MNPTF – PT2

NPM2V1F
17 july 2001

Mobile Number Portability Task Force :
PT2 : Network Architecture and Signalling

HISTORY

Date	Version	Evolution
27/02/2001	V11	Creation of draft version
16/03/2001	V20	Update of draft version based on M-PT2 input
23/03/2001	V21	Update of V20 based on M-PT2 feedback
28/03/2001	V30	Update of V21 based on M-PT2 feedback Including billing impact of routing mechanisms Including interworking with other services Including proposed Routing Number format Including interworking GSM-TETRA
05/04/2001	V40	Update of V30 based on M-PT2 feedback Including Reference documents Including Definitions and Abbreviations (based on draft M-PT1)
09/04/2001	V41	Update of V40 based on Proximus feedback Including Roaming impact
10/04/2001	V50	Update of V41 based on M-PT2 feedback
19/04/2001	V51	Update of V50 based on M-PT2 feedback
04/07/2001	V60	Review during first PT2ad-hoc meeting
24/07/2001	V70	Update of V60 based on BIPT comments: removal of definitions which are already present in M-PT1 deliverable removal of footer

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1 SCOPE

Define the network architecture and signalling aspects of Mobile Number Portability in Belgium in common agreement between all Mobile Operators, in a way to ensure a working implementation by the due date set forward by the government.

The implementation chosen by the Mobile Operators should allow Fix Operators to take actively part in the MNP process.
Focus will be set on defining a common technical interface between the different national networks.

The different Serving Network Functionalities are treated in detail. The Serving Network Functionalities consist of the following functions :

- The Call Trap Function
- The Database Query Function
- The Routing Information Addition Function
- The Range Analysis Function

2 REFERENCE DOCUMENTS

ETSI EN 301 716 v7.3.1 (GSM 03.66)	Digital Cellular Telecommunications system (Phase 2+) ; Support of Mobile Number Portability (MNP) ; Technical Realisation ; Stage 2
ETSI TR 101 118 v1.1.1	Network Aspects (NA) ; High level architectures and solutions to support number portability
ETSI TR 101 122 v1.1.1	Network Aspects (NA) ; Numbering and addressing for number portability
ETSI TR 101 621 v1.1.1	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
ITU Q.730 (12/99)	Specifications of Signalling System No 7 – ISDN Supplementary Services
ITU Q.769-1 (12/99)	ISUP enhancements for the support of number portability
	M-PT1 draft delivery document
Belgacom ICX – C2213 (Ed. 5)	Technical specifications " Address Information Templates".

3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

This section contains all definitions of terminology specifically used in M-PT2. For general definitions, refer to the M-PT1 deliverable.

Number Range Holder :

The (mobile) network operator to which the number range is assigned by the BIPT. The MNPTF-PT1 document refers to this as the "Number Block Allocated Mobile Network Operator (NAMNO)".

M-PT :

Inter-operator Project Teams discussing the different aspects of MNP.

Serving network :

A network that performs all or a part of the Serving Network Functionality. The Functionality may be split across multiple networks.

Serving Network Functionality :

The serving Network Functionalities consist of the following functions :

- The Call Trap Function
- The Database Query Function
- The Routing Information Addition Function
- The Range Analysis Function

Home PLMN (HPLMN) :

The network of the HLR containing the customer data.

T8 :

Time between execution of porting at Donor network and adaptation of the real-time NP-DB in the other networks upon receipt of the broadcast message.

Transit network :

A network offering the transport of the call between two other networks, e.g. the Number Range Holder network that serves as Transit network between the Originating network and the HPLMN in case of Onward Routing.

3.2 ABBREVIATIONS

All the abbreviations below have also been included in the M-PT1 deliverable.

CCBS : Call Completion to Busy Subscriber
CLI : Calling Line Identity
CLIP : CLI Presentation
CLIR : CLI presentation Restriction
COLP : Connected Line Presentation
COLR : Connected Line presentation Restriction
ETSI : European Telecommunications Standards Institute
FAC : ISUP Facility message
FPLMN : Foreign PLMN
GMSC : Gateway MSC
GSM : Global System for Mobile communications
HLR : Home Location Register
HPLMN : Home PLMN
IAM : Initial Address Message (ISUP)
IN : Intelligent Networks
ISUP : ISDN User part
ITU : International Telecommunications Union
MAP : Mobile Application Part
MNP : Mobile Number Portability
MSC : Mobile service Switching Centre
MSISDN : Mobile Station ISDN number
MSRN : Mobile Station Roaming Number
NP-DB : Number Portability Database
OQoD : Originating call Query on Digit analysis
PLMN : Public Land Mobile Network
QoHR : Query on HLR Release
REL : ISUP Release message
RN : Routing Number
SCCP : Signalling Connection Control Part
SMS : Short Message Service
SRF : Signalling Relay Function
SRI : Send Routing Information (MAP)
SS7 : Signalling System N°7
TETRA : Terrestrial Trunked Radio
TQoD : Terminating call Query on Digit Analysis
VMSC : Visitor MSC

4 CALL ROUTING MECHANISMS

4.1 ONWARD ROUTING

4.1.1 General description

With the Onward Routing principle, the call to a potentially ported MSISDN is routed to the Number Range Holder network. The Number Range Holder network has access to the NP-DB to retrieve the routing information, corresponding to the called MSISDN. If the MSISDN is ported, an IAM will be sent to the HPLMN (I2). If the MSISDN is not ported (i.e. Number Range Holder network = HPLMN) , the call will be treated internally within the network.

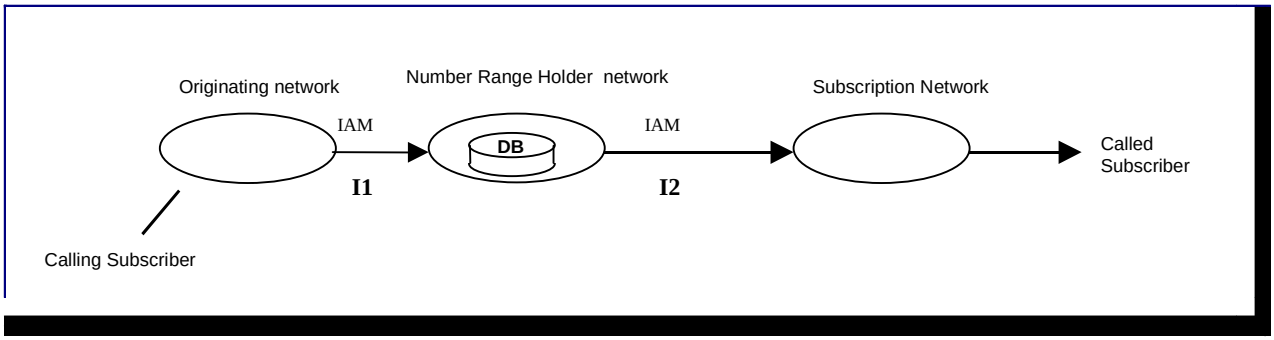

Fig 4.1.1 – "Onward Routing" by Number Range Holder network.

Every Number Range Holder network shall support as a minimum Onward Routing for own number range ported out numbers.

This solution might be a valuable option to avoid major impacts on the network at start-up of MNP. This can only be valid for operators having no charging differentiation between different mobile destination networks.

For completeness it should be noted that one or more Transit networks could be involved between the Originating network and the Number Range Holder network. These Transit networks can either use the Onward routing principle or take actively part in the MNP process (see 4.2, 4.3 and 4.4). To explain the Onward Routing principle, it is assumed that all Transit networks involved apply Onward Routing.

4.1.2 Network operator responsibilities

Originating network :	Uses the traditional routing plan for routing the call to the Number Range Holder network.
Number Range Holder network:	Responsible for retrieving routing information for the ported MSISDN and to route the call to the HPLMN.
HPLMN :	Responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed.

4.1.3 Impact on the ISUP interface

I1 : no impact
I2 : needs to be able to support the used addressing method (see 6. Numbering and Addressing)

4.1.4 Billing impact

When Onward Routing is used, the Originating network has no indication whether the called MSISDN has been ported or not. This means that for inter-operator calls the Originating network operator can not make any billing differentiation, between a call to a MSISDN ported out from its Number Range Holder network and a MSISDN which has not been ported.

An Originating / Transit network might have different interconnect charges with the Number Range Holder network and the HPLMN. With Onward Routing, the Number Range Holder network will also be involved in calls to a MSISDN within its own number range, ported out to another network. No possible solution has been identified to allow the Originating network to verify the interconnect invoices for calls to a MSISDN ported out from the Number Range Holder network.

