

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

BIPT

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1. Scope

The purpose of the document is to define the network architecture and the signalling mechanisms needed for the support of Number Portability in Belgium.

The scope of Number Portability in this document is limited to Geographic Number Portability, as described in the law of 21 March 1991 article 105bis §6.

2. References

- [1] ETSI TR 101 118 High Level Network Architectures and Solutions to Support Number Portability
 - [2] ETSI TR 101 122 Numbering and Addressing for Number Portability
 - [3] Draft ITU-T recommendation Q.NP
 - [4] ETSI TR 101 xxx Signalling Requirements for Number Portability
 - [5] ITU-T Rec. E.164 The International Public Telecommunication Plan
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3. Definitions and Abbreviations

3.1 Definitions

For definitions, please refer to NPTF PT1 document entitled “ Service Description Number Portability for Geographic Numbers”, section 4.1.

3.2 Abbreviations

For abbreviations, please refer to NPTF PT1 document entitled “ Service Description Number Portability for Geographic Numbers”, section 4.2.

4. Technical solutions to provide number portability

In the following sections, the technical solutions that have been selected to provide number portability are described and analyzed. Three solutions on the interface between the operators are examined :

- Onward Routeing
- - All call query
- Query on Release [network option only or on bilateral agreement]

Each operator should be able to decide about its own network architecture, network functions and design within its network, as long as external requirements (on the interface between operators) are fulfilled. Solutions to support number portability should allow migrations between the technical solutions. A Network Operator may perform several network functions as described in this document.

In this respect Onward Routeing and All call query solutions can seamless interwork on the interfaces between the Serving Network and the Recipient Network. Both approaches imply the transfer of the same signalling information elements in the forward direction only.

Contrary , the Query On Release solution puts restrictions on the functions inside operator domains when to be supported on the interfaces between operators. The Query On Release solution implies the transfer of signalling information in the backward direction.

The application of the Query On Release solution is restricted to internal network domain usage only. Upon bilateral agreement between two operators, it can also be used on the interface between both operator's networks.

The following number translation principles may be used to deliver the call to the correct destination:

- One step number translation:

The one step number translation approach requires only one query during call set-up. The NP query performed by the serving network will either determine that the called number is not ported or it will return a Routeing Number (RN) that can be used to route the call. The RN identifies the recipient exchange that provides service to the ported number (see section 5).

- Two step number translation:

The two step number translation approach requires two queries during call set-up to a ported number. The NP query performed by the first serving network will either determine that the called number is not ported or it will return a Routeing Number (RN) that can be used to route the call. The RN identifies the Recipient network (see section 5). In this case, a second query has to be performed by the recipient network to identify the recipient exchange¹.

- Multiple number translation:

In this approach every network through which a call passes must perform a query to ensure correct routeing of the call. This approach requires no special addressing arrangements across points of interconnect between networks, i.e. no routeing information is exchanged over the network interface.

The following chapters describe models of technical solutions that can be used to offer Geographic Number Portability. The emphasis on placing the NP DB in the figures is from where the DB access is performed and what triggered the DB access. Despite the figures show the location of the DB within the domain of a particular Network it shall be understood that the DB might very well be located outside that domain (e.g. a DB commonly used by several operators). The DB mentioned here is the real-time DB used for the call handling of the calls to ported numbers.

The figures in section 4 correspond to a one step number translation principle.

Also the network operator responsibilities and the impacts on the interfaces are related to the one step number translation principle.

The scenarios, network operator responsibilities and impacts on the interfaces for the other number translation principles are not described in this document.

Four main types of Networks are described and identified as involved (depending on the level of NP evolution in the Networks concerned) in setting up a call to a ported subscriber:

- 1) Originating Network,
- 2) Transit Network,
- 3) Donor Network,
- 4) Recipient Network.

