. Draft regulation for number portability for digital mobile telephony services was circulated for comments on 8 November 1999. 15 January 2001 was proposed as a new implementation date. The proposed regulation for number portability for public digital mobile telephony services is comparable to the existing regulation for number portability for fixed public telecommunications services.

### 5.3 Technical preconditions

- The IMSI shall not be ported, hence the recipient network of the porting process will issue a new IMSI for the ported subscription.
- The subscriber of a ported number can use exactly the same services as non-porting customers in the same recipient network. That is: whether the Directory Number of a subscriber belongs to the recipient network or is ported to the recipient network shall have no influence on the services offered to the customer by that recipient network.
- The services offered by the initial donor network and/or the donor network have no influence on the services offered by the recipient network. When a subscriber ports a Directory Number to a new network then the donor network no longer provides support for the services of the ported number (e.g. supplementary services).

NOTE: This also implies that if a service supported in the donor network is not available on the recipient network then number portability mechanisms need not provide that service for the subscriber of a ported number.

- A network can be a donor of numbers and a recipient of numbers. A Directory Number can be ported more than once; a ported number can be ported back to its initial donor network.
- The solution for MNP shall have a minimal adverse effect upon the quality of service offered to subscribers of ported and non-porting numbers. It may be the case that the quality of service for subscribers of ported and non-porting numbers differs slightly (e.g. due to additional call set-up delay).
- Any additional delay in call set-up to ported numbers shall be minimised.
- The technical implementation of MNP shall support optimisation of the use of network and inter-network resources so as to minimise costs associated with transport of traffic and/or appropriate signalling and/or processing activities (e.g. optimal routing).
- The solution(s) chosen for MNP shall support Network Integrity.
- The specifications of MNP shall focus on interconnect.
- The solution(s) for MNP shall be based on International Recommendations and ETSI Standards.
- The specified solution(s) for MNP shall have a limited effect on the interface(s).
- The specified solution(s) shall be possible to be used by all parties included in the defined routing and portability domain. One long-term solution shall be specified. If the specification of another solution is required, they shall be able to co-exist and interwork.

## 6 Methods for Mobile Number Portability

The methods described in chapter 6 are all based on the ETSI standards for MNP [7]. In chapter 6.1 the terms All Call Query (ACQ) and Onward Routing (OR) are used instead of direct routing and indirect routing. These terms have been chosen in order to be compliant with the terms used for call related traffic in SS 63 63 90 [5]. However since the terms ACQ and OR are by definition call related, the terms Direct Routing and Indirect Routing are used for non-call related traffic, as done in the ETSI MNP standards [7].

The term OpDB refers to databases which are used in association with MNP traffic handling. Depending on the evolutionary level in a particular network, the OpDB may be located in different places of the network.

The term RefDB refers to a reference database, which is used by all service providers as a reference in association with MNP administrative handling. The RefDB is a network external entity. The RefDB stores and updates all service providers ported numbers.

If the All Call Query (call related) and Direct Routing (non-call related) methods are used, it is the Originating network that will interrogate an OpDB for all calls (to portable numbers), to check if the number has been ported or not and route the call to the terminating network. The OpDB will in this case contain information of all ported numbers in the national numbering plan.

If the Onward Routing (call related) and Indirect Routing (non-call related) methods are used, it is the Initial donor network that will interrogate an OpDB, but only for its own numbers, and route the call to the terminating network. The OpDB will in this case contain information of only the initial donor operator's own ported-out numbers.

In the figures there are no databases handling traffic shown in the recipient networks, even though it is necessary to perform further database interrogations in order to identify a specific HLR when more than one HLR is used in the network.

The figures and text in chapter 6 only describes the case when a number is ported.

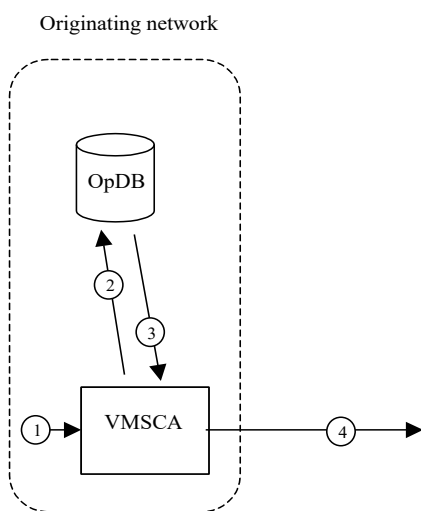
## 6.1 Call related methods

### 6.1.2 All Call Query method

Mobile originated calls to subscribers with ported numbers within the fixed public telecommunications services portability domain are handled according to the procedures in SS 63 63 90 [5]. The following paragraphs describe routing of calls to ported numbers within the public digital mobile telephony services portability domain. The All Call Query method implies that the Originating network has the knowledge that the Directory Number is ported and can route the call directly to the Recipient network without involving the Initial donor network. The figures in chapter 6.1.2 only show the case for mobile originating calls.

