



GOVERNMENT OF BERMUDA
Ministry of Energy, Telecommunications and E-Commerce

The Department of Telecommunications

Number Portability for Bermuda Consultation Document

**Ministry of Energy, Telecommunications
& E-Commerce**

22nd August 2008

Closing Date for Responses 29th September 2008

Table of Contents

1	Introduction	3
2	Structure of this Consultation	4
3	Regulatory Objectives.....	5
3.1	Regulatory Objectives	5
4	Background to this Consultation.....	6
4.1	Background	6
4.2	Scope of this Consultation.....	6
5	Number Portability: The Context	7
5.1	Introduction.....	7
5.2	Development of LNP in USA	7
5.3	Development of NP in Europe	9
5.4	Technical Solutions for LNP	9
5.4.1	On-Switch LNP Solutions	10
5.4.2	Off-switch Solutions	12
5.4.3	Routing of Calls Using an Off-Switch Solutions.....	13
5.5	NP Penetration and Success Factors in Europe	16
5.5.1	Fixed NP	16
5.5.2	Mobile NP	17
5.6	NP Penetration and Success Factors in USA	18
6	Number Portability in Bermuda	21
6.1	The Bermuda Context	21
6.2	Technical Solutions in Bermuda	22
6.2.1	On- Switch Solutions	22
6.2.2	Off- Switch Solutions	24
6.2.3	Summary of Potential LNP Solutions for Bermuda	25
6.3	Proposed Inter-Carrier Working Group for Bermuda	25
7	Conclusion	26
	Annex 1: List of Questions asked in this Consultation Paper	27

1 Introduction

For competition to deliver benefits in a telecommunications market place it is necessary for customers to be able to freely choose the services of an alternative carrier should they wish. One mechanism that may assist in enabling choice is Local Number Portability (LNP).

LNP may help to promote competition and maximise the benefits of a competitive telecommunications market for customers. LNP allows a customer to change carrier while still retaining his or her existing telephone number. For example, if a customer can keep its telephone number when changing carrier then the customer can avoid a number of costs associated with a number change. Those costs can be significant, particularly for business customers. As a consequence, with lower switching costs to the customer of changing carrier, there is more potential for the development of competition and market entry. The lack of LNP in a market can be considered to be a "barrier to switching" and thus can limit the effect of competition.

This consultation paper is designed as the first step in enabling the Ministry of the Environment, Telecommunications and E-Commerce (METEC) to develop a policy for LNP covering both wireline and wireless services for Bermuda.

Whilst the most pressing reasons for the introduction of LNP lie in the wireline and wireless networks in Bermuda the solution adopted for LNP should ideally be capable of being applied, with the minimum amount of adaption, to other types of LNP as well as being able to accommodate new network technologies including Voice over Internet Protocol (VoIP).

METEC, therefore, wishes to consult stakeholders on the best way forward for LNP in Bermuda.

2 Structure of this Consultation

This consultation paper is structured as follows:

- Section 3 sets out the regulatory objectives for the measures being considered;
- Section 4 outlines the background to this consultation and details any discussions held with carriers to-date;
- Sections 5 and 6 considers LNP, how it can be implemented and the options for Bermuda;
- Section 7 sets out the conclusion and next steps.
- Annex 1 lists the questions respondents are asked to consider in this consultation.

The consultation period will run from Friday 22nd August to Monday 29th September 2008. Written comments should be submitted before 5.00pm on Monday 29th September 2008.

Please submit your responses in MS Word or Adobe Acrobat format by email to gtelecom@gov.bm and a hard copy delivered by hand to:

Hiram Edwards
Acting Director of Telecommunications
Department of Telecommunications
F.B. Perry Building
2nd Floor
40 Church Street
Hamilton HM 12
Bermuda

All comments should be clearly marked "**Comments on Number Portability in Bermuda: Consultation Document**".

The Minister intends to make responses to this consultation available on the Government of Bermuda website. Any material that a respondent considers to be commercially sensitive should be put into a separate Annex and clearly marked "IN COMMERCIAL CONFIDENCE".