Notes :

- For most incoming International calls the Originating Network will be the Network containing the incoming international gateway. The similar is applied for an incoming call from a PLMN, i.e. that the first incoming GW exchange in the fixed network is regarded as Originating Exchange unless the PLMN has NP DB query capabilities also for Numbers belonging to the fixed network.
- In the described models, the different types of networks are clearly identified as separate entities. The interfaces between these entities are to be considered as “functional interfaces”. In practice, however, Network Operators may play the role of several types of networks. In this case, the interfaces between Network Operators have to support the different “functional interfaces” requirements involved.

¹ The second query may not always be required (e.g. operator with single switch, access gateway corresponding with recipient exchange, etc.)

4.1. Onward Routing

4.1.1 General Description

With the onward routing principle, the call to a ported number is routed to the Donor Network by the Originating and possibly Transit Network. The onward routing principle is illustrated in figure 1.

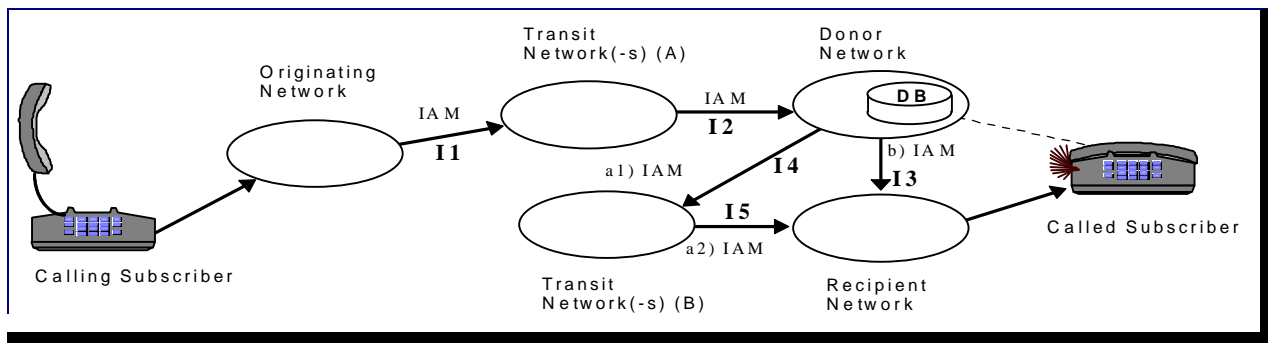


Figure 1, Call Rerouting to Recipient Network by Onward Routing principles from Donor Network.

In figure 1, the Donor Network receives an incoming call. It then detects that the called number has been ported-out to another network and retrieves the Routing Number (RN). It thereafter reroutes the call onward towards the Recipient Network using retrieved Routing information.

Option a1 and a2 is valid when Donor Network either has no direct interconnection to Recipient Network or when overflow traffic is placed via Transit Network B.

The option b is valid when direct interconnection exists between Donor Network and Recipient Network

Please note that the Transit Network(-s) are optional, i.e. direct interconnections connections between Originating Network and Donor Network might very well exist and the same also between Donor Network and Recipient Network. Note also that the Transit Network(-s) A and B can be the same depending on network structure and call case.

4.1.2 Network operator responsibilities

In terms of responsibilities, we refer to section 7.1 of document NPTF - PT1.

- Originating Network : no impact
- Transit Network (A) : no impact
- Donor Network : performs all the functions of the Serving Network
- Transit Network (B) :
 - must have the capability to analyse and route the call to the Recipient Network based on address layout and template of the RN . (Range Analysis function on the Routing Information)
- Recipient Network : performs all the functions of the Recipient Network

4.1.3 Impact on the interfaces

- I1 : no impact
- I2 : no impact
- I3 : must support the address layout and template of the RN
- I4 : must support the address layout and template of the RN
- I5 : must support the address layout and template of the RN

4.2. Query on Release (QoR)

4.2.1. Query on Release by Transit Network

4.2.1.1. General Description

With this principle the Donor Network releases the call to the preceding network. When the preceding Network to Donor initiates NP actions, i.e. a NP DB query, at reception of a Release Message, this case is often referred to as "Query on Release (QoR)".

