# Operator Number Portability in Swiss Fixed Telephone Networks

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*Abstract* — **This document outlines general technical requirements and solutions for assuring Number Portability in telephone networks and compares the most commonly used techniques. It also gives an insight into the general specifications for the technical and administrative implementation of Number Portability within the Swiss telecommunications network.**
**In the context of this document Number Portability refers only to Operator Number Portability. Geographic Number Portability (Location Number Portability) is not in within the scope of this document.**

*Keywords* — **Number Range Holder, Donor service provider, recipient service provider, Number Portability Routing Number, BAKOM, INet, Teldas**

## I. Introduction

With introduction of Intelligent Networks (IN) and the deregulation of Telecommunication markets, a whole range of new services and features has arrisen for subscribers in telephone networks. One feature which has become possible and is today mandatory in most countries with deregulated telecom markets is Number Portability (NP).

There are different kinds of Number Portability, but all of them basically mean the possibility for the telephone operator to offer their subscribers the option of retaining the same telephone number should they wish to change telecommunications service provider (Operator Number Portability - ONP), their location (Location Number Portability – LNP) or their service (Service Number Portability – SNP). We will concentrate only on Operator Number Portability (ONP) in this paper.

As of 1st March 2000 all Telephone Service Providers (TSP) in Switzerland are obliged by Law to provide their subscribers with the ONP service. Swiss Regulator, the Federal Office for Communications BAKOM – Bundesamt für Kommunikation (also OFCOM in French, UFCOM in Italian), defined that the Operator Number Portability shall be applicable to E.164 numbers of:

- public telephone services based on the fixed network (ISDN/PSTN)
- mobile telephone services (GSM900/GSM1800)
- non-geographic services (freephone, shared-cost services, PRS, UPT, etc.)
- short numbers for directory services (in Switzerland 18xy)

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## II. Definition of terms

### A. ONP Specific terminology

Due to the specific interworking between Telecom Service Providers which is necessarry for ONP, there are several new terms and entities which needed to be established:

***Number Range Holder service provider -*** The Number Range Holder (NRH) is the service provider to which the subscriber was connected to before the first change of telecommunications service provider. The Number Range Holder service provider is allocated a geographical number range (block of 10'000 numbers), to which a portable number belongs, by the administrator of the national numbering plan (BAKOM). The NRH doesn't exist for non-geographical numbers as Individual Number Allocation numbers (INA) and Directory Service numbers.

***Donor service provider -*** The Donor Service Provider (SP) is the service provider to which the subscriber was connected before the change of telecommunications service provider. The term Donor as used in this document means the Donor Service Provider. The NRH SP and the Donor SP are only the same when the first time the subscriber ports away, or when the subscriber ports back into the donor network and away again.

***Recipient service provider -*** The Recipient service provider is the service provider to which the subscriber is connected after the change of telecommunications service provider. The term Recipient as used in this document means the Recipient Service Provider.

***Transit telecommunications service provider -*** The Number Range Holder service provider, the Donor service provider and the Recipient service provider are connected to the transit telecommunications service provider if no direct interconnection is available between them. The term Transit TSP as used in this document means the Transit Service Provider.

***Number Portability between telecommunications service providers for geographic numbers -*** A service, which enables subscribers to retain their telephone number, if they wish to change telecommunication service provider without changing their line location (postal address of installation).

***Geographic numbers -*** Geographic numbers belong to the national numbering plan and identify fixed-line connections. Before the implementation of geographic Number Portability, geographic numbers contain information as to the line's physical location e.g. "052" indicates the Winterthur area.

***Number Portability Routing Numbers NPRN -*** An address, which is allocated to a portable number by a TSP in order that calls can be routed correctly to a Recipient service provider. The network routing address cannot be dialed by the subscriber and clearly identifies a telecommunications service provider nation-wide.

***Prefix -*** A digit or sequence of digits which has to be dialed as part of a telephone number in order to leave a dialing code area e.g. "052" will prefix calls to the Winterthur area from another part of Switzerland.

