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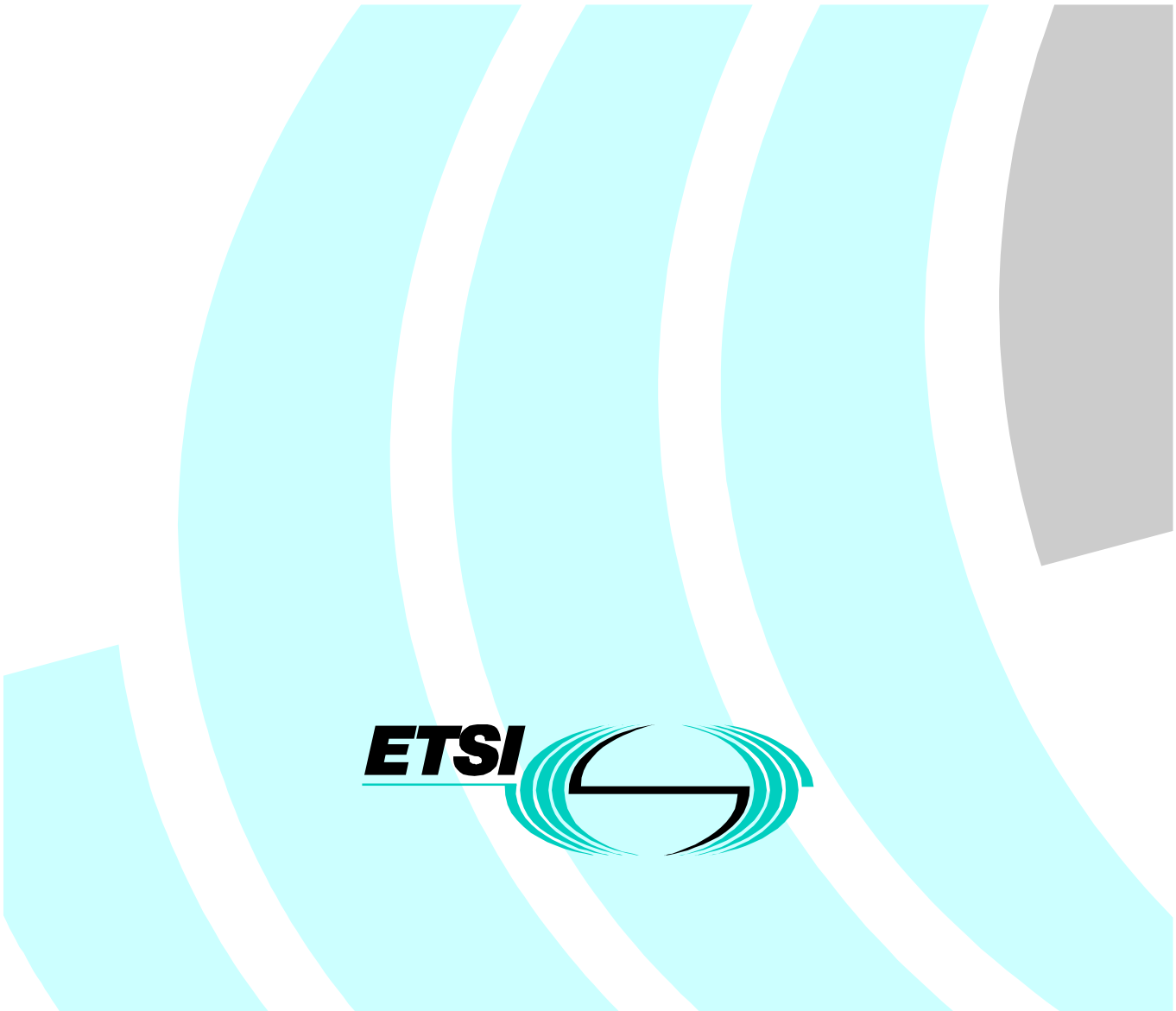
Technical Report

Number Portability Task Force (NPTF); Guidance on choice of network solutions for service provider portability for geographic and non-geographic numbers



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Foreword

This Technical Reporte (TR) has been produced by ETSI Technical Committee Services Protocol for Advanced Networks (SPAN).