#### IN-solution based on ETSI EN 301 716, Annex A, ref. [7]

Figure 6.2 shows the architecture where the IN-solution (OQoD) has been chosen to implement MNP in the Originating network.



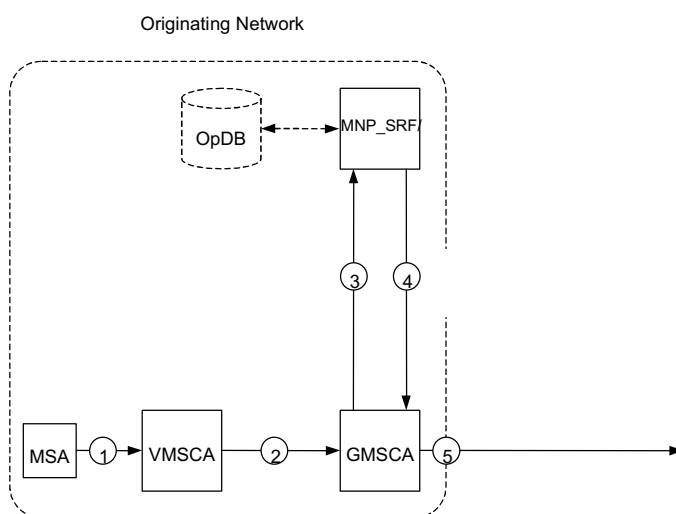
**Figure 6.2:** Call to a ported number using OQoD procedure

1. A call is initiated by Mobile Subscriber A towards Mobile Subscriber B, using the Directory Number of the called subscriber;

2. When VMSCA receives the call setup indication, it will send a database query to the OpDB as a result of analysis of the received Directory Number. The Directory Number is included in the query sent to the OpDB;
3. The OpDB detects that the Directory Number is ported and responds back to the VMSCA with a Routeing Number pointing out the Recipient network;
4. The call is routed to the Recipient network based on the Routeing Number carried in ISUP IAM message; also the Directory Number is included in IAM.

**MNP-SRF solution based on ETSI EN 301 716, Annex C, ref. [7]**

Figure 6.3 shows the architecture where the MNP-SRF solution has been chosen to implement MNP in the originating network.



**Figure 6.3:** National mobile originated call to a ported number using All call query

1. MSA originates a call to the Directory Number;
2. VMSCA routes the call to the network's GMSCA;
3. When GMSCA receives the ISUP IAM, it requests routeing information by submitting a MAP SRI to the MNP\_SRF.
4. When the MNP\_SRF receives the message, it analyses the Directory Number in the CdPA and identifies the Directory Number as being ported to another network. As the message is a SRI message, the MNP\_SRF responds to the GMSCA by sending an SRI ack with a RN + Directory Number;
5. GMSCA uses the (RN +) Directory Number to route the call to GMSCB in the recipient network.

**Main pros (+) and cons (-) for the All Call Query method, see also ETSI TR 101 118 [1]:**

- + It allows the Donor Network to discontinue maintaining data for subscriber numbers no longer in response for.
- + As efficient utilisation of Network resources, as for calls to non-ported numbers.
- + All supplementary services will work, as for calls to non-ported numbers, thanks to no dependency on other networks (than used for other calls) to set up the call to recipient.
- + Originating Network has full control over call routing.
- + Statistical circuit quality counters will work as today thanks to no release involved prior to redirection.

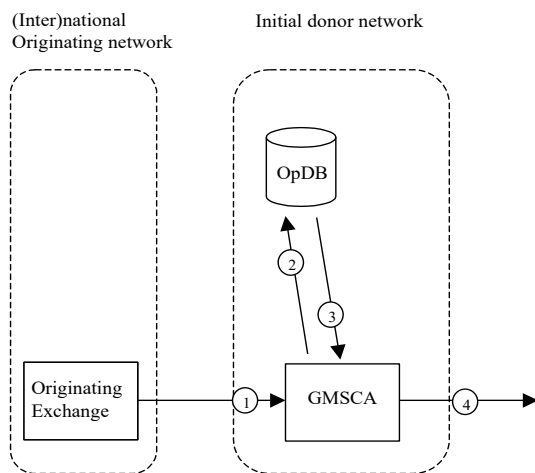
- + Donor Network will not need to consider processing capacity for incoming calls to ported-out numbers.
- + Equal treatment of calls to both subscribers of ported and non-ported numbers.
- + No interference with Carrier Selection.
- + Robust network since no dependency on other networks in getting routing information for calls to ported-out numbers.
- Might be longer call set-up time for calls to subscribers of non-ported numbers, than in the Onward routing case.
- Additional processing capacity (the query) is needed.
- Large processing capacity required in OpDB since all calls will require database query.