## III. Swiss regulations concearning ONP

BAKOM defined the 98xxx digit string as the NPRN for Swiss telephone networks, where xxx represents the unique TSP code. All porting activities must be synchronised between the directly involved TSPs, with the recepient being the trigger point for initializing the synchronisation process. A subscriber only has to sign a standard form (Power of Attorney) authorizing the recipient TSP to represent him in the porting process. The typical lead time for porting a geographical number in Switzerland is three weeks from the receipt of Power of Attorney by the Recipient TSP. There is no requirement from BAKOM to the Recipient to provide former Supplementary Services (e.g. Call Completion to Busy Subscriber (CCBS, Voicemail, etc.)

Under the initiative of BAKOM, the Teldas Group has been established in Switzerland. The members of this group are TSPs which are holders of ONP or INA numbers. Teldas is responsible for operating the centralized TSP INet Server. The TSP INet Server holds the offline database for ONP and INA which records all ported numbers and the INA number data including the tariff data. It manages all concerning aspects of the administrative process between the TSPs.

Additionally, Swiss TSPs must support porting of Concatenated Voicemail number. This is a number from the National Numbering Plan, which has the prefix 0860, placed in front of the National Significant Number to indicate the corresponding Voicemail access number.

We will just name some of the steps involved in a standard porting case in Swiss network. We will take an initial porting of a subscriber from the Donor to the Recipient. In an Initial Porting the Donor is by definition also the Number Range Holder however for the purpose of this example solely the term Donor will be used.

The following general steps have to be considered in a porting process:

- Request to port a number: the Subscriber contacts the Recipient
- Recipient sends a Work Order and Power of Attorney to the Donor
- Donor sends an acknowledgement (accept or reject) to the Recipient within 10 working days
- Synchronization
- Activation / Deactivation / Routing
- Hand-over
- Broadcasting
- Wholesale Billing

Because efficient provision of Number Portability to end-customers relies on clear operational procedures between the involved TSPs, the Teldas Group has put together a Multilateral ONP Service Level Agreement. This agreement is obligatory to all TSPs which have own geographical number ranges. In order to foster compliance with the provisions of the ONP procedures, the involved parties defined and applied multilaterally Minimum Service Levels, linked to financial incentives and an obligation to provide information of mutual importance.

Therefore it is crucial that the different entities in an Operator network which are directly involved in the OPN procedures are robust and have fall-back procedures in place. Every hand-over of a number is scheduled at the exact date and time to minimise outage to the end-customer. Financial penalties for not reaching the mutually agreed milestones on time can be up to 400 CHF for a single subscriber line per day.

## IV. Technical solutions

There are several techniques which have established themselves as preferrable solutions for ONP in telephone networks. We can generally make a distinction between two broad techniques used to implement ONP: On-Switch solution and Off-Switch solution.

On-Switch solution utilises only the routing information between the switches to find the Portable Number. The On-Switch solutions are quick to implement but are very restricted and have several setbacks. It is very inflexible, non-scalable and requires extensive development for call processing mechanisms and in signalling. It should be viewed merely as an interim or short-term solution for ONP.

All relevant TSPs in Switzerland implemented Off-Switch solutions from the beginning. Therefore, we will focus only on Off-Switch solutions which require the use of IN nodes (Number Portability Database – NPDB) for determining the location of the called party. We will also ignore the Transit Service Provider for the sake of simplicity, and we will only use a model based on Originating, Donor, and Recipient networks.

We should also mention that all the methods have different variations and the actual implementation in a Network depends on the specific network topology, as well as particular service for which the ONP solutions are applied (mobile, fixed, INA, non-geographical numbers etc.). The following examples are intended only to illustrate the different principal methods which can be applied. We will use only one call scenario and will not consider different call scenarios (incoming, outgoing, on-net, off-net, etc.)

### A. All-Call Query (ACQ)

Fig. 1 shows the call flow for the ACQ solution. The different call steps are as follows:

1) The Originating Network receives a call from the caller and sends a query to the Number Portability Database (NPDB).

2) The NPDB returns the routing number associated with the dialled directory number (DN) in the format NPRN+DN (e.g. **98013**525341234).

3) The Originating Network uses the NPRN to route the call to the recipient network where NPRN is extracted and the remaining DN is used for routing the call to the called party.