4.1.5 Pros and Cons

Real-time NP-DB :	**(+) :**	Except for the Number Range Holder, none of the involved networks need to know if the called MSISDN has been ported or not. The size of the NP-DB in the preceding networks will be limited and the maintenance of the ND-PB will be less complex.
Signalling impact :	**(+) :**	Limited impact on signalling over the interconnection.
Optimised Routing :	**(-) :**	For calls to a ported MSISDN, the Number Range Holder network is still used as Transit network, to route the call to the HPLMN. As a consequence the overall network resources are not used as efficient as for calls to a non-ported MSISDN.
Impact on Services :	**(-) :**	A call to a ported MSISDN is still routed via the Number Range

		Holder network. The functionalities of the call will need to be supported by this Number Range Holder network, to allow the call to pass.
Call set-up time :	**(+) :**	A set-up delay will not be introduced by the Originating network for a call to a non-ported MSISDN, since no NP-DB query is performed.
	(-) :	For calls to a ported MSISDN, the call set-up time will be longer, due to the inefficient routing.
Tromboning :	**(-) :**	Tromboning will happen if for a ported-in MSISDN the HPLMN is the same as the Originating network.
Network Complexity :	**(+) :**	Limited impact on the network (e.g. routing algorithms in Originating network don't need to change).

4.2 CALL DROPBACK

4.2.1 General description

With the Call Dropback mechanism, the call to a potentially ported MSISDN is first routed to the Number Range Holder network, without performing a NP-DB query (I2). In the forward direction towards the Number Range Holder network (IAM), an indication needs to be inserted, indicating whether or not the re-routing on Call Dropback is supported. If the MSISDN is ported out from the Number Range Holder network, a REL message (release cause #23), or FAC message, with special indication that the MSISDN has been ported, will be sent back to the preceding network (I2). Re-routing information is enclosed in this release message (retrieved after NP-DB query). Based on the retrieved re-routing information, the previous network will route the call to the HPLMN. If the HPLMN is the same as the Transit network , the call is treated internally within the Transit network.

Note that between the Originating network and the Transit A network and between the Transit A network and the Number Range Holder network, other Transit networks can be involved. The REL/FAC message, generated by the Number Range Holder network, will be sent backwards, until the first network using the Call Dropback mechanism, is reached.

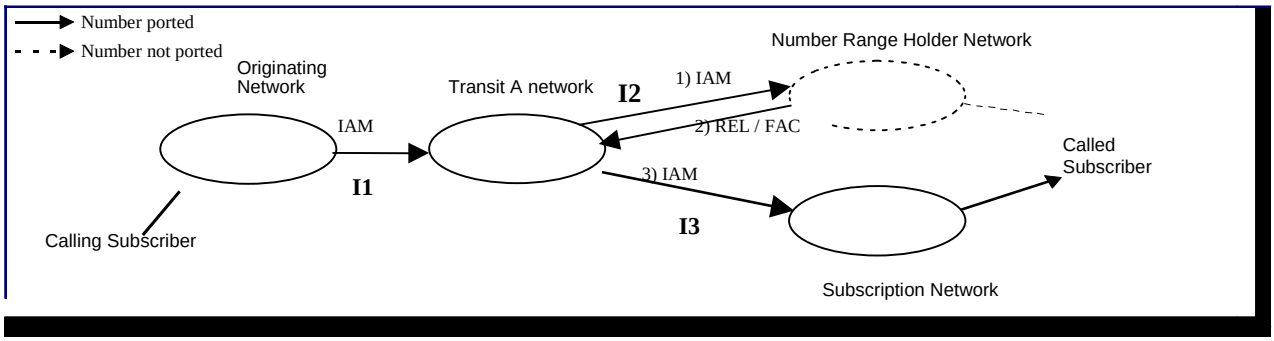

Fig 4.2.1 – "Re-routing on Call Dropback" by Transit network

4.2.2 Network Operator responsibilities

Originating network : Uses the traditional routing plan for routing the call to the Number Range Holder network.

Transit A network : The Transit A network will initially route the call, using the traditional routing plan for routing the call to the Number Range Holder network.
On receipt of the REL message with release cause #23, the Transit A network is responsible to route the call to the HPLMN.

Number Range Holder network: If the MSISDN is not ported, the Number Range Holder network is responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed.
If the MSISDN is ported, the Number Range Holder network retrieves routing information from the NP-DB and will return the REL message (with release cause #23), or the FAC message, containing the routing information.

HPLMN : The HPLMN is responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed.

4.2.3 Impact on the ISUP interface

I1 : no impact
I2 : a bilateral agreement on the use of the Call Dropback mechanism is needed.
I3 : needs to be able to support the used addressing method (see 6. Numbering and Addressing)

4.2.4 Billing Impact

When Call Dropback is used, the Transit network will know which network the ported MSISDN is subscribed to. This means that for inter-operator calls the Transit network operator can make a billing differentiation, between a call to a MSISDN ported out from its Number Range Holder network and a MSISDN which has not been ported.

A Transit network might have different interconnect charges with the Number Range Holder network and the HPLMN. The interconnect invoice issues, as identified with Onward Routing, will not exist for the Transit network involved in the Call Dropback mechanism. These interconnect issues do apply for the Originating network, in case a transit network supporting the Call Dropback functionality is different from the Originating network.

Extra signalling will be sent over the interconnect between the Number Range Holder network and the first network supporting the Call Dropback mechnism. The charging of SS7 signalling, timeslot allocation (until dropback) and database query in the Number Range Holder network can be a point of discussion between the operators agreeing to use the Call Dropback option.

4.2.5 Pros and Cons

Real-time NP-DB :	**(+) :**	Except for the Number Range Holder, none of the involved networks need to know if the called MSISDN has been ported or not. The size of the NP-DB in the preceding networks will be limited and the maintenance of the ND-PB will be less complex.
Signalling impact :	**(-) :**	Signalling information needs to be exchanged, indicating the support of the Call Dropback mechanism and returning the routing information. An agreement between operators is therefore needed. The use of Call Dropback causes an increase of signalling load on the interconnect.
Optimised Routing :	**(+) :**	On receipt of the routing information (from the Number Range Holder) the first network supporting Call Dropback will perform optimised routing towards the HPLMN.
Impact on Services :	**(-) :**	Since the Number Range Holder network is still reached to get routing information, a risk of interference of this network still exists on the functionalities of the call to a ported MSISDN.
Call set-up time :	**(+) :**	A set-up delay will not be introduced by the Originating network for a call to a non-ported MSISDN, since no NPDB query is performed.
	(-) :	For calls to a ported MSISDN, the Number Range Holder

		network is still involved to retrieve routing information. This leads to an increase of the call set-up time.
Tromboning :	**(+) :**	Calls to a ported MSISDN will be released by the Number Range Holder Network. Therefore no tromboning will happen.
Network Complexity :	**(-) :**	The specific signalling needed to support Call dropback is currently not supported by most operators.

4.3 QUERY ON RELEASE

4.3.1 General description

With the Query on Release mechanism, the call to a potentially ported MSISDN is first routed to the Number Range Holder network, without performing a database query (I2). If the MSISDN is ported out from the Number Range Holder network, a REL message with release cause #14 will be sent back to the previous network (I2). On receipt of this special release, this previous network will perform a database query. Based on the retrieved routing information, the call will be routed to the HPLMN. If the HPLMN is the same as the transit network , the call is treated internally within the transit network.

Note that between the Originating network and the Transit A network and between the Transit A network and the Number Range Holder, other Transit networks can be involved. The REL message, generated by the Number Range Holder network, will be sent backwards, until a network, using the Query on Release mechanism, is reached.

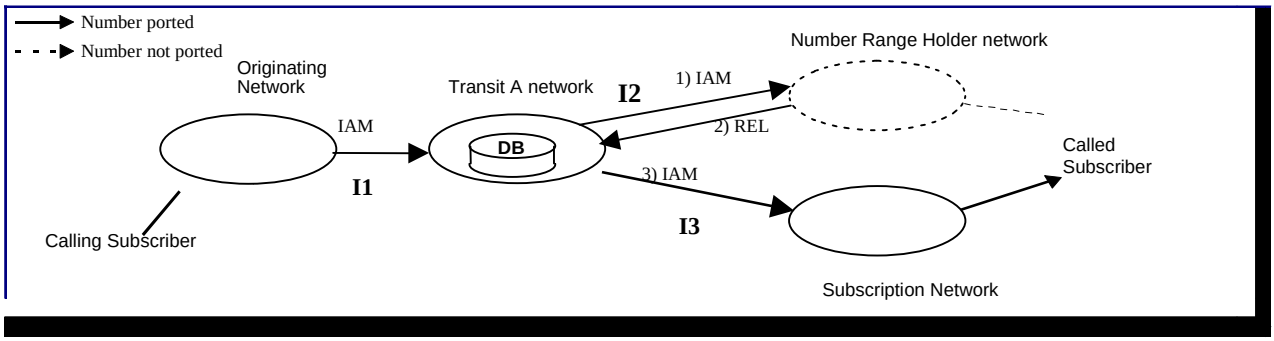

Fig 4.3.1 – "Query on Release" by Transit network

4.3.2 Network Operator responsibilities

Originating network : Uses the traditional routing plan for routing the call to the Number Range Holder network.

Transit A network : The Transit A network will initially route the call, using the traditional routing plan for routing the call to the Number Range Holder network. On receipt of the REL message with release cause #14, the Transit A network is responsible to retrieve routing information (database query) and to route the call to the HPLMN.

Number Range Holder network: For a call to a non-ported MSISDN, the Number Range Holder network is responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed. If the MSISDN is ported, the Number Range Holder network will return the Release message with release cause #14.

HPLMN : The HPLMN is responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed.