Figure 2 outlines the case when the DB query takes place in the Transit Network prior to the Donor Network.

The release message contains a certain indication (e.g. special cause value or Diagnostics Information) telling that the called number is ported-out. (see section 7 for details)

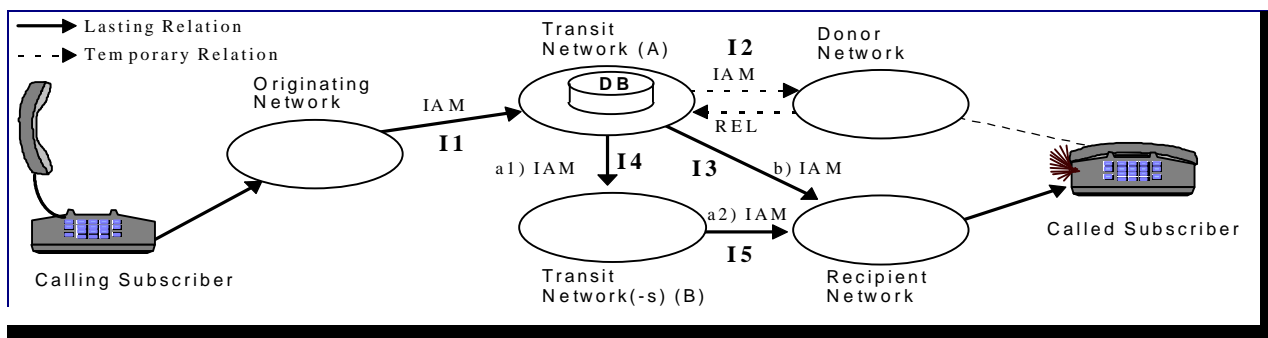


Figure 2, Query on Release by Transit Network.

In figure 2, the Donor Network receives an Incoming call. It then detects that the called number has been ported-out to another network. It then determines that one of the preceding Networks has QoR capability. It thereafter releases the call with a certain indication telling that called number is ported-out. The transit network then traps the Release, determines that preceding network has no QoR capability, makes a NP data base query and reroutes the call onward towards the Recipient Network. In this scenario the Transit Network has access to a NP DB to retrieve the Routeing Information.

Option a1 and a2, in figure 2, is valid when Transit Network A either has no direct interconnection to Recipient Network or when overflow traffic is placed via Transit Network B.

The option b, in figure 2, is valid when direct interconnection exists between Transit Network A and Recipient Network.

4.2.1.2. Network Operator responsibilities

In terms of responsibilities, we refer to section 7.1 of document NPTF - PT1.

- Originating Network : no impact
- Transit Network (A) :
 - performs all the functions of the Serving Network except the Call Trap Function
 - triggers a DB query on the Release message
- Donor Network : performs the Call Trap Function and releases the call
- Transit Network (B) :
 - must have the capability to analyse and route the call to the Recipient Network based on address layout and template of the RN . (Range Analysis function on the Routeing Information)
- Recipient Network : performs all the functions of the Recipient Network

4.2.1.3 Impact on the interfaces

- I1 : no impact
- I2 : support the Release message with a certain indication
- I3 : must support the address layout and template of the RN
- I4 : must support the address layout and template of the RN
- I5 : must support the address layout and template of the RN

4.2.2. Query on Release by Originating Network

4.2.2.1. General Description

With this principle the Donor Network releases the call to the preceding network. When the preceding Network to Donor initiates NP actions, i.e. a NP DB query, at reception of a Release Message, this case is often referred to as "Query on Release (QoR)".

Figure 3 outlines the case when the DB query takes place in the Originating Network.