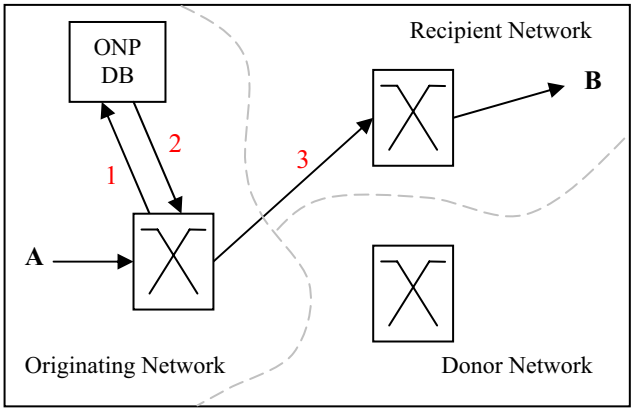


Fig.1 Call flow in an All Call Query method

### B. Query on Release (QoR)

Fig. 2 shows the call flow for the QoR method. Those call stages are following:

1) The originating network receives a call from the caller and routes the call to the donor network.

2) The donor network releases the call and indicates that the dialled directory number has been ported out of that switch.

3) The originating network sends a query to its NPDB.

4) The NPDB returns the dialled directory number with its associated NPRN in front.

5) The originating network uses the NPRN to route the call to the recipient network.

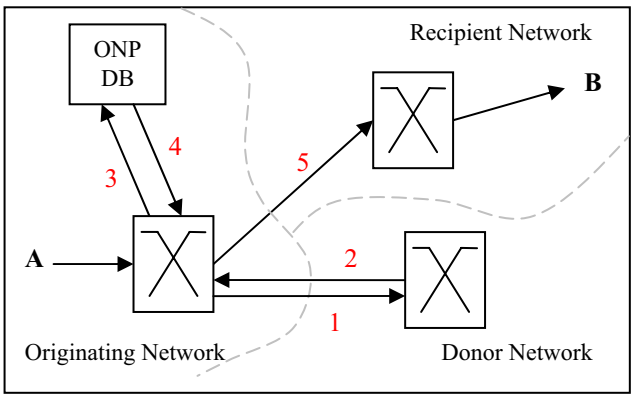


Fig.2 Call flow in a Query on Release method

### C. Onward Routing (OR)

Fig. 3 shows the call flow for the Onward Routing method. Those call steps are as follows:

1) The originating network receives a call from the caller and routes the call to the donor network.

2) The donor network detects that the dialled directory number has been ported out of the donor switch and checks with an internal NPDB.

3) The internal NPDB returns the NPRN associated with the dialled directory number (e.g. **98013**525341234).

4) The donor network uses the routing number to route the call to the recipient network.

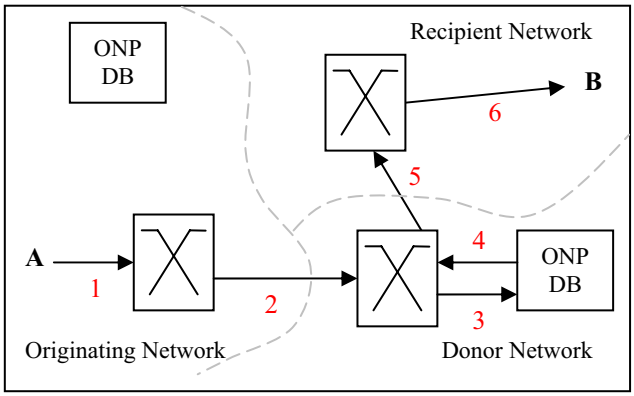


Fig. 3 Call flow in an Onward Routing method

### D. Call Dropback

Fig. 4 shows the call flow for the Call Dropback solution. This solution is also known as "Return to Pivot (RTP)" and didn't have wide use in Switzerland, but is recognised as a standard technique, so we will mention it here. The call steps are as follows:

1) The originating network receives a call from the caller and routes the call to the donor network.

2) The donor network detects that the dialled directory number has been ported out of the donor switch and checks with an internal NPDB.

3) The internal NPDB returns the NPRN + dialled directory number.

4) The donor network releases the call by providing the routing number.

5) The Originating Network uses the routing number to route the call to the recipient network.