Introduction

The ETSI Number Portability Task Force (NPTF) has created a series of technical reports describing various aspects of number portability. These include High Level Service Description for Number Portability TR 101 119 [1], High level architectures for number portability TR 101 118 [2] and Numbering and addressing for number portability TR 101 122 [3]. Whilst these documents provide considerable technical information, including many pro and con discussions, they do not provide specific guidance concerning use in Europe. Since there are a large number of possible implementation combinations contained in the technical reports, multi vendor interoperability and interconnections between network operators will be difficult without additional direction. The present document focuses on interfaces between networks. Issues within a network are not specifically addressed, although there are some notes concerning information internal to a network.

1 Scope

The present document is to analyse the interrelationships of the various technical components involved in providing service provider number portability and provide guidance on use in Europe between networks.

NOTE: For the purpose of the present document, the term "Service Provider Number Portability" is used to describe Service Provider Portability for geographic and non-geographic numbers.

2 References

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

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

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

[2] TR 101 118: "Network Aspects (NA); High Level Network Architecture and Solutions to support Number Portability".

[3] TR 101 122: "Network Aspects (NA); Numbering and Addressing for Number Portability".

3 Abbreviations

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

ACQ	All Call Query
Ccat	Concatenated
DB	DropBack
Exch	Recipient exchange
IN	Intelligent Network
NA	Network Aspects
NPTF	Number Portability Task Force
NTP	Network Termination Point
None	No routeing number used
OR	Onward Routeing
POI-NNet	Point of interconnection -Next network
POI-RNet	Point of interconnection - Recipient Network
Psep	Partially separated
QoR	Query on Release
Rnet	Recipient network
Sep	Separated

4 Possible Number Portability Solutions

Contained within the three technical reports detailed in clause 2, there are three technical components that are to be included in any solution (application) for service provider number portability:

1) the architecture being used;
2) the method of transporting a routeing number;
3) the entity addressed by the routeing number.

Architectures: There are four architectures described in the technical reports:

1) Onward Routeing (OR);
2) All Call Query (ACQ);
3) Query on Release (QoR);
4) Dropback (DB).

Transport of routeing number: There are four transport methods described:

1) Concatenated (Ccat);
2) Separated (Sep);
3) Partially separated (Psep);
4) No routeing number used (None).

NOTE 1: In TR 101 122 [3] there was an option of Routeing Number only. This has similar characteristics to a NTP and hence it has been omitted as a specific item from the present document.

Addressed entity: There are six possible entities identified by the routeing number:

1) Network Termination Point (NTP);
2) Recipient exchange (Exch);
3) Point of interconnection - Recipient Network (POI-RNet);
4) Point of interconnection -Next network (POI-NNet);
5) Recipient network (Rnet);
6) No routeing number. (None).

NOTE 2: In some solutions more than one entity may be addressed as the call transits the network.

NOTE 3: For the purposes of the present document, POI-NNet refers to an address of a point of interconnection exiting the serving network while POI-RNet refers to an address of a point of interconnection entering the recipient network. If there is no transit network involved, these could be the same point.

The above creates a three dimensional matrix of 4x4x6 or 96 possible ways to implement service provider number portability.

5 Appropriateness of Number Portability solutions

Although the previous clause identified a number of options for choice of architecture, transportation of the routeing number and entity to be addressed by the routeing number, there are a number of these possibilities which are either completely inappropriate, or appropriate only under certain circumstances. This clause considers which of the possibilities are appropriate.

5.1 Architecture

None of the architectures identified are impracticable; however, the options could be viewed as more or less appropriate dependant upon whether a short or long term solution is being devised.

Onward Routeing is best considered as a short to medium term solution, as it can be implemented relatively quickly using existing technologies and network architectures. However, it is inappropriate where the level of traffic to ported numbers becomes a significant proportion of total traffic, as all of this traffic will route via the donor network.

Conversely, All Call Query would typically be a longer term solution, as it implies either exchange modifications to hold a database of all ported numbers within the domain, or implementation of IN technologies across all exchangees. Further, the administrative procedures will take longer to establish, as multi-lateral agreements on exchange of information about ported numbers are required, rather than the bilateral agreements possible for onward routeing. However, where traffic levels to ported numbers are high, the architecture is appropriate as calls will be routed in the most efficient manner, not involving the donor. Care are to be taken in ACQ implementations where the serving exchange may not be able to determine the end of dialed digits.

A migration path from OR to ACQ is possible without modifications to the signalling system and therefore ACQ and OR can co-exist.