### 6.1.3 Onward Routing method

Mobile originated calls to subscribers with ported numbers within the fixed public telecommunications services portability domain are handled according to the procedures in SS 63 63 90 [5]. The following paragraphs describe routing of calls to ported numbers within the public digital mobile telephony services portability domain. The Onward Routing method implies that the Originating network has no knowledge whether the Directory Number is ported or not and uses the traditional routing plans for routing the call to the Initial donor network for further routing decisions.

#### IN-solution based on ETSI EN 301 716, Annex A, ref. [7]

Figure 6.5 shows the architecture where the IN-solution (using TqoD) has been chosen to implement MNP in the Initial donor network. The other architecture called QoHR, involves the HLRA in the Initial donor network in order to avoid unnecessary requests to the OpDB, see ref. [7].



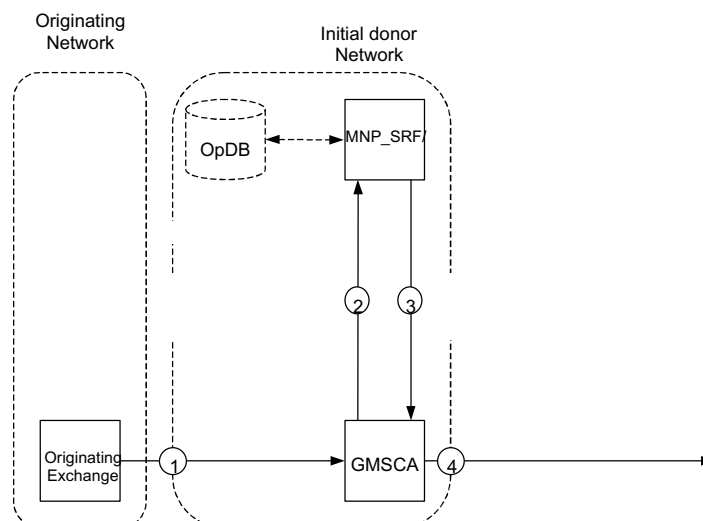
**Figure 6.5:** Call to a ported number using TqoD procedure

1. From an Originating Exchange a call is set up to the Directory Number. The call is routed to the Initial donor network;
2. When GMSCA receives the ISUP IAM, it will send a database query, including the Directory Number, to the OpDB as a result of analysis of the received Directory Number;
3. The OpDB detects that the Directory Number is ported and responds back to the GMSCA with a Routing Number pointing out the Recipient network;

- The call is routed to the Recipient network based on the Routing Number carried in ISUP IAM message; also the Directory Number is included in IAM.

#### MNP-SRF solution based on ETSI EN 301 716, Annex C, ref. [7]

Figure 6.6 shows the architecture where the MNP-SRF solution (using indirect routing) has been chosen to implement MNP in the Initial donor network. The other architecture uses indirect routing with reference to the Recipient network, see ref. [7].



**Figure 6.6:** Call to a ported number using Onward routing.

- From an Originating Exchange a call is set up to the Directory Number. The call is routed to the Initial donor network;
- When GMSCA in the Initial donor network receives the ISUP IAM, it requests routing information by submitting a MAP SRI to MNP\_SRF.
- When the MNP\_SRF receives the message, it analyses the Directory Number in the CdPA and identifies the Directory Number as being ported to another network. As the message is an SRI message, the MNP\_SRF responds to the GMSCA by sending an SRI ack with a RN + Directory Number;
- GMSCA uses the RN + Directory Number to route the call to GMSCB in the Recipient network.

#### Main pros (+) and cons (-) for the Onward Routing method, see also ETSI TR 101 118 [1]:

- + The preceding Networks do not need to know if called number has been ported or not. This possibility limits the impact on management systems of Donor.
- + No new forward call indication is needed towards the Donor.
- + Additional processing capacity is only required for calls to ported-out numbers.
- The functionality level for the call is dependent on the Donor Network.
- The network resources are not used as efficient as for calls to subscribers of non-ported numbers.
- New routing information is needed in forward direction from Donor towards Recipient Network.
- Call set-up time will differ between calls to ported-out and not ported numbers.

- A potential problem with network destination dependant charging where the end-users might be charged differently if the called Directory Number belongs to network A instead of network B.