4.3.3 Impact on the ISUP interface

I1 : no impact
I2 : a bilateral agreement on the use of release cause #14 is needed.
I3 : needs to be able to support the used addressing method (see 6. Numbering and Addressing)

4.3.4 Billing Impact

When Query on Release is used, the Transit network will know which network a ported MSISDN is subscribed to. This means that for inter-operator calls the Transit network operator can make a billing differentiation, between a call to a MSISDN ported out from its Number Range Holder network and a MSISDN which has not been ported.

Transit A network might have different interconnect charges with the Number Range Holder network and the HPLMN. The interconnect invoice issues, as identified with Onward Routing, will not exist for the Transit network involved in the Query on Release mechanism These interconnect issues do apply for the Originating network, in case a transit network supporting the Query on Release functionality is different from the Originating network.

Extra signalling will be sent over the interconnect between the Interrogating network and the Number Range Holder network. The charging of SS7 signalling and timeslot allocation (until dropback) can be a point of discussion between the operators agreeing to use the Query on Release option.

4.3.5 Pros and Cons

Real-time NP-DB :	**(-) :**	The routing information for each ported MSISDN, relevant to the interconnect where Query on Release is used, needs to be present in the NP-DB of the first network supporting Query on Release. This increases the size and complexity of the NP-DB.
Signalling impact :	**(-) :**	Release cause #14 needs to be supported between the involved networks. An agreement between operators is therefore needed. The use of Query on Release causes an increase of signalling load on the interconnect.
Optimised Routing :	**(+) :**	On receipt of the special release from the Number Range Holder network, the first network supporting Query on Release will perform optimised routing.
Impact on Services :	**(-) :**	A call to a ported MSISDN still involves the Number Range Holder network. A risk of interference of this network still exists on the functionalities of the call to a ported MSISDN
Call set-up time :	**(+) :**	A set-up delay will not be introduced by the Originating network for a call to a non-ported MSISDN, since no NP-DB query is performed.
	(-) :	For calls to a ported MSISDN, the Number Range Holder

network is still involved, to check the portability status. This leads to an increase of the call set-up time.

Tromboning :	**(+) :**	Calls to a ported MSISDN will be released by Number Range Holder network. Therefore no tromboning will happen.
Network Complexity :	**(-) :**	The specific signalling needed to support the Query on Release will need to be supported. The Number Range Holder network needs to be able to distinguish between a ported-out MSISDN and unallocated MSISDN. When the destination is an unallocated MSISDN, the call should be released in a normal way (Release Cause 1 "Unallocated Number"). When the destination has been ported out, the call needs to be released with the special release (Release Cause 14).

4.4 ALL CALL QUERY

4.4.1 General description

This principle requires a NPDB query, prior to routing the call towards the HPLMN.

In the scenario in fig 4.2.1, the Transit A network has access to the NP-DB to retrieve the routing information, corresponding to the potentially ported MSISDN. If the MSISDN is ported, the call will be routed to the HPLMN (I3). If the MSISDN is not ported (i.e. Number Range Holder network = HPLMN), the call will be routed towards the Number Range Holder network (I2).

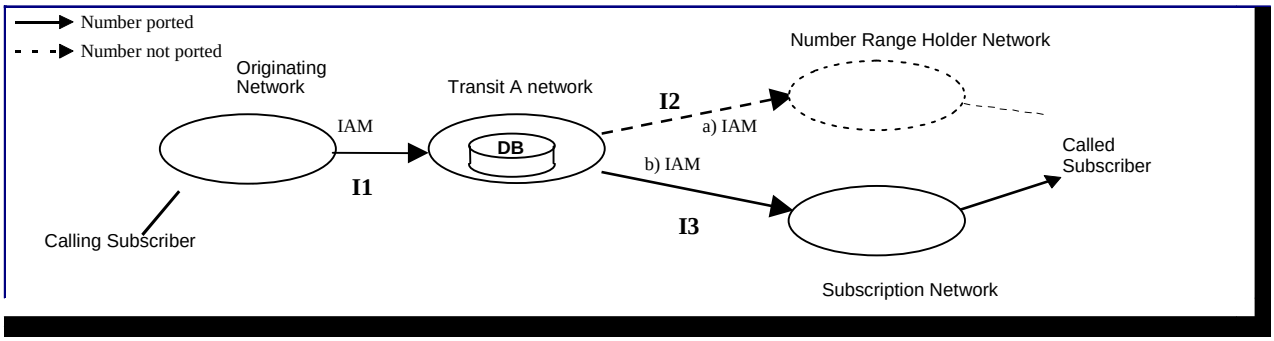

Fig 4.4.1 – "All Call Query" by Transit network

This solution might become a more valuable option as the number of ported MSISDN increases.

4.4.2 Network Operator responsibilities

Originating network :	Uses the traditional routing plan for routing the call to the Number Range Holder network.
Transit A network :	Responsible for retrieving routing information (database query function) and to route the call to the HPLMN (or Number Range Holder network, if the MSISDN is not ported)
Number Range Holder network:	If the MSISDN is not ported, the Number Range Holder network is responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed. If the MSISDN is ported, the Number Range Holder network is not involved.
HPLMN :	The HPLMN is responsible for retrieving the location information (SRI) from the HLR where the called MSISDN is subscribed.

4.4.3 Impact on the ISUP interface

I1 : no impact
I2 : no impact
I3 : needs to be able to support the used addressing method (see 6. Numbering and Addressing)

4.4.4 Billing Impact

When All Call Query is used, the Originating network will know which network a ported MSISDN is subscribed to. This means that for inter-operator calls the Originating network operator can make a

billing differentiation, between a call to a MSISDN ported out from its Number Range Holder network and a MSISDN which has not been ported.

An Transit network might have different interconnect charges with the Number Range Holder network and the HPLMN. With All Call Query, all Serving Network Functionalities are performed by the Transit network. The interconnect invoice issues, as identified with Onward Routing, will not exist for the Transit network performing All Call Query. These interconnect issues do apply for the Originating network, in case a transit network supporting All Call Query is different from the Originating network.

4.4.5 Pros and Cons

Real-time NP-DB :	(-) :	The network performing the query, needs to be able to retrieve the routing information for each ported MSISDN in the portability domain. The routing information for each ported MSISDN needs to be present in the NP-DB of the Interrogating network. The NP-DB query for non-ported MSISDN will require extra database transactions. This increases the size and complexity of the NP-DB.
Signalling impact :	(+) :	Limited impact on interconnect signalling network.
	(-) :	Extra network internal signalling for calls to a non-ported MSISDN.
Optimised Routing :	(+) :	For all calls within the portability domain, optimised routing is performed for the first network performing All Call Query.
Impact on Services :	(+) :	The Number Range Holder network is not involved in a call to a ported MSISDN. No impact on the functionalities of the calls will be imposed.
Call set-up time :	(+) :	Minimal delays for calls to a ported MSISDN, since Number Range Holder network is not involved.
	(-) :	For a call to a non-ported MSISDN, a delay to perform the query will be introduced.
Tromboning :	(+) :	All Serving Network Functionalities are performed by the Originating network. Therefore no tromboning will happen.
Network Complexity :	**(+) :**	Limited impact on the network.

4.5 COMPARISON BETWEEN DIFFERENT ROUTING MECHANISMS

	Onward Routing	Call Dropback	Query on Release	All call Query
Real-time NPDB	(+) Routing information needs to be present for the own ported numbers only.	(+) Routing information needs to be present for the own ported numbers only.	(-) Routing information for the ported MSISDN, relevant to the interconnection for which the Query on Release is activated, needs to be present in the NPDB.	(-) The routing information for each ported MSISDN within the portability domain needs to be present in the NP-DB.
Signalling Impact	(+) Limited impact on interconnect signalling.	(-) The use of the Call Dropback mechanism causes an increase of signalling load on the interconnect.	(-) The use of the Query on Release mechanism causes an increase of signalling load on the interconnect.	(+) Limited impact on interconnect signalling. (-) Increase in internal signalling for calls to non-ported MSISDN.
Optimised Routing	(-) Inefficient use of network resources for call to ported MSISDN.	(+) Efficient use of network resources.	(+) Efficient use of network resources.	(+) Efficient use of network resources.
Impact on Services	(-) Functionalities of calls to a ported MSISDN need to be supported by Number Range Holder network.	(-) A risk of interference of the Number Range Holder network exists on the functionalities of the call to a ported MSISDN.	(-) A risk of interference of the Number Range Holder network exists on the functionalities of the call to a ported MSISDN.	(+) No impact of Number Range Holder network on functionalities of the calls to a ported MSISDN.
Call Set-up time	(-) For calls to a ported MSISDN the call set-up time will be longer due to the inefficient routing.	(-) For calls to a ported MSISDN the call set-up time will be longer due to the retrieval of routing information from the Number Range Holder.	(-) For calls to a ported MSISDN the call set-up time will be longer due to the check of the portability status by the Number Range Holder.	(-) A NP-DB query is also done for non-ported numbers. This will cause an increased call set-up time for calls to a non-ported MSISDN.
Tromboning	(-) For calls to a ported-in MSISDN, if Originating network is the same as the HPLMN, tromboning will exist.	(+) No tromboning.	(+) No tromboning.	(+) No tromboning.
Network Complexity	(+) Limited impact on network	(-) The specific signalling needed to support the Call Dropback is currently not supported by most operators.	(-) The specific signalling needed to support the Query on Release will need to be supported.	(+) Limited impact on network.
Billing Impact	(-) Number Range Holder network will serve as Transit network. A transit offer needs to be defined.	(-) The charging of SS7 signalling and the NP-DB query can be a point of discussion.	(-) The charging of SS7 signalling can be a point of discussion.	(+) No billing impacts identified.