The release message contains a certain indication (e.g. special cause value or Diagnostics Information) telling that the called number is ported-out. (see section 7 for details)

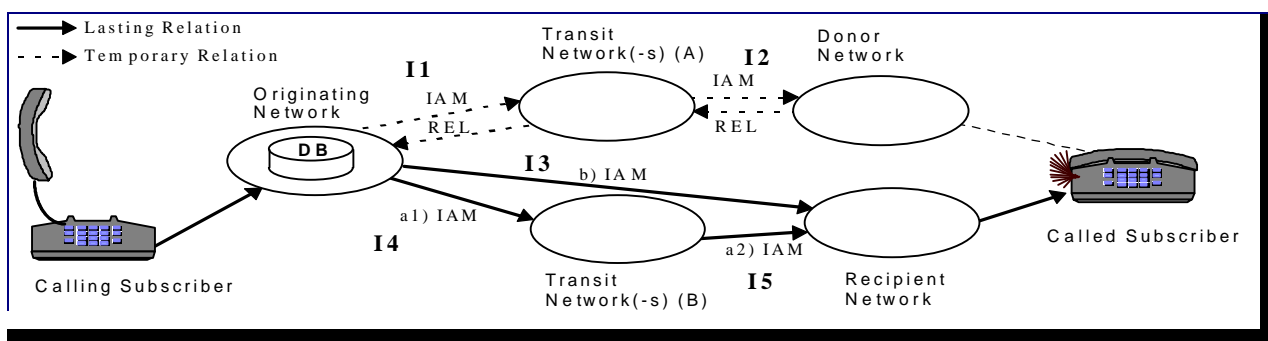


Figure 3, Query on Release by Originating Network.

In figure 3, the Transit Network (A) lets the Release Cause pass through to the Originating Network. The Originating Network, at reception of the Release Cause, makes a DB query to retrieve the Routeing Number and reroutes the call to the Recipient Network. In this scenario the Originating Network has access to a NP DB to retrieve the Routeing Information.

Option a1 and a2, in figure 3, is valid when Originating Network either has no direct interconnection to Recipient Network or when overflow traffic is placed via Transit Network B.

The option b, in figure 3, is valid when direct interconnection exists between Originating and Recipient Networks.

Please note that the Transit Network(-s) are optional, i.e. direct interconnections connections between Originating Network and Donor Network might very well exist and the same also between Donor Network and Recipient Network. Note also that the Transit Network(-s) A and B can be the same depending on network structure and call case.

4.2.2.2. Network Operator responsibilities

In terms of responsibilities, we refer to section 7.1 of document NPTF - PT1.

- Originating Network :
 - performs all the functions of the Serving Network except the Call Trap Function
 - triggers a DB query on the Release message

- Transit Network (A) : let the Release Cause pass through to the Originating Network
- Donor Network : performs the Call Trap Function and releases the call
- Transit Network (B) :
must have the capability to analyse and route the call to the Recipient Network based on address layout and template of the RN . (Range Analysis function on the Routeing Information)
- Recipient Network : performs all the functions of the Recipient Network

4.2.2.3. Impact on the interfaces

- I1 : support the release message with a certain indication
- I2 : support the release message with a certain indication
- I3 : must support the address layout and template of the RN
- I4 : must support the address layout and template of the RN
- I5 : must support the address layout and template of the RN

4.3. All Call Query (one step)

4.3.1. All call query by Transit

4.3.1.1. General Description

A third option is the principle of always query a NP Data Base prior to Routing the call towards Donor/Recipient Network, i.e. routing according to "all call query one step" principles as outlined in figure 4 below.

In this scenario the Transit Network (A) has access to a NP DB to retrieve the Routing Information corresponding to the ported number.