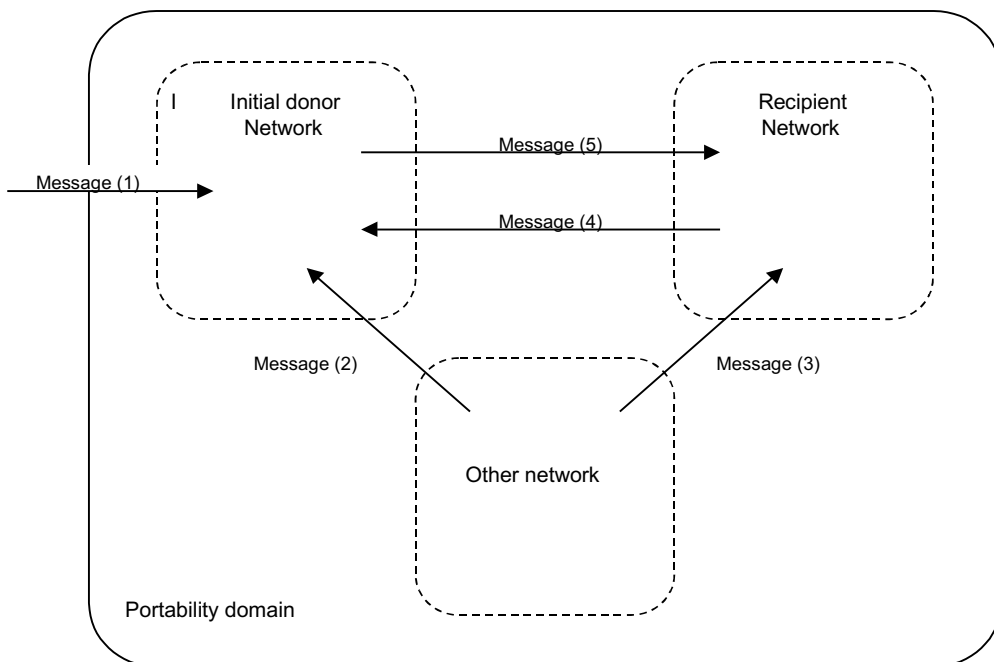
- A potential problem with identifying the network that shall receive the interconnection termination fee, e.g. the network where the B-subscriber has his subscription.

## 6.2 Non-call related methods

### 6.2.1 General

Non-call related functions is needed to support teleservices e.g. SMS as defined by ETSI, and supplementary services e.g. CCBS.

Figure 6.7 illustrates the routing of non-call related signalling messages between networks in a number portability environment as described in ETSI MNP standards [7].



**Figure 6.7:** Routing of non-call related signalling messages in a number portability environment.

If a non-call related signalling message is originated outside the portability domain, this message (1) is received by the Initial donor network. The Initial donor network routes the message (5) onward to the Recipient network.

If a non-call related signalling message is originated in a network inside the portability domain and this network supports direct routing, this message (3) is routed to the Recipient network.

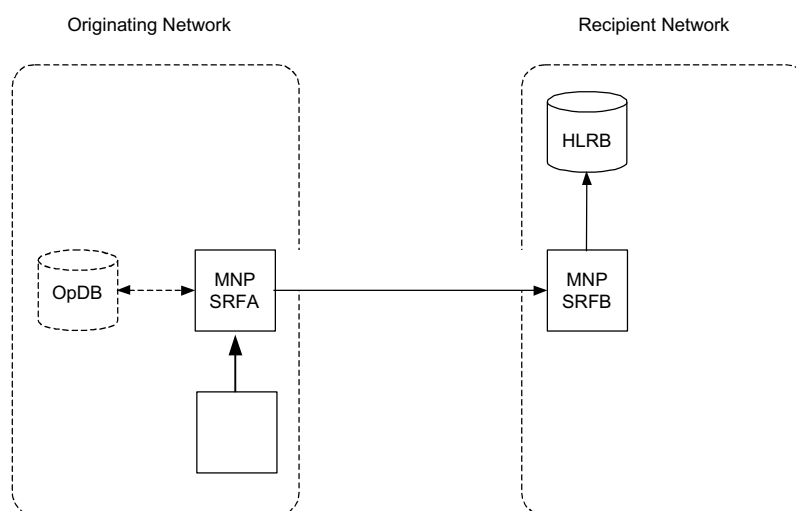
If a non-call related signalling message is originated in a network inside the portability domain and this network does not support direct routing, the message (2, 4) is routed to the Initial donor network. The Initial donor network routes the message (5) onward to the Recipient network. This is referred to as indirect routing.



## 6.2.2 Direct routing

### MNP-SRF solution based on ETSI EN 301 716, Annex B, ref. [7]

Figure 6.8 shows the signalling relay function for support of MNP (MNP-SRF) operation for routing a non-call related signalling message for a ported or non-ported number where the Originating network supports direct routing. If the Originating network is the Recipient network, MNP-SRFA and MNP-SRFB coincide, i.e. the signalling message passes the MNP-SRF only once.



**Figure 6.8:** MNP-SRF operation for routing a non-call related signalling message for a ported or non-ported number where the Originating network supports direct routing.

When MNP-SRFA receives a non-call related signalling message, MNP-SRF operation is triggered. The MNP-SRF functionality analyses the Directory Number in the CdPA and identifies the Recipient network using information which may be retrieved from an OpDB. The MNP-SRF function then modifies the CdPA according to the rules agreed for the portability domain and routes the message to MNP-SRFB in the Recipient network.

When MNP-SRFB receives the message, MNP-SRF operation is triggered. The MNP-SRF functionality analyses the Directory Number in the CdPA and identifies the Directory Number as being ported into the network using information which may be retrieved from an OpDB. The MNP-SRF function then reroutes the message to HLRB.