Fig 4.5 – Comparison between different routing mechanisms

5 QUERY MECHANISMS

5.1 DATABASE QUERY FUNCTION

The Database Query Function is the function accessing the NP-DB in order to ascertain whether or not a MSISDN is ported. As a result routing information is retrieved, which, depending on the used routing mechanism, can be used to assure the routing of the call to the appropriate destination.

The set-up delay, introduced by this query function should be negligible and will not depend on the used routing mechanism.

5.2 IN CALL-RELATED TECHNICAL SOLUTIONS

5.2.1 Originating call Query on Digit Analysis – OQoD

In this case, the Originating network already has the ability to check whether the called MSISDN is ported or not.

A call is initiated by customer A to a MSISDN belonging to PLMN B (1). As a result of analysis of the received MSISDN, the VMSCA performs a database query to the NP-DB, to find out if the MSISDN is ported or not (2).

If the MSISDN is not ported, the VMSCA will continue the normal set-up procedure (3).

If the MSISDN is ported, the NPDB will return routing information indicating the HPLMN. The Originating network can route the call directly to the HPLMN without involving the Number Range Holder network (3).

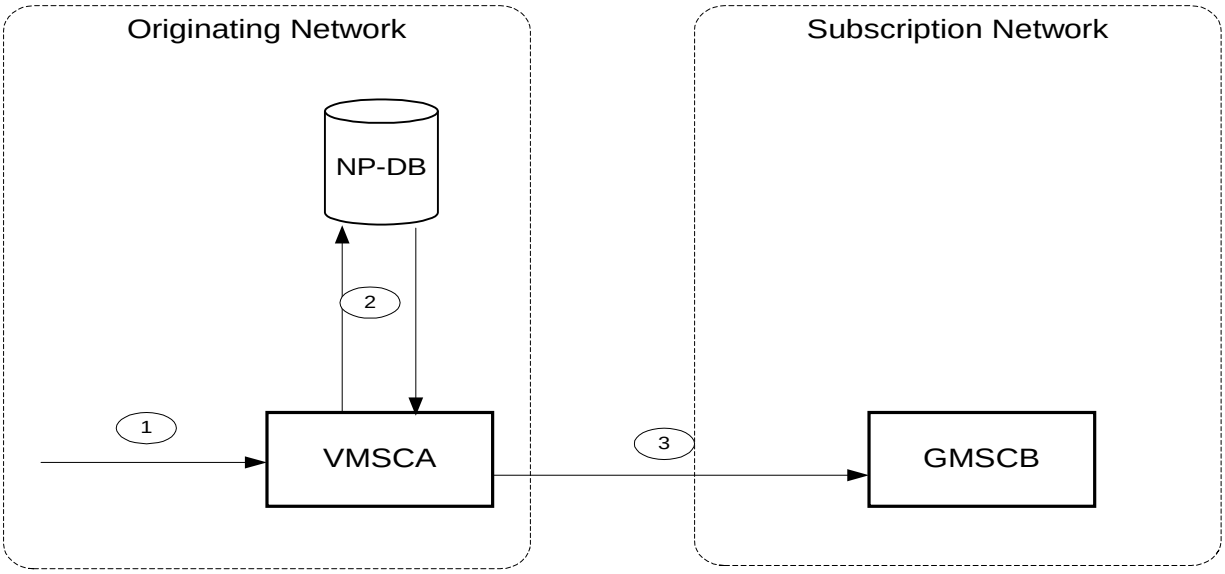

Fig 5.1.1 – OQoD – Originating Call Query on Digit Analysis.

5.2.2 Terminating call Query on Digit Analysis – TQoD

This query mechanism can be used if the Number Range Holder network originates the call or if the Number Range Holder network needs to support onward routing. The Originating network, if not the same as the Number Range Holder network has no knowledge whether the MSISDN has been ported or not and uses the traditional routing plan for routing the call to the Number Range Holder network.

5.2.2.1 Call to non-ported MSISDN

When the GMSC in the Number Range Holder network receives a call to a potentially ported MSISDN of its own number range (1), it will send a database query to the NP-DB (2).

If the MSISDN is not ported, the NPDB will instruct the GMSC to continue the normal call set up procedure. The HLR interrogation (3) will provide the MSRN, necessary to route the call to the Visitor network (4).

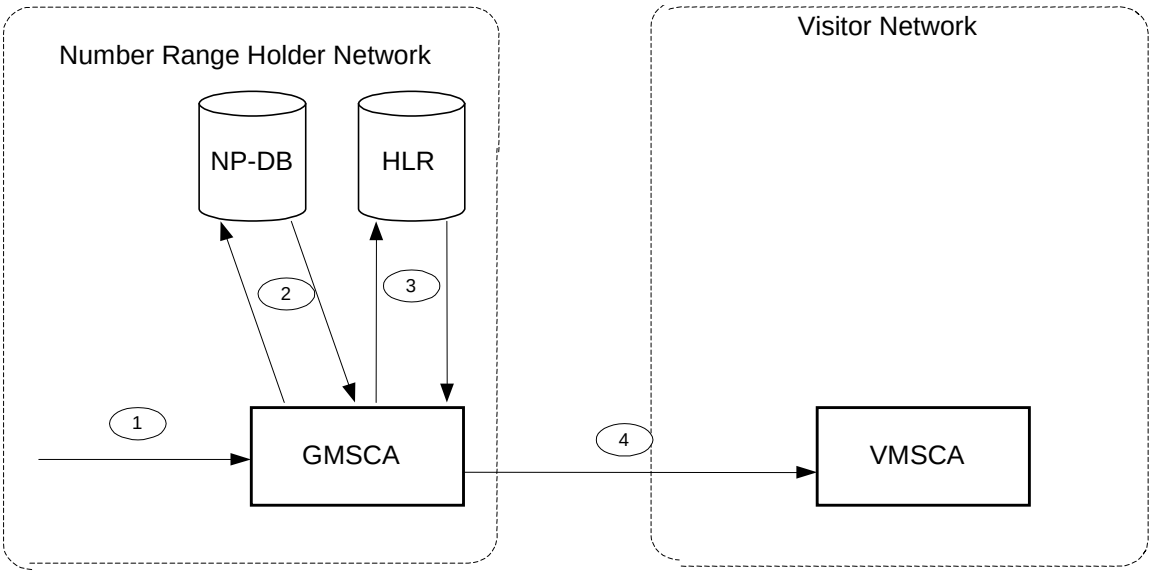

Fig 5.1.2.1 – TQoD - Call to a non-ported MSISDN

5.2.2.2 Call to ported MSISDN

When the GMSC in the Number Range Holder network receives a call to a potentially ported MSISDN of its own number range (1), it will perform a NP-DB query (2).

If the MSISDN is ported, the NP-DB will provide the routing information, necessary to route the call to the HPLMN (3).

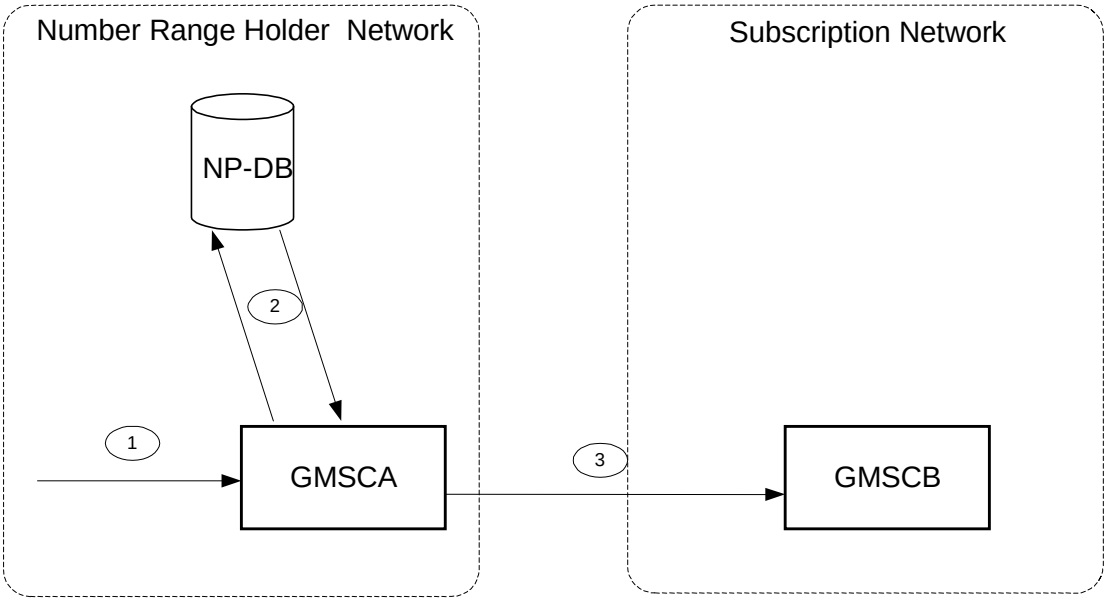

Fig 5.1.2.2 – TQoD - Call to a ported MSISDN

5.2.3 Query on HLR release - QoHR

This query mechanism can be used if the Number Range Holder network originates the call or if the Number Range Holder network needs to support onward routing. The Originating network, if not the same as the Number Range Holder network, has no knowledge whether the MSISDN has been ported or not and uses the traditional routing plan for routing the call to the Number Range Holder network.