Dropback and Query on Release architectures fall between Onward Routeing and All Call Query, in that they are best suited to where there is a moderate level of traffic to ported numbers. Both options avoid calls routeing via the donor network hence avoid inefficient routeing, but both still involve the donor network in processing of the calls. Query on Release imposes less load on the donor network, but does so at the expense of requiring a database and multilateral agreements as in the All Call Query option. Dropback has the advantage of not requiring such a database, but imposes the responsibility on the donor to maintain records of where calls are ported.

5.2 Transportation of the Routeing Number

Four options have been identified, including not transporting any routeing number.

Concatenating the routeing number with the destination number is seen as a good short term solution, as it may require little or no development to signalling systems. Some form of indication that the contents of the signalling field is a concatenated number is required. This may be a special nature of address value, or an unused value of the most significant numbering digit. However, the later is potentially wasteful with regard to numbering resources.

Separated fields for carrying the routeing number and directory number is seen as a better long term solution as it maintains the distinction between the two functions of addressing and numbering and thus allows independent evolution of these items. However, it requires development of the signalling system.

Partially separated addressing provides no benefit beyond that for separated addressing. In fact it may complicate the situation by mixing addressing and naming in one parameter. This option is therefore not recommended.

Passing no routeing number has the advantage that (at the network boundary at least) there is no need for extra signalling fields to carry routeing numbers and therefore requires no development to the signalling system.

5.3 Entity addressed by Routeing Number

Six options have been identified for the entity to be addressed by the routeing number, including not actually having a routeing number. In carrying out this analysis, it is important to recognize that what is being considered is the Routeing Number used at network interfaces, not that used internally to a network.

Addressing the NTP with the routeing number would be highly problematic. This would imply one routeing number for each number ported (or at least each customer). It also requires additional administrative procedures, and would result in costly changes to routeing numbers whenever any network configuration resulted in a customer connection being changed. This option is therefore not recommended.

Addressing the Exch has the advantage that it provides sufficient information to route the call to the ported customer, meaning that there is no need to carry out subsequent database lookups to route the call. Reconfigurations of the recipient network may require changes to routeing numbers.

Addressing the POI-RNet has two possible interpretations: A specific trunk group between two specific exchanges; or the address of a transit node serving a geographic area. The first interpretation leads to many complexities in data base administration and traffic handling in a multi operator environment and are to be eliminated as a possible interpretation. The second interpretation is feasible and could help optimize call routeing in some situations. One possible example is a transit node that serves several small exchanges. This option has the disadvantage that some recipient network reconfigurations may require changes to routeing numbers.

Addressing the POI-NNet seemingly serves no purpose; as the call is passed to a network, it is clear that this are to be the next network in the call path to the recipient network, so providing a routeing number to confirm this does not achieve anything above passing no routeing number. This option is therefore not recommended.

Addressing the Rnet has the advantage that network operators do not need extensive knowledge of the internal configuration of the recipient network. The routeing number is sufficient to route the call as far as the recipient network. However, identification of the recipient network may not be sufficient for other operators to optimally route the call, because if the recipient network is large, there may be many routes to it, but the operator may have no alternative but to hand-over the call at the nearest Point of Interconnection. The recipient network will need to examine the directory number digits to determine how to complete the call. This may require a further data base query.

Passing no routeing number (None) has the advantage that each network operator requires little information on the internal configuration of other networks. However, this approach does have the disadvantage that multiple database queries will be required within a given call path, as each network will have to carry out such checks in order to determine how to route the call. This option is therefore only suited to all call query architectures, or combined architectures (see clause 7).

5.4 Further Considerations

Based on the above discussion, several of the possible technical parameters are not recommended. Removing these options from consideration leaves a matrix of:

- four architectures (OR, ACQ, QoR, & DB);
- three means of transporting routeing numbers (Ccat, Sep, & None);
- four entities to be addressed by routeing numbers (Exch, POI-Rnet, Rnet & None).

With these adjustments, there are 48 ways to implement service provider number portability as is depicted in annex A. However, as will be seen in clause 6, many of these options are not practically possible. In addition, combined solutions are also possible. In all combined cases, the second step uses All Call Query. The subject of combined cases is discussed further in clause 7.

6 Number portability options that should not be used

TR 101 119 [1] pointed out that there are many parameters to be considered in the selection of the best solution for implementing number portability. These factors include technical, service, cost, efficiency and administrative issues. The present document is unable to look at all of these issues, but does focus on the technical items. The following single architecture items should be eliminated from consideration for technical reasons.