#### Main pros (+) and cons (-) for the Direct routing method:

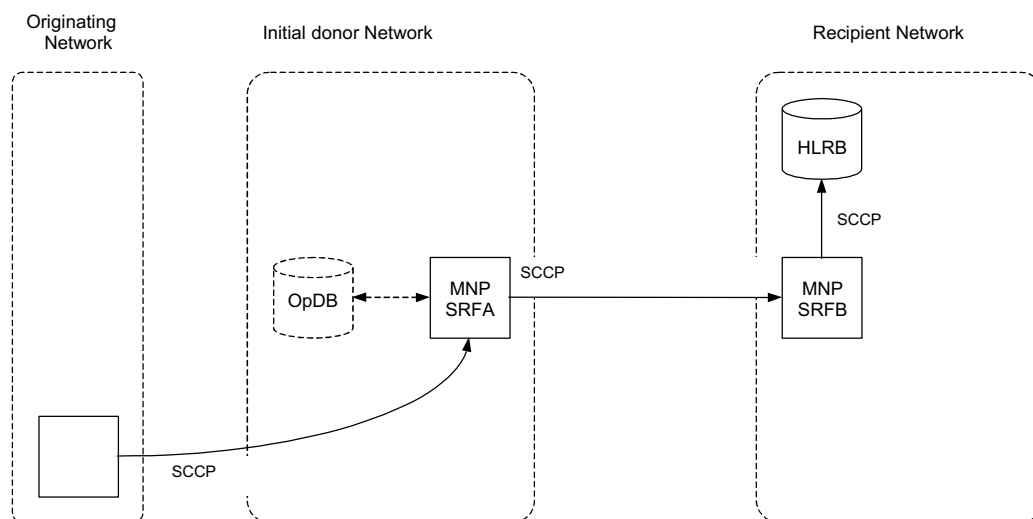
- + It allows the Donor Network to discontinue maintaining data for subscriber numbers no longer in response for.
- + As efficient utilisation of Network resources, as for non-call related signalling messages to non-ported numbers.
- + Originating Network has full control over routing of non-call related signalling messages.
- + Donor Network will not need to consider processing capacity for incoming non-call related signalling messages to ported-out numbers.
- + Equal treatment of non-call related signalling messages to both subscribers of ported and non-ported numbers.

- + Robust network since no dependency on other networks in getting routing information for non-call related signalling messages to ported-out numbers.
- Additional processing capacity (the query) is needed.
- Large processing capacity required in OpDB since all non-call related signalling messages will require database query.

### 6.2.3 Indirect routing

#### MNP-SRF solution based on ETSI EN 301 716, Annex B, ref. [7]

Figure 6.9 shows the signalling relay function for support of MNP (MNP-SRF) operation for indirect routing (i.e. via the Initial donor network) of a non-call related signalling message to a subscriber of a ported number.



**Figure 6.9:** MNP-SRF operation for indirect routing (i.e. via the Initial donor network) of a non-call related signalling message to a subscribers of a ported number.

A non-call related signalling message from the Originating network is routed on the Directory Number global title to MNP-SRFA in the Initial donor network.

When MNP-SRFA receives the message, MNP-SRF operation is triggered. The MNP-SRF functionality analyses the Directory Number in the CdPA and identifies the Recipient network using information which may be retrieved from an OpDB. The MNP-SRF function then modifies the CdPA according to the rules agreed for the portability domain and routes the message to MNP-SRFB in the Recipient network.

When MNP-SRFB receives the message, MNP-SRF operation is triggered. The MNP-SRF functionality analyses the Directory Number in the CdPA and identifies the Directory Number as being ported into the network.. The MNP-SRF function then reroutes the message to HLRB.

#### Main pros (+) and cons (-) for the Indirect routing method:

- + The preceding Networks do not need to know if called number has been ported or not. This possibility limits the impact on management systems of Donor.
- + No new forward indication is needed towards the Donor.
- + Additional processing capacity is only required for non-call related signalling messages to ported-out numbers.

- The functionality level for the non-call related signalling message is dependent on the Donor Network.
- The network resources are not used as efficient as for non-call related signalling messages to subscribers of non-ported numbers.
- New routing information is needed in forward direction from Donor towards Recipient Network.
- A potential problem with network destination dependant charging where the end-users might be charged differently if the called Directory Number belongs to network A instead of network B.
- A potential problem with identifying the network that shall receive the interconnection termination fee, e.g. the network where the B-subscriber has his subscription.

### **6.3 Compatability between different methods**

#### **Call related signalling**

The IAM sent to the Recipient network may contain additional routing information. Within a portability domain the method how to convey the Routing Number in the IAM between 2 PLMNs shall be agreed upon by the 2 network operators involved. In Sweden, the method how to convey the Routing number for the interconnection between two networks is unique and provides the transfer of both Routing number (for ported numbers) and the Directory Number.