5.2.3.1 Call to ported MSISDN

When GMSCA receives the IAM, it requests routing information by submitting a MAP SRI to the HLRA including the MSISDN in the request.

If the MSISDN is ported, the HLRA returns a MAP SRI ack with an “Unknown Subscriber” error (no record found).

If the QoHR mechanism is supported, the GMSCA, on receipt of the error indication, will perform a NPDB query, including the MSISDN. The received routing information will allow the Number Range Holder network to route the call to the HPLMN.

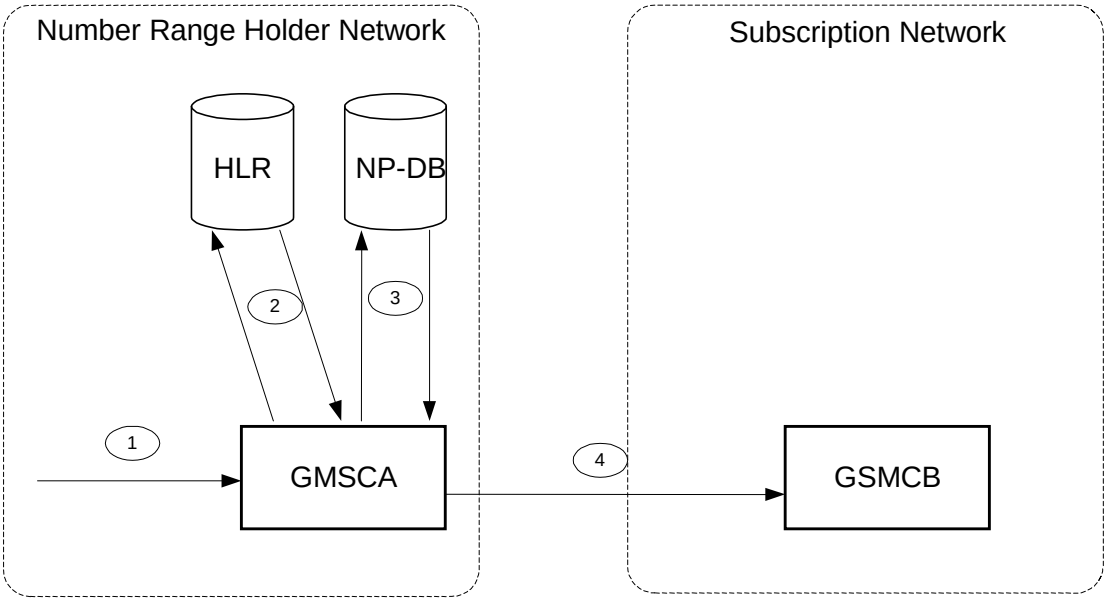

Fig 5.1.3.1 – QoHR - Call to a ported MSISDN

If the QoHR mechanism is not used, on receipt of the error indication, the Number Range Holder network can start either the Query on Release procedure either the Call Dropback procedure, depending on the indications forwarded by the preceding network (see “4.2 Call Dropback” and “4.3 Query on Release”).

5.3 SRF CALL-RELATED TECHNICAL SOLUTIONS

In a PLMN supporting the MNP database query, call related signalling messages are relayed by an MNP-SRF within the own PLMN. The MNP-SRF obtains routing information from the NP-DB to identify the HPLMN associated with a particular national MSISDN.

From the perspective of the PLMN in which the MNP-SRF resides (PLMN performing the database query), the called MSISDN will be one of the following :

- **Case 1 :** Own MSISDN ported out (section 5.2.1)
- **Case 2 :** Own MSISDN not ported out (section 5.2.2)
- **Case 3 :** Foreign MSISDN ported in (section 5.2.2)
- **Case 4 :** Foreign MSISDN not known to be ported (section 5.2.1)
- **Case 5 :** Foreign MSISDN ported to another foreign network (section 5.2.1)

In Case 1 and 5, a SRI ack is sent back to the GMSC, containing routing information indicating the HPLMN. The Call flow for Case 4 is the same, but the routing of the call towards the Number Range Holder network is done based on the MSISDN.

In Case 2 and 3, the MNP-SRF relays the message to the HLR, containing the customer data for the called MSISDN.

5.3.1 MSISDN not subscribed in Interrogating network (Case 1, 4, 5)

In case the customer is ported to another network (case 1, 5), the calls can be routed with or without reference to the new HPLMN.

In case a foreign customer is not known to be ported (case 4), only the routing with no reference to the HPLMN can be used.

In all cases the use of routing with no reference to the HPLMN is proposed by the M-PT2 forum.

Routing with reference to the HPLMN :

If routing with reference to the new HPLMN is used, the SRF function of the PLMN is requested to send the routing information back to the Interrogating GMSC (SRI ack containing RN+MSISDN). The signalling flow will be similar to the one for the non-call related equivalent.

Routing with no reference to the HPLMN :

When the GMSCA receives a call to a potentially ported MSISDN (1), it requests information about the location of the called MSISDN, by sending a SRI message (2). The MNP-SRF obtains routing information from the NP-DB (3).

If the MSISDN is ported out from the interrogating network, or ported from a foreign network to another foreign network, the MNP-SRF will return a SRI ack message (4), containing routing information indicating the HPLMN.

If the MSISDN is not known to be ported, the MNP-SRF will return a SRI ack message (4), containing the MSISDN number only. The call will be routed to the Number Range Holder network, using the MSISDN.

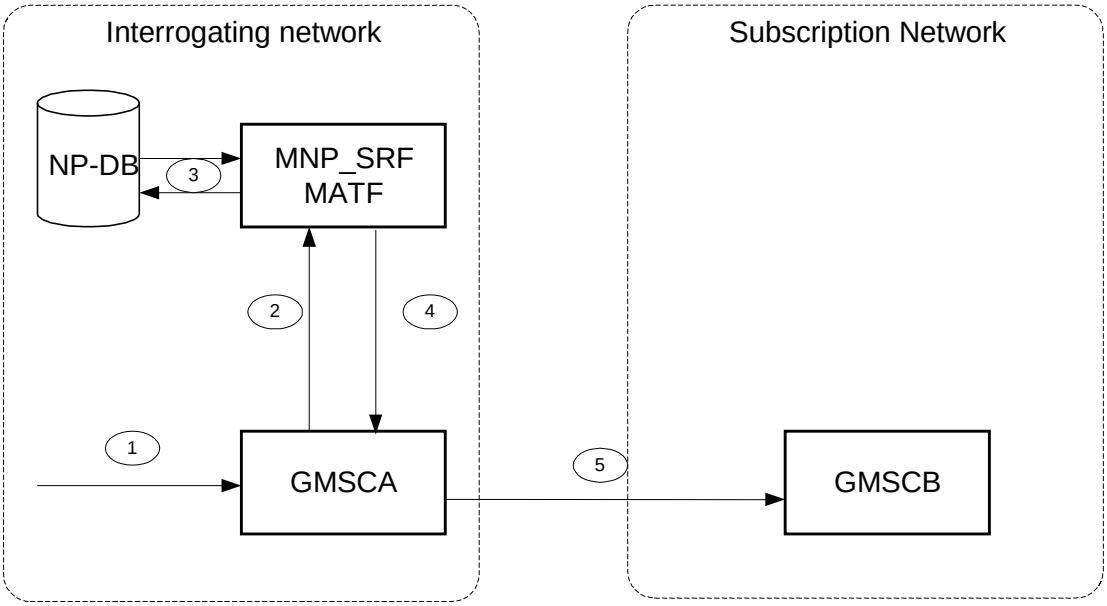

Fig 5.2.1 – SRF call related function – MSISDN not subscribed in Interrogating network

5.3.2 MSISDN subscribed in Interrogating network (Case 2, 3)

When the GMSCA receives a call to a potentially ported MSISDN (1), it requests information about the location of the called MSISDN, by sending a SRI message (SRI). The MNP-SRF obtains routing information from the NP-DB (3).

If the MSISDN is not ported out from the interrogating network, or is ported in from a foreign network, the MNP-SRF will send the SRI message to the HLR containing the customer data of the called MSISDN (4).

When the HLR receives the SRI, it responds to the GMSCA by sending a SRI ack message with a MSRN that identifies the Visitor network (5). The call is routed to the Visitor network, based on the MSRN (6).