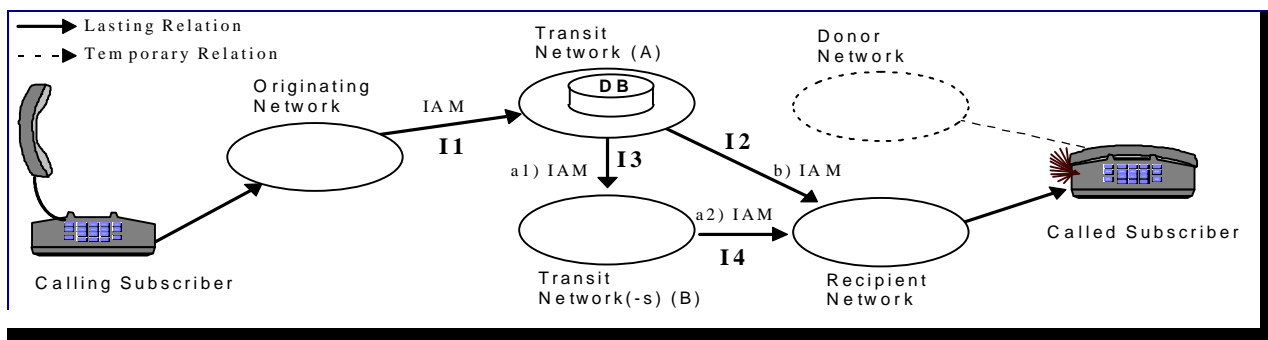


Figure 4, "All call Query" by Transit Network.

As can be seen from the figure 4 above the Donor Network is not involved at all in the call set up to the ported subscriber.

Calls might be routed back from Transit A, to Originating network in the case that Originating and Recipient networks are the same.

4.3.1.2. Network Operator responsibilities

In terms of responsibilities, we refer to section 7.1 of document NPTF - PT1.

- Originating Network : no impact
- Transit Network (A) : performs all the functions of the Serving Network
- Donor Network : not involved
- Transit Network (B) :
 must have the capability to analyse and route the call to the Recipient Network based on address layout and template of the RN . (Range Analysis function on the Routing Information)
- Recipient Network : performs all the functions of the Recipient Network

4.3.1.3. Impact on the interfaces

- I1 : no impact
- I2 : must support the address layout and template of the RN
- I3 : must support the address layout and template of the RN
- I4 : must support the address layout and template of the RN

4.3.2. All call query by Originating Network

4.3.2.1. General Description

The same principles, as described in section 4.3.1.1, are valid but with the difference here that the query is performed by the Originating Network having access to a NP DB to retrieve the Routing Information.

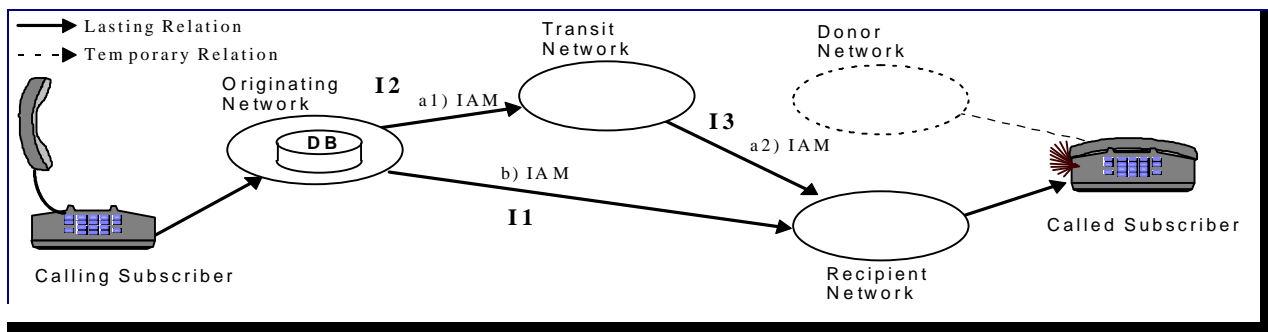


Figure 5, All call Query by Originating Network.

As can be seen in the figure 5, the Donor Network is not involved in the call set-up at all, however optionally the Transit Network (see case a1 and a2 above) might be transiting the call to the Recipient Network.