Two alternative solutions for call related signalling (IN based and MNP-SRF based) are specified in the ETSI MNP-standard [7]. In general, IN-based and MNP-SRF (call-related) solutions are compatible and may coexist in the same portability domain. The only restriction refers to the case where the Initial donor network relays call-related MAP messages (i.e. SRI for national calls) to the Recipient network. If this solution is selected by at least one network operator within a portability domain, all the PLMNs and transit networks affected must fulfil certain requirements, i.e. the network integrity precondition is not fulfilled.

In the rest of the possible architectures for MNP, no interworking problems have been identified. In these cases, network architectures used within one PLMN (e.g. IN, MNP-SRF) are regarded as operator dependent.

Three routing conventions are specified for call related signalling in the ETSI MNP-standard [7], All call query (direct routing), Onward routing (indirect routing) and Onward routing (indirect routing) with reference to the Recipient network<sup>1</sup>. In order to reduce the risk of looping and incompatibility situations, all the networks within the portability domain shall use the same routing convention either All call query (direct routing) or Onward routing (indirect routing). As an alternative, Onward routing (indirect routing) can interwork successfully with All call query (direct routing) if the routing number is transferred in the IAM or if dedicated traffic connections are used.

#### **Non-call related signalling**

The routing method for non-call related messages is performed in the SCCP (referred to as SCCP relay). The SCCP GT Called party address sent to the Recipient network may contain additional routing information. Within a portability domain the method how to convey the Routing number in the SCCP GT between 2 PLMNs shall be agreed upon by the 2 network operators involved. In Sweden, the method how to convey the Routing number for the interconnection between two networks is unique and provides the transfer of both Routing number (for ported numbers) and the Directory Number.

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<sup>1</sup> Onward routing (indirect routing) with reference to the Recipient network has been excluded as routing convention in Sweden.

One solution for non-call related signalling (MNP-SRF based) is specified in the ETSI MNP-standard [7]. Two routing conventions are specified for non-call related signalling in the ETSI MNP-standard [7], direct and indirect routing. In order to reduce the risk of looping and incompatibility situations, all the networks within the portability domain shall use the same routing convention either direct routing or indirect routing. As an alternative, indirect routing can interwork successfully with direct routing if the Routing number is transferred in the SCCP CdPA or if dedicated traffic connections are used.

NOTE: In case the indirect routing method is applied, the SCCP routing on DPC+SSN capability cannot be used along with SCCP relay mechanism. The routing on DPC+SSN capability requires the support of an additional mechanism to relay TCAP dialogues.

In case the indirect routing method is applied, the Directory Number as well as the Routing number must be conveyed to the recipient network in the SCCP GT information. This necessity is required to avoid possible looping and to perform SCCP relay.

## 6.4 Need for a short term solution

The requirements imposed on an alternative short-term solution are as follows.

- It must be a method that can be introduced quicker than the long-term solution if the latter cannot meet the required implementation dates.
- The method must be compatible with the network interface supported by the long-term solution and shall easily be migrated to the long-term solution.
- The method must make it possible for public telecommunications operators to be part of the Portability and Routing Domains with reasonable technical efforts.

Since ETSI have specified both an All Call Query and an Onward Routing method for call related traffic and both an Direct and Indirect Routing method for non-call related traffic, there is no need for an additional national solution, since the Onward Routing method (for call related traffic) and Indirect Routing method (for non-call related traffic) fulfils the requirements above (it is not clear if Onward Routing (call related) and Indirect Routing (non-call related) puts restrictions on some supplementary services).

## 6.5 Conclusions

### 6.5.1 Call related

The following methods have been analysed for use as call related methods:

1. All Call Query (Direct Routing) as specified in ETSI EN 301 716, ref. [7]
2. Onward Routing (Indirect Routing) as specified in ETSI EN 301 716, ref. [7]

Call Dropback and Query on Release have not been specified by ETSI for use of MNP, and have therefore not been analysed. The two methods are described in ETSI TR 101 118 [1] and ETSI TR 101 621 [8].

Both All Call Query and Onward Routing as specified by ETSI have been chosen for call related traffic in Sweden to be used for MNP. All Call Query is recommended as the technically preferred and the more long-term solution since it amongst other things applies more efficient routing in the network than Onward Routing.

In order to avoid looping and incompatibility situations between the two chosen methods, the routing number shall always be transferred in the IAM for ported numbers (identifying the Recipient network).

The choice of implementing the chosen methods by using either an IN-based or MNP-SRF solution are regarded as operator dependent, except for the MNP-SRF solution using Indirect routing with Reference to Recipient Network, which is not

fulfilling the Network Integrity precondition and shall therefore not be used for MNP in Sweden.

The choice of portability methods between public telecommunications operators in Sweden does not exclude the use of other methods internally in an operator's network as long as the network interface and procedures are not affected and network integrity is respected between public telecommunications operators.

The first network within the Routing Domain receiving incoming calls from outside the Routing Domain should, in terms of number portability, be considered as the originating network.