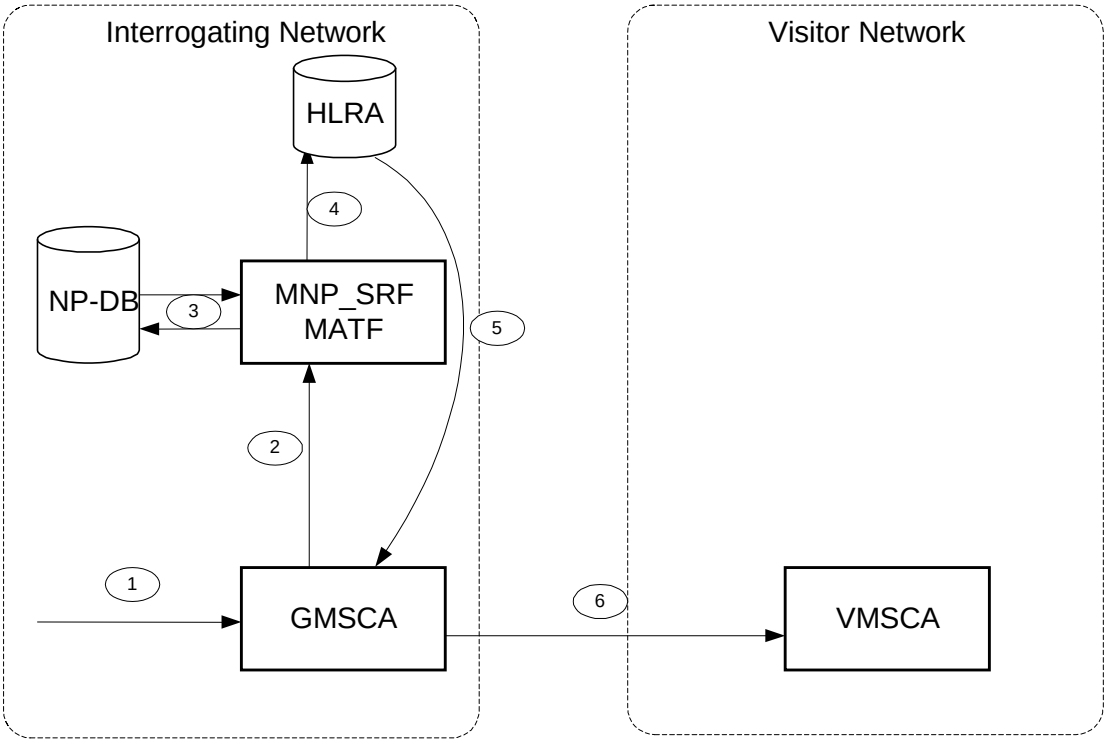

Fig 5.2.2 – SRF call related function – MSISDN subscribed in Interrogating network

5.4 NON-CALL-RELATED TECHNICAL SOLUTIONS

In a PLMN supporting the MNP database query, non-call related signalling messages are relayed by an MNP-SRF within the own PLMN. The MNP-SRF obtains routing information from the NP-DB to identify the HPLMN associated with a particular national MSISDN.

If the PLMN does not support the NP-DB query, non-call related signalling will be relayed to a MNP-SRF within the Number Range Holder network.

From the perspective of the PLMN in which the MNP-SRF resides (PLMN performing the NP-DB query), the called MSISDN will be one of the following :

- **Case 1 :** An own MSISDN ported out
- **Case 2 :** An own MSISDN not ported out
- **Case 3 :** A foreign MSISDN ported in
- **Case 4 :** A foreign MSISDN not known to be ported
- **Case 5 :** A foreign MSISDN ported to another foreign network

In Case 1, 4 and 5 the MNP-SRF relays the message to the HPLMN.

In Case 2 and 3, the MNP-SRF relays the message to the HLR, containing the customer data for the called MSISDN.

The only application for non-call related signalling, active on the national inter-PLMN connections, is the Short Message Service (SMS). The different non-call related cases will be described by means of the SMS application.

5.4.1 MSISDN not subscribed in Interrogating network (Case 1, 4, 5)

When the GMSCA receives a Forward_SM to a potentially ported MSISDN (1), it requests information about the location of the called MSISDN, by sending a SRI_for_SM message (2). The MNP-SRF obtains routing information from the NP-DB (3).

If the MSISDN is ported out from the interrogating network, or ported from a foreign network to another foreign network, the MNP-SRF will send a SRI_for_SM message to the HPLMN (4), containing routing information indicating the HPLMN.

If the MSISDN is not known to be ported, the MNP-SRF will send a SRI_for_SM message to the Number Range Holder network (4), containing the MSISDN number only.

The MNP-SRF within the HPLMN (or Number Range Holder network if the MSISDN is not known to be ported) will interrogate the HLR containing the customer data, to obtain a MSC address indicating the Visitor Network (5). A SRI_for_SM ack message, containing the obtained MSC address, will be returned to the GMSCA of the Interrogating network (6).

A Forward_SM message will be send to the Visitor Network, using the MSC address (7).

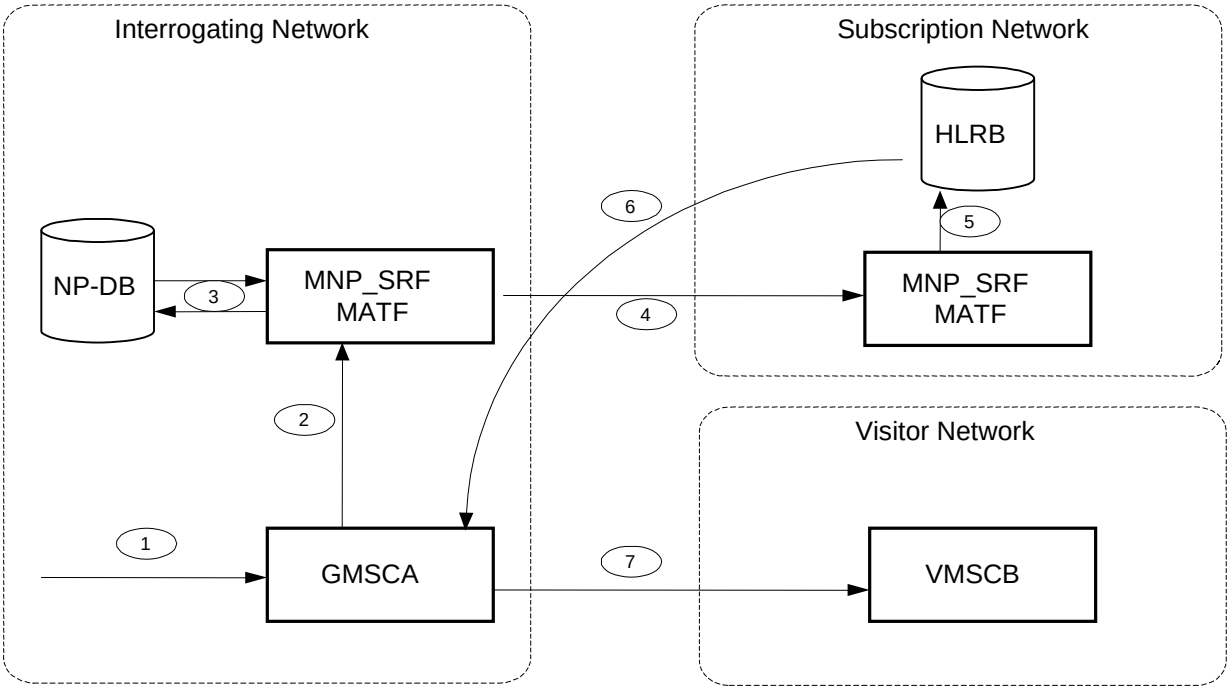

Fig 5.3.1 – SRF non-call related function – MSISDN not subscribed in Interrogating network

5.4.2 MSISDN subscribed in Interrogating network (Case 2, 3)

When the GMSCA receives a Forward_SM to a potentially ported MSISDN (1), it requests information about the location of the called MSISDN, by sending a SRI_for_SM message (2). The MNP-SRF obtains routing information from the NP-DB (3).

If the MSISDN is not ported out from the interrogating network, or is ported in from a foreign network, the MNP-SRF within the Interrogating network will interrogate the HLR containing the customer data, to obtain a MSC address indicating the Visitor Network (4). A SRI_for_SM ack message, containing the obtained MSC address, will be returned to the GMSCA (5).

A Forward_SM message will be send to the Visitor Network, using the MSC address (6).