6.1 Routeing Number identifies something when it is not carried

If the routeing number is said to identify something, but is not being carried, then the implementation cannot exist. It therefore follows that some options are not possible; 3, 6, 9, 15 18, 21, 27, 30, 33, 39, 42, 45.

6.2 Routeing Number doesn't identify anything but is carried

If the routeing number is said not to identify anything, there is no point in carrying it. It therefore means that the following options are implausible; 10, 11, 22, 23, 34, 35, 46, 47.

6.3 Information sent back by Donor network is to be consistent

It would not be practicable for the donor network utilizing dropback type techniques to return a different value of Routeing Number dependent upon the originating exchange. It therefore follows that the combination of drop back with PoI is not valid, ruling out the options; 40, 41.

Similarly, as drop back sends a routeing number, this should be made use of, i.e. ruling out option 48.

6.4 Donor exchange (network) should only respond once - OR & DB

In both Onward Routeing and Drop Back, the donor exchange (network) supplies the necessary routeing information. It does not make sense to repeatedly ask the donor exchange for routeing information as the call transits the network. Therefore, the information supplied by the donor exchange (network) the first time are to be sufficient to route the call to the recipient exchange. This would eliminate No routeing number, Point of interconnection-Recipient Network, and Recipient network from the matrix of possible connections under the Drop Back and Onward Routeing options, thus eliminating options: 16, 17, 18, 19, 20, 21, 22, 23, 24, 40, 41, 42, 43, 44, 45, 46, 47, 48.

6.5 Donor exchange (network) should only respond once - QoR

It is our view that the donor network should only need to respond once during a call set up to indicate that a number is ported. All addressing options that involve additional QoR set up sequences to the donor network should be eliminated from further consideration when QoR is the method used. This would eliminate Recipient network, Point of Interconnection, and No routeing number from the matrix of possible connections under the QoR option. Options 28, 29, 30, 31, 32 33, 34, 35 36 are thus eliminated.

7 Combined Number Portability solutions

While clause 6 deals with options where only one type of architecture is used, it is also possible to combine different architectures. The number of possible options is quite large, hence we have not attempted to list them all, only the combined solutions that are considered plausible.

7.1 Explanation of combined solutions

In the cases where the routeing number addresses the recipient network, or the routeing number is only used for network-internal routeing (the routeing number is not passed across the network boundary), multiple networks carry out a database query to route a call to a ported number.

NOTE 1: If the routeing number identifies the recipient network, then, for example, in the case where the recipient network contains one exchange, or the DN provides sufficient information to route the call internally in the recipient network to the recipient exchange, one query is sufficient to be able to complete the call. This means that the solution consists of only one stage, instead of two.

In the case where the routeing number addresses the recipient network, there are two stages in the routeing of the call: in the first stage routeing information is obtained from the database to route the call to the recipient network; in the second and last stage routeing information is obtained to route the call internally in the recipient network to the recipient exchange. In case the routeing number is only used for network internal routeing, there are multiple stages: each network that retrieves routeing information from a database to route the call to the next network constitutes a stage. In two-stage and multi-stage solutions all stages except the first are to use All Call Query (ACQ).

NOTE 2: This ACQ can be performed network internal using QoR techniques in some situations. In the first stage ACQ may or may not be used. If ACQ is not used, the solution is called a combined solution. In addition to the choice of architectures in the first stage, the choice of concatenated addressing versus separated addressing is an independent decision in each stage.

7.2 Plausible combined Number Portability solutions

As a variant of a two or multi-stage ACQ solution, the first stage could be replaced by a query on release. This means a combined solution where the first stage uses query on release. As for all two-stage and multi-stage solutions subsequent stage(s) use ACQ.

NOTE: This ACQ can be performed network internal using QoR techniques in some situations.

Compared to a two-stage or multi-stage ACQ solution this brings the benefit that in the first stage the network only makes database queries for calls to ported numbers, instead of queries for all calls.

Another plausible option is to use onward routeing as a first stage in a combined solution. As for all two-stage and multi-stage solutions subsequent stage(s) use all call query. As onward routeing and all call query architectures can coexist (see subclause 5.1), this solution is a possible intermediate step in a migration scenario from a situation where all networks use an onward routeing solution to a situation where all networks use an all call query solution.