The Minister regrets that he is not in a position to respond individually to the responses to this consultation.

This document does not constitute legal, technical or commercial advice; the Minister is not bound by this document and may amend it from time to time. This document is without prejudice to the legal position or the rights and duties of the Minister to regulate the market generally.

3 Regulatory Objectives

3.1 Regulatory Objectives

In its recent regulatory reform policy METEC proposes to implement significant changes to many aspects of the regulation of communications in Bermuda. However, these changes largely reflect an updated approach to achieving Government's existing regulatory objectives, as opposed to a completely new set of objectives, as it remains the steadfast aim of the Government's policy to foster the development of the public telecommunications sector to the benefit of the people and economy of Bermuda. METEC has proposed the following regulatory objectives:

- To ensure that the people of Bermuda are provided with reliable and affordable access to quality public communications services;
- To enhance Bermuda's competitiveness in the area of communications so that Bermuda is well positioned to compete against its "real" global competitors in the tourism and international business markets;
- To encourage the development of a public communications sector which is responsive to the requirements of users (both individuals and businesses) and which provides its users with choice, innovation, efficiency, and affordability;
- To encourage the development and rapid migration of innovative technologies to Bermuda;
- To promote the orderly development of Bermuda's public communications sector;
- To encourage sustainable competition and create an invigorated public communications sector which would lay the groundwork for the further development of communications reliant industries;
- To encourage the development and maintenance of resilient and fault-tolerant infrastructures;
- To promote investment in the public communications sector and in communications reliant industries thereby stimulating the economy and employment; and
- To promote Bermudian ownership and Bermudian employment at all levels of the communications industry.

METEC believes that LNP provides a key functionality to customers that are in support of the regulatory objectives quoted above.

4 Background to this Consultation

4.1 Background

In recent one-on-one meeting with carriers there was interest expressed in LNP as a means to lower barriers to competition. However, the market in Bermuda is relatively small when compared with most other markets in Europe and certainly the USA. In view of this it is important that any measures adopted in Bermuda are proportionate to the level of demand and that LNP is implemented and configured in a manner such as to maximise the benefits but to also ensure that associated costs are at a level proportionate to any such benefits.

This consultation is focussed on gaining an understanding of three issues:

- The underlying reasons for carriers requesting LNP and any critical components of LNP functionality;
- The scale of demand for LNP (this may affect the suitability of different technical solutions for the service); and,
- Technical and operational options for implementing LNP in Bermuda.

4.2 Scope of this Consultation

The introduction of LNP is discussed in detail in this consultation paper with a particular focus on the options for technical implementation as this will be the main determinant of the cost and timing for introducing the service.

Operational processes to support the ordering, provisioning and ongoing management of LNP will also need to be designed to reflect the size of the Bermudian market place. METEC considers that it may be appropriate for carriers not to consider processes that are based on highly sophisticated automated interfaces and protocols such as those introduced in larger jurisdictions. In order to reduce overall costs, processes should be based on appropriate communication methods and interfaces considering the scale of Bermuda and the potential volume of porting requests.

If METEC concludes that LNP should be mandated in Bermuda, then more detailed work will be necessary to specify the framework for the operational procedures and technical solution required. METEC will be relying on the further co-operation and input of the carriers at that stage.

5 Number Portability: The Context

5.1 Introduction

LNP in most jurisdictions is a remedy specified by a National Regulatory Authority (NRA) that is applicable to all carriers in the market and not a remedy that is specifically directed to carriers that are deemed dominant in specific markets.

There are several different types of number portability in use across the world, ranging across wireline and wireless telecommunications networks. This consultation document addresses:

- 'fixed number portability' on wireline networks, whereby a customer of a wireline network can port its number from one access carrier to another, when the customer changes its access carrier, and;
- 'mobile number portability' on wireless networks, whereby a customer of a wireless network can port its number from one wireless carrier to another, when the customer changes its wireless carrier.
- 'cross number portability' whereby a customer of a wireless network can port its number from the wireless carrier to a wireline carrier and a customer of a wireline network can port its number from the wireline carrier to a wireless carrier, when the customer changes its carrier.