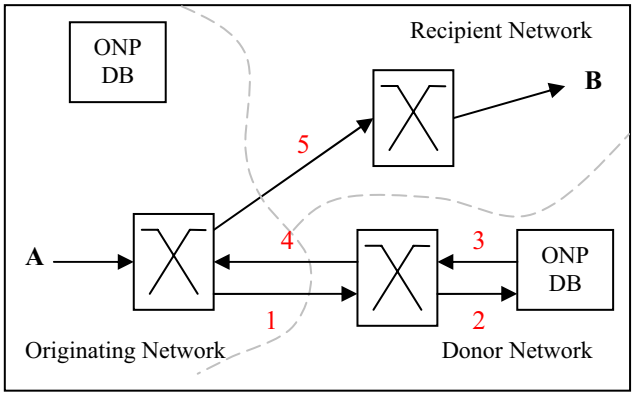


Fig. 4 Call flow in a Call Dropback method

## V. Comparison of the most common methods

As it can be seen from the above mentioned examples, only the ACQ solution does not involve the donor network when routing the call to the recipient network of the dialled ported number. The other three solutions involve call setup to, or signalling with the donor network.

This is an obvious advantage, especially in networks where the large incumbent TSP is usually the donor. Using this method, the smaller TSP can eliminate the transit fees of the donor. On the other hand, the implementation of this method has impact on provisioning, billing and administrative systems and often on the field force of the TSPs. This makes the implementation far more complex and expensive and is due to this only recommended for bigger TSPs with good interconnections and a large call volume.

Only the Onward Routing solution requires the setup of two physical call segments, one from the Originating network to the Donor network and the other from the Donor network to the Recipient network. The Onward Routing technique is the least efficient in terms of using the network transmission facilities. The Query on Release and Dropback schemes set up calls to the Donor network first but release the call back to the Originating network that then initiates a new call to the Recipient network. For the Query on Release and Dropback schemes, circuits are still reserved one by one between the Originating network and the Donor network when the Originating network sets up the call towards the Donor network. Those circuits are released one by one when the call is released from the Donor network back to the Originating network. The All Call Query technique is the most efficient in terms of using the switching and transmission facilities for the call.

The ACQ and QoR schemes involve Centralized NPDBs for the Originating network to retrieve the routing information. Centralized NPDB means that the NPDB contains ported number information from multiple networks, and is usually administered by an independent entity. In Switzerland, it is the Teldas group which is responsible for this. The centralized NPDB is on the INet Server. All TSPs have the possibility to connect to the server over a secure connection, and use the NPDB online. However, it's much more common practice that the Service Providers connect at certain intervals and synchronise (download the changes) from the INet NPDB to their internal NPDB. This can be done for all, or for a part of the DB (just INA numbers, for example).

This is in contrast to the internal (local) network-specific NPDB that is used for the Dropback and OR schemes. The internal NPDB only contains information about the numbers that were ported out of the donor network. However, the internal NPDB can be also used to determine the location of a portable number within a TSP's own network. It can also be used for Emergency Call Routing (ECR), where emergency calls have to be routed very precisely based on the origin of the subscriber. This is especially important in Switzerland where there are three different languages spoken, depending on the area.

## VI. Conclusion

In the early 2000s the two most commonly used methods for ONP in Switzerland were Query on Release and Onward Routing. The main reasons for this were the deadlines set by the Regulator and the complexity of implementation. The implementation was quicker, cheaper and required having only the network specific (local) NPDB. Meanwhile, non-incumbent TSPs established direct interconnections between each other. The tendency was to establish own NPDBs which are regularly updated with the data from the centralized NPDB (TSP INet server). Today, the incumbent TSP, Swisscom, still uses QoR. All major non-incumbent TSPs in Switzerland (cablecom, Sunrise…) use All Call Query. We should mention that this method is still used only partially by some TSPs. This means that they have local NPDBs and do not update this data with the INet Server. Their local servers contain porting information from subscribers which were either ported in or out of their network. Other numbers are simply routed to the incumbent provider which then determines the correct destination provider. Since this involves transmission fees, larger TSPs which are well interconnected with others but haven't achieved full ACQ method are moving towards full ACQ.

Since its introduction in the Swiss telephone network, Number Portability has proved to be an important step in opening up the market for the benefit of the consumer. Perhaps the best indication of this is the fact that today well over 90% of telephone subscribers in Switzerland which decide to change their Telephone Service Provider, also chose to port their numbers.

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