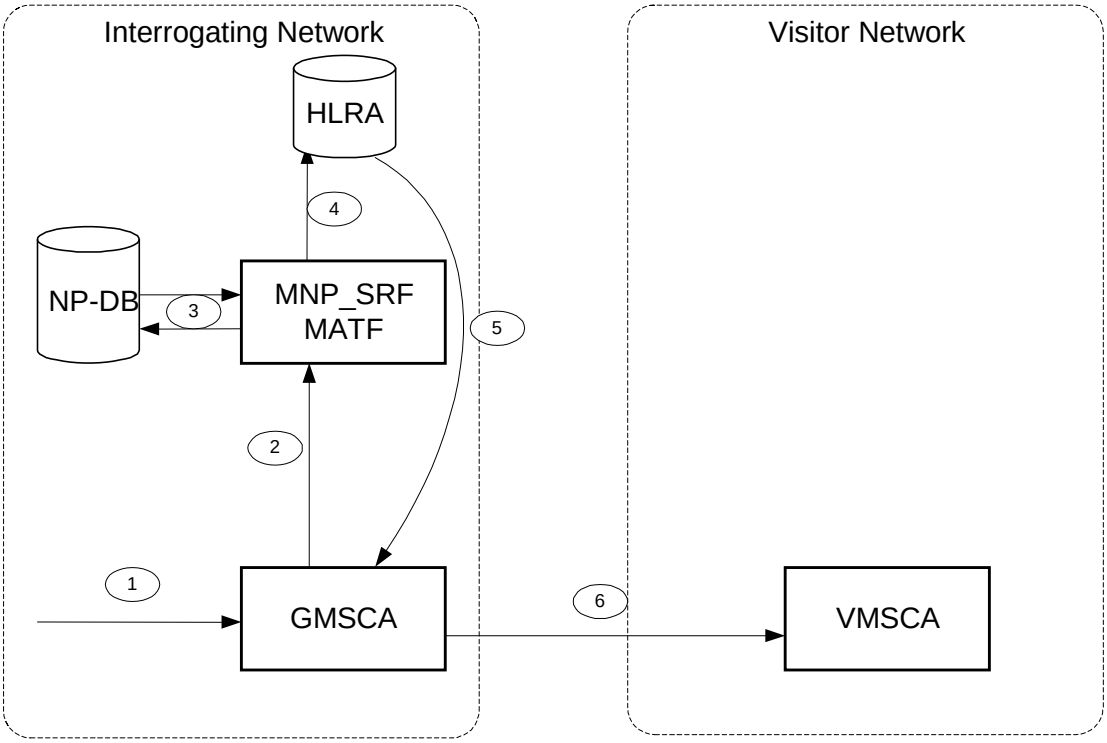

Fig 5.3.2 – SRF non-call related function – MSISDN subscribed in Interrogating network

6 NUMBERING AND ADDRESSING

Once an Interrogating network has determined that a MSISDN has been ported, two methods can be supported for the exchange of information on the interface between the Interrogating network and the Number Range Holder network :

- No routing information is exchanged on the interface between both operators. This solution consists in sending the "MSISDN only" on the interface. No distinction is made between a ported and a non-ported MSISDN on the interface.
- Routing information is exchanged on the interface between both operators for a ported MSISDN.

6.1 ADDRESSES AND NUMBERS

This section describes the numbering and addressing to be applied, in case the routing information is exchanged on the SS7 interface.

For Non-Call related SCCP signalling, only the Concatenated address layout (section 6.1.1) can be used for the SCCP Called Party Address.

With Mobile Number Portability, it is no longer sufficient to use the destination MSISDN to identify the HLR in the HPLMN where the customer data of a ported MSISDN are stored. Additional information, the Routing Number (RN), is needed to be able to route the call. The used address layout may have one of the following formats :

- Concatenated address (section 6.1.1)
- Separated address (section 6.1.2)

6.1.1 Concatenated address layout

With this type of address, the MSISDN and RN are concatenated in the ISUP Called Party Number (call related) and SCCP Called Party Address (non-call related) signalling field.

This field will therefore have the following format :

Call Related :

RN	MSISDN

Where RN = Routing Number (defined in 6.2)
MSISDN = Mobile Station ISDN (national format without leading '0').
Nature of Address : UNKNOWN/Spare

Non-Call Related : *(TO BE VALIDATED BEFORE NEXT REVIEWED VERSION)*

RN	MSISDN

Where RN = Routing Number (defined in 6.2)
MSISDN = Mobile Station ISDN (national format without leading '0').
Nature of Address indicator : National Significant

In Belgium, the solution of concatenated address layout has been chosen for the Fixed Number Portability implementation and is recommended by the M-PT2 forum as well.

6.1.2 Separated address layout

With this addressing type, the Routing Number and MSISDN are carried in two different fields in the signalling messages. The address, identifying the destination of the ported MSISDN (i.e. RN), is used to route the call. The MSISDN is transparently carried in a separate signalling parameter and is only used by the HPLMN, to set up the call.

This possibility will be studied in detail when ETSI / ITU-T documents will be stable.

6.2 ADDRESSABLE ENTITIES FOR ROUTING PURPOSES

Entities which need to be addressed by a routing number (RN) are identified in this section. It is the responsibility of the HPLMN to provide the RN.

The different solutions are :

- **HPLMN :** in this solution, the RN identifies the network where the customer will be located on completion of the porting process. The HPLMN will be responsible to ensure the correct HLR is interrogated.
- **HLR in the HPLMN :** in this solution, the RN identifies the HLR in the HPLMN where the customer data of the ported MSISDN are stored.

With the use of the Concatenated Address layout, initially, the RN shall contain the hexadecimal digit 'C', because :

- It avoids National Numbering Plan capacity consumption.
- It is in line with the Fixed Number Portability implementation and the implementation of Carrier Selection routing.

In this case the used Nature of Address for the ISUP Called Party Number will be "Unknown / Spare", in compliance to the Belgacom ICX C2213. The SCCP Called Party Address will have the *(inter)*national format.

In the long run, the hexadecimal digit 'C' can be abandoned from the SS7 Concatenated Address layout, by using the ITU-T standard NoA value 0001000 "Network Routing Number concatenated with Called Directory Number". The migration to this solution has to be analysed in detail when the ETSI / ITU-T documents will be stable.

Depending on the solution for the addressable entity, the following coding of the RN is proposed by the M-PT2 forum :

HPLMN : 'C'4Q00

Where Q corresponds to the PLMN (Q=4 for Dolphin)
(Q=7 for Belgacom Mobile)
(Q=8 for KPN)
(Q=9 for Mobistar).

HLR in the HPLMN : 'C'4Qyz

Where Q corresponds to the PLMN (Q=4 for Dolphin)
(Q=7 for Belgacom Mobile)
(Q=8 for KPN)
(Q=9 for Mobistar).

yz corresponds to an index (01…yz…99) chosen by the new HPLMN.

For reasons of simplicity on the interconnect, the Mobile PT2 forum proposes the first solution (one RN for each operator) to be used at an initial stage. This will however have impact on the keeping up to date of the real-time database and needs therefore to be validated by M-PT3 and PT F M.

7 INTERWORKING WITH OTHER SERVICES

7.1 CLI BASED SERVICES

None of the CLI based services (CLIP/CLIR) should be affected by the porting operation.

7.2 COLP/COLR

The connected line identity presentation / restriction, if supported on the interconnect, must not be impacted by the porting operation.

7.3 ORIGINALLY CALLED NUMBER

This signalling parameter must contain the originally called number (in case of call forwarding or number translation). Precautions should be taken to avoid that the routing information appears in this parameter.

7.4 CCBS

Today this service is not supported on the interconnect between the network operators. Once supported, it will be affected as other non-call related signalling scenarios.

7.5 ROAMING

7.5.1 Call Related roaming cases

No technical impact of MNP on call related roaming cases has been detected so far. The HPLMN should be able to offer the same roaming services to its ported and non-ported customers.

7.5.2 Non-Call Related roaming cases

The following SMS cases will be impacted by the implementation of MNP if no roaming agreement exists between the F-PLMN and the Number Range Holder Network.

7.5.2.1 SMS from F-PLMN

In the case below, when the F-PLMN has no roaming agreement with the Number Range Holder network, two situations might occur :

- F-PLMN does not send SRI-for-SM to Number Range Holder Network
- F-PLMN sends SRI-for-SM to Number Range Holder network, which aborts the attempt to deliver the SMS.