### **6.5.2 Non-call related**

The following methods have been analysed for use as non-call related methods:

1. Direct routing (MNP-SRF), as specified in ETSI EN 301 716, ref. [7]
2. Indirect routing (MNP-SRF), as specified in ETSI EN 301 716, ref. [7]

Both Direct routing and Indirect routing as specified by ETSI have been chosen for non-call related traffic in Sweden to be used for MNP. Direct routing is recommended as the technically preferred and the more long-term solution since it amongst other things applies more efficient routing in the network than Indirect routing.

In order to reduce the risk of looping and incompatibility situations between the two chosen methods, the routing number shall always be transferred in the SCCP CdPA for ported numbers (identifying the Recipient network), see also the note in chapter 6.3.

The choice of portability methods between public telecommunications operators in Sweden does not exclude the use of other methods internally in an operator's network as long as the network interface and procedures are not affected and network integrity is respected between public telecommunications operators.

The first network within the Routing Domain receiving incoming non-call related signalling messages from outside the Routing Domain should, in terms of number portability, be considered as the originating network.

## **7 Network interface**

Generally, the same routing information and method should be supported at the signalling interfaces applicable for call related and non-call related (e.g. Concatenated addressing).

### **7.1 Call related**

- The chosen method(s) should support the same 'generic' signalling interface.
- Two-step routing<sup>1</sup> should be applied for calls to ported numbers since it allows for privacy of the recipient network and that less data base updates are needed, since other data bases (OpDB, RefDB and AdmDB) need not to be updated e.g. when the recipient network operator performs internal restructuring of its network.
- The network interface for mobile number portability shall as much as possible follow the network interface described in SS 63 63 90, and shall be based on the new Swedish standard for ISUP [11].

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<sup>1</sup>The first step includes a number translation to obtain a Routing number indicating the Recipient network of the called party. The second step includes the identification of the HLR serving the called party and a number translation to obtain the Roaming number (MSRN) indicating the MSC/VLR where the called party is located at a certain time. The second step is performed for every mobile terminated call irrespective of MNP and can be referred to as the HLR interrogation.

## 7.2 Non-call related

The network interface adopted for MNP non-call related shall be based on the SCCP relay mechanism (see also ETSI MNP-standard [7]). The SCCP routing shall use the GT addressing and shall be based on ITU-T Rec. Q.711 – 715, see ref. [12], in order to be able to use the SCCP hop counter to prevent indefinite looping of messages between networks.

## 8 Portability and Routing Domain

The following assumptions are made in this report:

- All public telecommunications networks, offering public digital mobile telephony services in Sweden, shall be part of the Portability Domain.
- All public telecommunications networks offering public fixed telephony services and public analogue and digital mobile telephony services shall be part of the Routing Domain for call related and non-call related traffic.

## 9 Administrative interface

The standard will not concern the Reference Database, the Administrative Interface, nor the Administrative Database. For that reason only information necessary for porting a Directory Number will be listed (i.e. information that is needed by the network solution).

The following mandatory and optional information is identified for the technical solutions.

### Mandatory information

- Directory Number  
The ported Directory Number.
- Date and time of porting  
The Year, Month, Day, Hour, Minute and Second of switchover.
- Donor network/Operator identity  
The identity of the public telecommunications operator's network from which the Directory Number is ported.
- Recipient network/Operator identity  
The identity of the public telecommunications operator's network to which the Directory Number is ported.

### Optional information

- Geographical information  
The area to which the Directory number is assigned.
- Service information  
Description of e.g. a service category.
- Additional charging information  
Charging information for the Directory Number defining other charging criteria than geographical data, e.g. subscriber class.
- Information for a special Point of Interconnection

The information is the Network Indicator (NI=3) + Signalling Point Code of a Special Point of Interconnection of the Recipient Exchange, e.g. the exchange to which the Directory Number is connected.

NOTE: The optional information above is copied from SS 63 63 90 [5], and is included in order to have a flexible solution for the future, even though some information may not be relevant to mobile number portability.

## **10 Fault handling**

If a call fails because the OpDBs are not correctly synchronised, the network which detects the inconsistency shall take appropriate measures.

Examples are when a Recipient network (not acting as transit network) receives a routing information corresponding to another network operator, or when a recipient network receives a routing information corresponding to either an exported number (i.e. loop), or a vacant number (i.e. database inconsistency between originating/donor and recipient)

## **11 Interworking between Public Telecommunications networks**

If two or more number portability methods are allowed, the impact of the chosen method in a preceding network on the procedures in a succeeding network has to be clarified.

In principle, calls from All Call Query (Direct Routing) networks need not be checked with respect to portability, whereas calls from Onward Routing (Indirect Routing) networks or networks using no method at all must be checked with respect to portability. This principle also applies to networks belonging to the Routing Domain but which are not part of the Portability Domain. I.e. if All Call Query (Direct Routing) is implemented in such a network, the succeeding network need not perform any portability check, but if no portability check is done, the succeeding network must perform a portability check.