4.3.2.2. Network Operator responsibilities

In terms of responsibilities, we refer to section 7.1 of document NPTF - PT1.

- Originating Network : performs all the functions of the Serving Network
- Donor Network : not involved
- Transit Network :
 - must have the capability to analyse and route the call to the Recipient Network based on address layout and template of the RN . (Range Analysis function on the Routing Information)
- Recipient Network : performs all the functions of the Recipient Network

4.3.2.3. Impact on the interfaces

- I1 : must support the address layout and template of the RN
- I2 : must support the address layout and template of the RN
- I3 : must support the address layout and template of the RN

5. Numbering, Addressing and Routing

On the interface between two operators, two methods have to be supported for the exchange of information once the Database Query Function has been carried out by one operator :

1°) No routing information is exchanged on the interface between both operators. This solution consists in sending the "DN only" on the interface. No distinction is made between ported and non-porting numbers on the interface.

2°) Routing information is exchanged on the interface between both operators for ported numbers. The following sections describe the numbering, addressing and routing principles to be applied in this case. The short term solution selected uses a concatenated addressing layout as described in sections 5.2.1 and 5.2.2.1. The possible long term solutions consist of a concatenated addressing layout as described in section 5.2.1 and 5.2.2.2 or a separated addressing layout as described in sections 5.2.3. and 5.2.4.

5.1 Addressable entities for routing purposes.

Entities which need to be addressed by a routing number (RN) in one or more routing solutions are identified in this section. It is the responsibility of the Recipient Network to provide the RN.

Recipient Network : in this option, the routing number identifies the network where the customer is now located. Therefore the routing process will need an additional information (i.e. DN) to be completed.

Exchange in the Recipient Network : in this option, the routing number identifies the exchange where the call has to be routed physically. Therefore the routing process within this exchange will need an additional information (i.e. DN) to be completed.

5.2 Types of addresses and numbers.

With network operator portability it is no longer possible to use the Directory Number, dialled by the calling party, to route the call to the customer. Additional information, the Routing Number (RN), is needed to be able to route the call. The Routing Information may have one of the following formats :

- concatenated address (sections 5.2.1, 5.2.2);
- separated address (sections 5.2.3, 5.2.4);

5.2.1 Concatenated address layout

In this type of address, two numbers are concatenated in the same signalling field (the Called Party Number) which is used to route the call. The field has the following format:



RN is a Routing Number prefixed for routing purpose.

5.2.2 Concatenated address template

5.2.2.1. Short Term solution

The use of the concatenated address format shall be identified with the hexadecimal digit 'C' for the RN, because:

- it avoids National Numbering Plan capacities consumption
- it is already used on the interface between Belgacom and the operators for the carrier selection calls to avoid clashes with normal cells (NSN format).²

Depending of the option for the addressable entity, the coding of the RN shall be:

- **Recipient Network:** 'C'00XX

with XX : identifier of a particular Recipient Network , XX is the only identifier to be used by all operators involved nationwide to indicate this particular "Recipient Network".
The value XX for each Operator concerned will be allocated by the BIPT.

- **Exchange in the Recipient Network:** 'C'pqyz or 'C'pxyz

With - pqyz or pxyz identifying the exchange nationwide with:
 - pq or p : identifying a NDC of the exchange
 - yz or xyz : subsequent digits to identify the particular exchange (NOC)

It will be the responsibility of the recipient operator to provide the correct routing number, avoiding clashes with other pqyz.

The pqyz or pxyz in the routing number will identify the exchange nation-wide and will be within the numbering range assigned (by the BIPT) to the recipient operator.

A call to 'C' pqyz will be routed (according to the normal routing principles) in the same way as a call to PQYZ (10.000 numbers block in the national numbering plan).³

5.2.2.2. Long Term solution

The long term solution is to abandon the hexadecimal 'C' and to use the ITU-T standard NoA (Nature of Address) value.