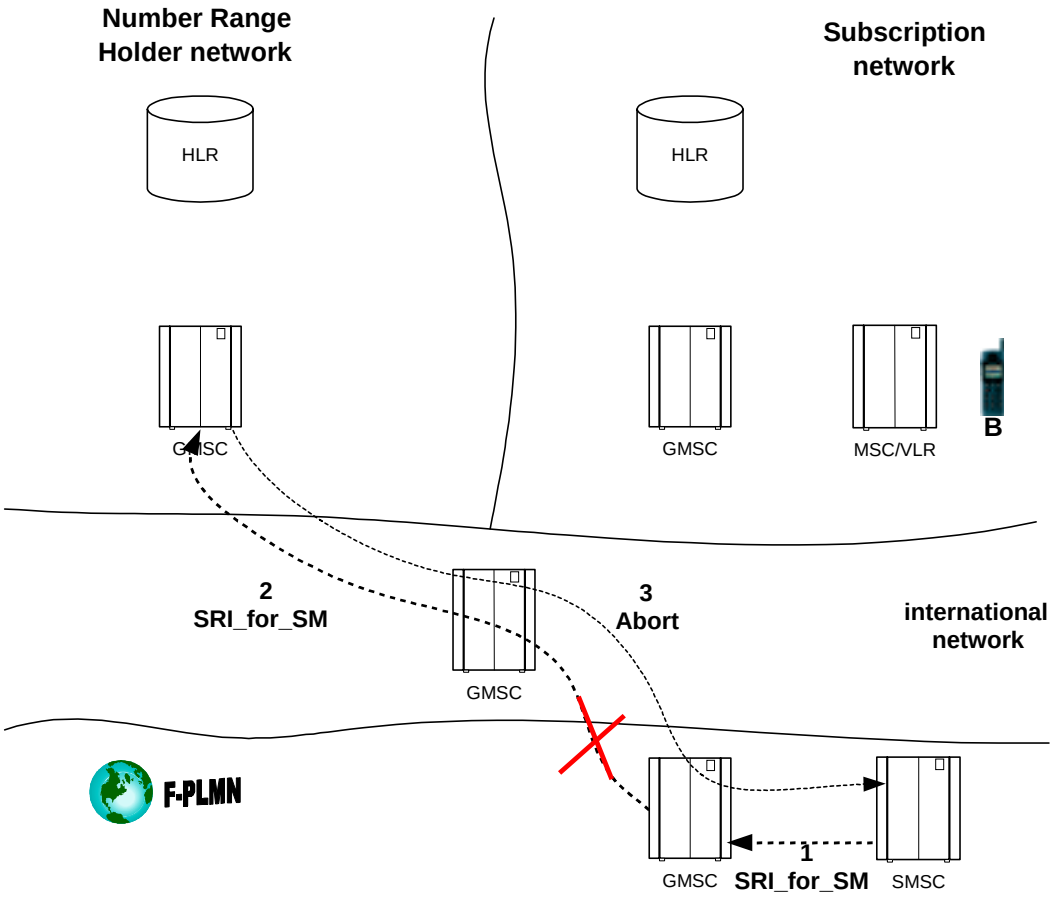

Fig 7.1.2.1 – SMS from foreign PLMN

7.5.2.2 SMS from Number Range Holder network

In the scenario below, when the F-PLMN has no roaming agreement with Number Range Holder network, two situations can occur :

- Number Range Holder network does not send Forward_SM to F-PLMN
- Number Range Holder network sends Forward_SM to F-PLMN, which aborts the attempt to deliver the SMS.

This constraint has already been detected during the opening of the SMS service between the different national operators and is not caused by the introduction of MNP.

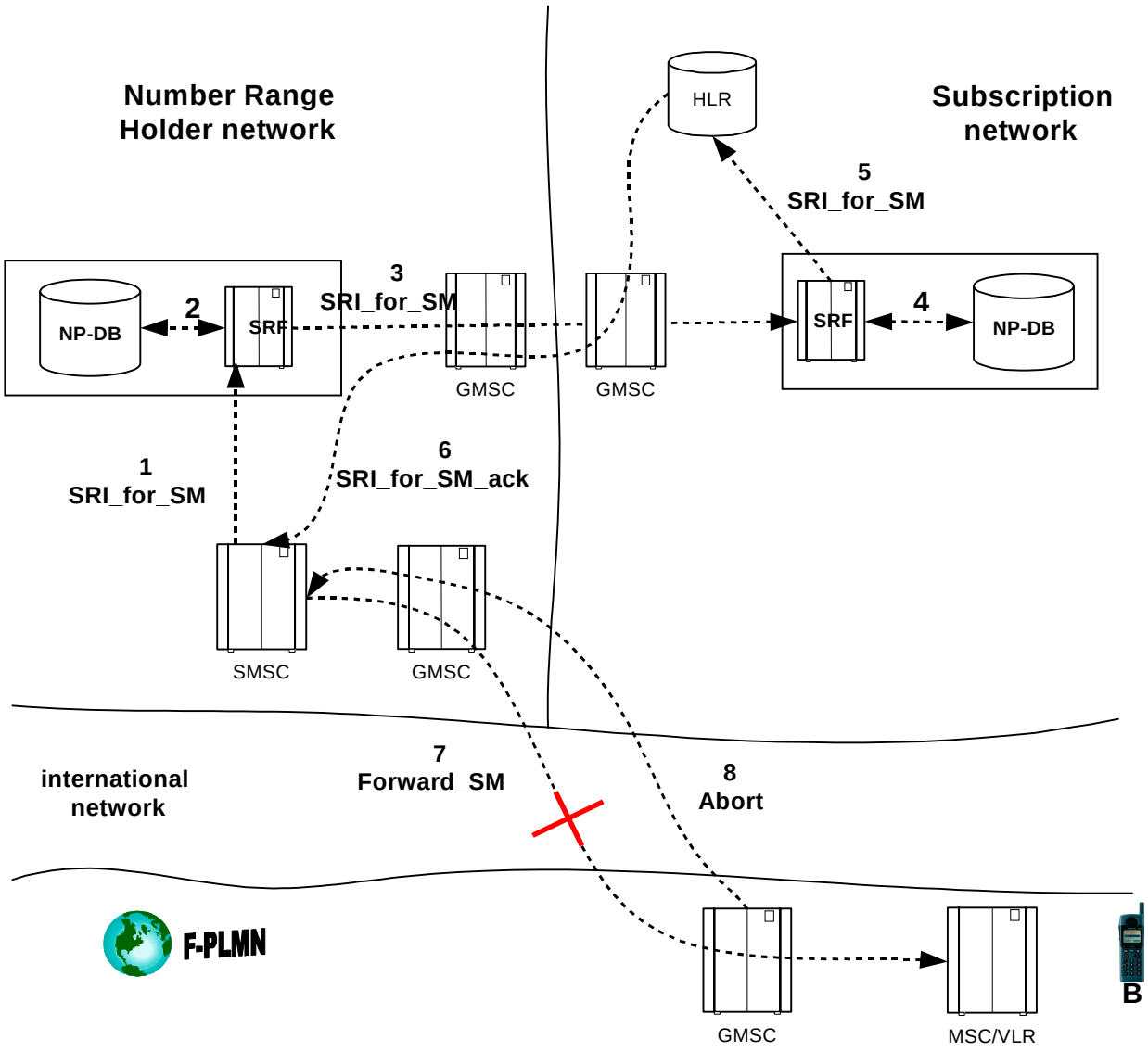

Fig 7.1.2.2 – SMS from Number Range Holder network

7.6 CARRIER (PRE-)SELECTION

For a Carrier selection call, the selected carrier is responsible to handle the call. This is valid independent of the porting status of the called MSISDN.

The real Originating network may not use the All Call Query solution for carrier selection calls. As a carrier is chosen, the call has to be routed to this Carrier following the agreed routing principles between Originating and Carrier operators.

The Carrier network acts as the Originating Network in the number portability concept. It will handle the calls in the same way as the calls really originating from its own network. If between the Number Range Holder network and the Carrier network the Query on Release solution is used, the release cause may not be sent back to the real Originating network.

7.7 INTERNATIONAL INCOMING CALLS

The network containing the international gateway, acts as the Originating Network in the number portability concept. It is the first network in the path able to detect whether the addressed MSISDN is ported or not. It will handle the calls in the same way as the calls really originating from its own network.

7.8 CALL FORWARDING

The network forwarding a call to a ported MSISDN, acts as the Originating Network in the number portability concept. It will handle the calls in the same way as the calls really originating from its own network.

8 MAIN CONCLUSIONS

- Every Number Range Holder network shall support as a minimum Onward Routing for own number range ported out numbers.
- In order to support Onward Routing, every operator can choose between TQoD, QoHR and SRF.
- Every originating operator can independently choose to implement OQoD or SRF for optimal routing.
- Query on release on the interfaces can be implemented between networks supporting ISUP cause #14. In this case, T8 should be small (preferably ~=0) and local Real Time NP-DB updates should be automated.
- Call Dropback can be implemented between networks supporting it.
- Every originating operator can independently choose to optimally route traffic to ported fixed numbers.
- Every mobile operator needs to support the SRF option for non-call related signalling.
- The format of the RN for Mobile operators is as described in section 6.2.
- Every operator to ensure the correctness of his local real-time NPDB
- Towards networks with whom Onward Routing is used, a Donor network shall support Onward Routing for subsequent portings during the porting process (delay between information broadcast & update of Real Time NP-DBs).
- Some roaming constraints have been identified, all linked to the sending of SMS to/from a foreign PLMN.
- The choice of the optimal short- and long term routing or query solutions will depend on the costs involved. Therefor a strong link will exist between the technical and economical aspects.

9 CONSTRAINTS

9.1 INTERWORKING GSM - TETRA

Currently no SMS interconnect agreement exists between TETRA and GSM operators. All SMS aspects discussed in this PT2 deliverable, are currently not applicable for a TETRA network operator.

9.2 SOLUTIONS MATRIX

The matrix below indicates the constraints each operator has identified in supporting the different technical options.

MNP PT2 Possible mechanisms						
	Proximus	**Mobistar**	**KPNO**	**Dolphin**	**FOLO**	**Decision forum**
Onward Routing Mobile Numbers Originating						OI
Onward Routing Fixed Numbers Originating						OI
Onward Routing Mobile Numbers Transit	MS	MS	MS	MS		IA
Onward Routing for Subsequent Portings (T8)	MS	MS	MS	MS		IA
Originating call Query on Digit Analysis Mobile Numbers						OI
Originating call Query on Digit Analysis Fixed Numbers						OI
Query on Release on the interface	C	CL	C	No		IB
Call Dropback	No	CL	?	No		IB
SRF Call Related						OI
SRF Non Call Related (SMS)	MS	MS	MS	n/a		IA

Legend

Must do	M
Can do	C
Can not do	No
As from the start	S
Later on	L
Interoperator All	IA
Interoperator Bilateral	IB
Operator Internal	OI
Not applicable	n/a