This leads to the conclusion that there must be an obligation to check all directly interconnected networks as regards the number portability method implemented. This may constitute a new section in Interconnect Agreements.

## **12 Relations to other working groups**

### **ITS AG15 Team ISUP**

The scope of their work is to specify a Swedish ISUP. Their work shall be ready 31 December 1999. A draft shall be ready 24 September 1999 and the specification will go out for ITS consultation 3 November 1999. The Team MNP have to forward proposals for functionality to be included into the Swedish ISUP to the Team ISUP.

### **ITS AG15 Team A-/B-nummer**

The scope of their work is to produce an Application Guide for handling Called party and Calling party numbers between public telecommunications networks. Their work shall be ready 31 December 1999. The Application Guide will go out for ITS consultation 3 November 1999. The Team MNP have to forward input on the chosen methods for MNP and traffic cases to the Team A-/B-nummer so that they can describe the handling of A- and B-numbers for MNP.

### **ETSI SMG3**

ETSI SMG is in a process of standardising MNP. The Stage 1 description (Service description) was approved by SMG in December 1997, and are now out for Public

Enquiry and Voting. It is expected to be published in January 2000. The Stage 2 description (Technical realization) was approved by SMG in February 1999, and are now out for Public Enquiry. It is expected to be published in July 2000. Any, from the Team common comments to the Stage 1 and Stage 2 descriptions, will be put in a document that can be used by the Swedish ETSI members as input to the Public Enquiry.

#### **ITU-T SG11**

ITU-T SG11 is in the process of defining the enhancements of the ISUP needed for supporting number portability. The draft Recommendation is named Q.769.1. The work shall be ready in December 1999.

### **13 Structure of Guide/Swedish Standard for MNP**

The specification for MNP shall use the same structure as in SS 63 63 90:1999 Edition 1 [5]. The specification shall have the status of a Swedish Standard.



**Annex A – Comparison between terms used in SS 63 63 90:1999 and ETSI draft MNP standards (Informative)**

<b>Terms used in SS 63 63 90:1999</b>	<b>Terms used in ETSI draft MNP standards</b>
<b>Entities</b>	<b>Entities</b>
<p><b>network operator</b></p> <p>An entity operating a public telecommunications network in order to route calls.</p> <p>NOTE: A network operator can also be the service provider.</p>	<p><b>Network operator</b></p> <p>A GSM PLMN operator.</p>
<p><b>Service provider</b></p> <p>An entity offering public telecommunication services to subscribers and users involving the use of network resources.</p> <p>NOTE: "Service Provider" is, in this standard, used in a generic sense, and may have a different status according to the service provided.</p>	<p><b>Service provider</b></p> <p>An entity which offers service subscriptions to individual subscribers and contracts with a network operator to implement services for a specific MSISDN. A service provider may contract with more than one network operator.</p>
<b>Numbers</b>	<b>Numbers</b>
<p><b>ported number</b></p> <p>A Directory Number subject to mobile number portability.</p>	<p><b>Portable number</b></p> <p>An E.164 number that can be ported between networks in one nation.</p> <p><b>Ported number</b></p> <p>A portable number that has undergone the porting process.</p>
<b>Networks</b>	<b>Networks</b>
<p><b>initial donor network</b></p> <p>The initial network to which a number range was allocated by the NPA.</p>	<p><b>Number range owner network</b></p> <p>The network to which the number range containing the ported number has been allocated.</p>
<p><b>Recipient network</b></p> <p>The network where a number is located after being ported.</p>	<p><b>Subscription network</b></p> <p>The network with which the customer's Service Provider has a contract to implement the customer's services for a specific MSISDN.</p> <p>NOTE: The term "recipient network" is used during the porting process. The recipient network becomes the "subscription network" after the completion of the porting process.</p>

<b>Other definitions</b>	<b>Other definitions</b>
<p><b>portability domain</b></p> <p>The part of the number ranges of the national numbering plan, where number portability is supported for a certain type of public telecommunications service.</p> <p>NOTE: One Portability Domain may represent e.g. specified fixed subscriber number ranges, another number ranges for public digital mobile telephony services.</p>	<p><b>Portability cluster</b></p> <p>A set of GSM PLMNs in a country between which MSISDNs may be ported.</p>
<p><b>Operational database (OpDB)</b></p> <p>A database used in real-time by the network operator or service provider for the correct routing of calls and non-call related signalling messages to ported Directory Numbers.</p> <p>NOTE: The Operational Database could form part of an IN implementation, could be embedded within the exchange or could be some other type of on-line database.</p>	<p><b>Number portability database (NPDB)</b></p> <p>The term is not defined.</p> <p>NOTE: NPDB is used to describe the term Routing number. This implies that NPDB is a database used for handling traffic. The term Routing number is defined as the data stored against the ported number in the NPDB.</p>