The use of the concatenated address format shall be identified with the standard ITU-T Nature of address value 0001000 "Network Routing Number concatenated with Called Directory Number".

The migration to this solution has to be analysed in detail when the ITU-T/ETSI documents will be stable.

5.2.3. Separated addresses layout

In this address type, the Routeing Number and the Directory Number are carried in two different fields in the signalling messages. The address identifying the destination of the ported call, Routeing Number, is used to route the call. DN is transparently carried in a separate signalling parameter and is only used at the called side to set up the call.

RN

DN

If the routeing number is a plain E.164 number from the range usually handled by the addressed exchange, no specific addressing scheme (for identifying the exchanges) is needed. this solution does not waste any numbering resources since the dialled number and routeing number are carried in separate fields. The numbering space for routeing numbers will always be sufficient, as all numbers from the national numbering plan can be used as routeing numbers. Contrary to prefix based solutions, no special treatment of Routeing Numbers needs to be provided by the routeing mechanism of the exchange.

² For carrier selection, the format used is 'C' 05XX and 'C'06XX

³ For inter-operator accounting both 'C'pqyz and PQYZ (of the called DN) can be used

But such a separated address solution requires, by definition, that signalling systems used are able to carry both RN and DN in separate signalling parameters.

5.2.4 Separated Address template

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

6. Signalling impacts

On the interface between two operators, two methods have to be supported for the exchange of information once the Database Query Function has been carried out by one operator :

1°) No routing information is exchanged on the interface between both operators. This solution consists in sending the "DN only" on the interface. No distinction is made between ported and non-porting numbers on the interface.

2°) Routing information is exchanged on the interface between both operators for ported numbers. The following sections describe the signalling impacts on the interfaces between network operators in this case.

The aim is to mention here the deltas (if any) specifically due to the Number Portability support between operators. This will be analyzed for the three technical solutions that have been selected :

- Onward Routing
-
- All call Query
- Query on Release

6.1 Onward Routing

As long as the call has not reached the Donor Network, there is no impact on the interfaces between Network Operators. When receiving an incoming call, the Donor Network detects that the called number has been ported-out to another network. It then retrieves the Routing Number (RN) to reroute the call onward to the Recipient Network. On the further interfaces involved in the call, the signalling impacts are given hereafter :

6.1.1. Concatenated address

- Short term solution

No impact except that overdecadic digits must be supported as the RN will begin with the hexadecimal digit 'C'.

- Long term solution

No impact except that the concatenated address format with RN has to be indicated with the standard ITU-T Nature of address value 0001000 " Network Routing Number concatenated with Called Directory Number"

6.1.2. Separated address

Signalling impact will be according to decisions to be taken by ITU-T and ETSI.

6.2 Query on Release

When the Donor Network receives an incoming call, it detects that the called number has been ported-out to another network and releases the call to the previous network (Transit or Originating Network).

6.2.1. Release cause

The standard ITU-T Release cause **14** ("QoR : ported number") will be used.

Once the Query has been performed on the Release cause (by Transit or Originating Network) , the call is further routed including the Routeing Information. On the further interfaces involved in the call, the signalling impacts are given hereafter :

6.2.2. Concatenated address

- Short term solution

No impact except that overdecadic digits must be supported as the RN will begin with the hexadecimal digit 'C'.

- Long term solution

No impact except that the concatenated address format with RN has to be indicated with the standard ITU-T Nature of address value 0001000 " Network Routing Number concatenated with Called Directory Number"

6.2.3. Separated address

Signalling impact will be according to decisions to be taken by ITU-T and ETSI.

6.3 All call Query

There is no signalling impact as long as the Query is not performed. Once the Query has been performed (by the Originating or Transit Network) , the call is further routed including the Routeing Information. On the further interfaces involved in the call, the signalling impacts are given hereafter :

6.3.1. Concatenated address

- Short term solution

No impact except that overdecadic digits must be supported as the RN will begin with the hexadecimal digit 'C'.