8 Conclusion

It has been shown that a multitude of solutions can be implemented for service provider number portability, based around the architecture for deriving the routeing number, the carriage of the routeing number, and the entity that the routeing number addresses. However, where a single architecture is used, only thirteen of these solutions are seen as appropriate, since the others are either impracticable, inefficient, or likely to cause operational difficulties. In addition to solutions utilizing a single architecture, implementations can be developed that consist of combinations of architectures; this report has highlighted a few of the more plausible combinations.

Clause 5 has highlighted that the choice of the parameters comprising each solution is determined by the relative level of traffic to ported numbers, the technical capabilities of the affected networks and the regulatory regime. It therefore follows that there is no single number portability solution which is optimal for every scenario, and that the implementation methodology may vary from network to network and from country to country.

Annex A (informative): Possible options

In all cases only one architecture is used for the complete process.

Combined solutions are discussed in clause 7.

Num.	Architecture	Addressed Entity at interface	Transport of Routeing number	Discarded because.
1	ACQ	Exch	Sep	
2	ACQ	Exch	Ccat	
3	ACQ	Exch	None	RN not carried 6.1
4	ACQ	POI-RN	Sep	
5	ACQ	POI-RN	Ccat	
6	ACQ	POI-RN	None	RN not carried 6.1
7	ACQ	RNet	Sep	
8	ACQ	RNet	Ccat	
9	ACQ	RNet	None	RN not carried 6.1
10	ACQ	None	Sep	RN identifies nil 6.2
11	ACQ	None	Ccat	RN identifies nil 6.2
12	ACQ	None	None	
13	OR	Exch	Sep	
14	OR	Exch	Ccat	
15	OR	Exch	None	RN not carried 6.1
16*	OR	POI-RN	Sep	Donor resp 6.4
17*	OR	POI-RN	Ccat	Donor resp 6.4
18	OR	POI-RN	None	RN not carried 6.1 Donor resp 6.4
19*	OR	RNet	Sep	Donor resp 6.4
20*	OR	RNet	Ccat	Donor resp 6.4
21	OR	RNet	None	RN not carried 6.1 Donor resp 6.4
22	OR	None	Sep	RN identifies nil 6.2 Donor resp 6.4
23	OR	None	Ccat	RN identifies nil 6.2 Donor resp 6.4
24	OR	None	None	Donor resp 6.4
25	QOR	Exch	Sep	
26	QoR	Exch	Ccat	
27	QOR	Exch	None	RN not carried 6.1
28*,#	QOR	POI-RN	Sep	Donor resp 6.5
29*,#	QOR	POI-RN	Ccat	Donor resp 6.5
30	QOR	POI-RN	None	RN not carried 6.1 Donor resp 6.5
31*,#	QOR	RNet	Sep	Donor resp 6.5
32*,#	QOR	RNet	Ccat	Donor resp 6.5
33	QOR	RNet	None	RN not carried 6.1 Donor resp 6.5
34	QOR	None	Sep	RN identifies nil 6.2 Donor resp 6.5
35	QOR	None	Ccat	RN identifies nil 6.2 Donor resp 6.5
36	QOR	None	None	Donor resp 6.5
37	DB	Exch	Sep	
38	DB	Exch	Ccat	
39	DB	Exch	None	RN not carried 6.1
40*	DB	POI-RN	Sep	RN consistency 6.3 Donor resp 6.4
41*	DB	POI-RN	Ccat	RN consistency 6.3 Donor resp 6.4
42	DB	POI-RN	None	RN not carried 6.1 Donor resp 6.4
43*	DB	RNet	Sep	Donor resp 6.4
44*	DB	RNet	Ccat	Donor resp 6.4
45	DB	RNet	None	RN not carried 6.1 Donor resp 6.4
46	DB	None	Sep	RN identifies nil 6.2 Donor resp 6.4
47	DB	None	Ccat	RN identifies nil 6.2 Donor resp 6.4
48	DB	None	None	RN sent in DB 6.3 Donor resp 6.4
*	This could be a single architecture solution, depending upon implementation. For example, if the recipient network has only one exchange or is able to identify recipient exchange from the directory number.			
#	It is possible to attempt to complete the call to the probable recipient exchange based on the DN and do another query within the recipient network if a release message is received.			

Bibliography

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

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

- ITU-T Recommendation E.164 (1997): "The international public telecommunication numbering plan".

History

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