- Long term solution

No impact except that the concatenated address format with RN has to be indicated with the standard ITU-T Nature of address value 0001000 " Network Routing Number concatenated with Called Directory Number"

6.3.2. Separated address

Signalling impact will be according to decisions to be taken by ITU-T and ETSI.

6.4 Interworking between solutions

If the QOR solution is not supported on the interface between Originating / Transit and Donor Network operators, and if the Donor Network uses the QOR solution, the release cause shall be limited backward to

the last SSP present in the Donor Network where the triggering has to take place (trunk based conditional triggering).

6.5 Migration between solutions

Since the Onward Routing and All call query solutions can seamless interwork, no migration problems are identified when an operator migrates from an Onward Routing solution towards an All call query solution.

If the Originating / Transit Network migrates from “non supporting of QOR solution” to “supporting of QOR solution” (and vice versa), the Donor Network has to deactivate (activate) the conditional triggering in the last SSP for the incoming trunks connected to that Originating / Transit Network.

7. Interworking with other services

For calls originating from ported numbers, there should be no distinction if this number is ported or not. The following sections are focused on the interworking with other services for calls towards ported numbers.

7.1 CLI based services

The working of services based on CLI (e.g. CLASS, CLIP/CLIR,...) should not be affected by the porting operation.

7.2 COLP/COLR

No impact. The connected line identity (Directory Number) must be presented / restricted , the line being ported or not ported. The Routing Information must never be shown to the calling party.

7.3 Originally Called Number

This parameter must contain the original called number (in case of call forwarding or number translation). Precautions should be taken as to avoid that the Routing Information appears in this parameter.

7.4 CCBS/CCNR

Today this functionality is not supported on the interface between operators. The number portability will not change the situation.

Solutions to support CCBS/CCNR in the future should be conform to the relevant ITU-T/ ETSI documents when they will be stable.

7.5 Carrier Selection

For a carrier selection call, the carrier is responsible to handle the call. This is valid for calls to non ported as well to ported numbers. This principle implies that :

- 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 carrier selection calls in the same way as the calls really originating from its own network :
 - If the “All Call Query” principle is the default solution of the network, it will be used for both carrier selection calls as for own originating calls
 - If the Donor Network uses the QOR solution and the carrier network supports the QOR, the release cause must be triggered within the carrier network. The release cause may not be sent backwards to the real Originating Network (conditional triggering on release cause and carrier selection code).

- If the carrier network does not support the QOR method, the Donor Network has to use the “Onward Routeing” principle or the QOR method but with the release cause limited backward to the last SSP present in the Donor Network where the triggering has to take place (trunk based conditional triggering).

7.6 International Incoming Calls

In case of international incoming calls, the Originating Network is effectively the network containing the gateway connected to the international network. The statements in section 7.5 are also applicable for this network.

7.7 Mobile Incoming Calls

In case of mobile incoming calls, the Originating Network is effectively the network containing the gateway connected to the mobile network. The statements in section 7.5 are also applicable for this network.

7.8 Call Forwarding

In case of QOR method used and a call forwarding activated to a ported number, the call forwarding exchange has to handle the triggering in order to initiate the call forwarding leg effectively to the ported number. The release cause may not pass back through this exchange.

7.9 IN services interworking

Precautions should be taken to assure the correct working of IN services for calls terminating to ported numbers.

7.10. Location Portability

There should be no impact. For destinations that are not yet operator ported, the donor network should be responsible for the correct delivery of calls to the location ported destinations.

8. Constraints

8.1. Analogue Exchanges

The analogue exchanges will not support Number Portability for the following reasons :

- they do not support the Signalling System N°7 (no TUP,ISUP,INAP,...).
 - they do not support a specific line class for ported numbers
 - they do not support the call forwarding features
 - the local (intra-exchange) calls to ported numbers will not be possible
 - they are of old technology (introduced in the network from 1973 on) and are no more upgradable regarding hardware and software (no modifications anymore)
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