LNP is a facility provided by one carrier to another which enables a customer to keep its telephone numbers when switching its business between those carriers. In the wireline market LNP is applicable where a carrier is able to provide access lines to a customer (whether through building alternative local loop infrastructure, using leased lines, using wireless local loop technology or using an existing carrier's local loop whether by commercial arrangement or regulated access). Thus, in the wireline network, LNP is only relevant in markets where competing carriers offer customer connections rather than using carrier selection or carrier pre-selection.

LNP allows a customer to change from one carrier to another carrier as long as the area code of the number remains in the same. As Bermuda only has one area code, this means that in Bermuda customers may be able to port their numbers:

- Between wireline carriers,
- Between wireless carriers,
- From a wireless carrier to a wireline carrier, and
- From a wireline carrier to a wireless carrier.

LNP has been implemented in a number of countries which have liberalised their telecommunications markets, as the need to change telephone numbers is considered a considerable barrier to switching suppliers for both residential and business users.

5.2 Development of LNP in USA

In 1995 the US telecommunications industry began to investigate ways of providing Local Number Portability (LNP). During 1995 and 1996 several state regulatory bodies, including the Illinois Commerce Commission (ICC), began the process of officially selecting the architecture to be used for LNP in their respective states.

In February 1996, under the supervision of the ICC and carriers participating in an ICC-workshop, an RFP was released inviting prospective vendors to submit a total solution and associated firm pricing proposal to provide a Number Portability Administration Center and Service Management System (NPAC SMS) to support the implementation of Number Portability in Chicago, Illinois. The RFP defined the LNP architecture to be used, the functions of the Service Management System and the management and integration functions of the Number Portability Administration Center (NPAC). Two functional interfaces into the Service Management System were defined for Service Providers: (1) Service Order Activation (SOA); and, (2) Local Service Management System (LSMS). The SOA is used to communicate information to the NPAC SMS and back to the Service Provider. The LSMS is the Service Providers' database containing all information required for correct call routing when a customer changes from one service provider to another. Also, the Low Technology Interface (LTI) was defined. The LTI is the graphical user interface (GUI) used for communication between the SOA, LSMS, and the NPAC SMS.

After considerable discussion and deliberation, AT&T/Lucent Technologies' Location Routing Number (LRN) architecture was selected by the ICC and other participating state regulatory bodies. The LRN method became the de facto industry standard in the USA and was adopted by the FCC in 1997. On February 8, 1996, President Clinton signed The Telecommunications Act of 1996 into law. It was the first major overhaul of telecoms law in almost 62 years. It provided a pro-competitive, de-regulatory national policy framework designed to open local telecommunications markets to competition¹. The FCC issued its First Report and Order adopted June 27, 1996 and released July 2, 1996 in Docket 95-116 regarding telephone number portability and provides the regulatory framework for making LNP a reality.

Telephone service providers have responded to the local number portability mandate by complying with Congress and the Federal Communications Commission (FCC) requirements. With local number portability, customers can keep their existing phone numbers even if they switch to a different phone service provider. The original service provider simply reassigns the phone number to the new carrier, so long as the service area code remains the same².

In August 1997, eight regional LNP databases were established based on the seven original Bell Operating Company (BOC) regions, and Canada making the eighth. Limited Liability Corporations (LLC) were formed in each of these regions to select the NPAC SMS vendor and service for their region. Lockheed-Martin Information Management Services ultimately became the vendor of choice for all eight LLCs. In November 1999, Lockheed-Martin Information Management Services became NeuStar, Inc. NeuStar continues to be the LNP Administrator managing the NPAC³.

Providers use SS7 to route calls throughout the US/Canada network. Calls to ported numbers are completed when a customer who calls a ported number sends the dialled number to a provider's SSP (Service Switch Point), where it is identified either as a local call or not. If the call is local, the switch has the NPA-NXX in its routing table as portable, so it sends a routing request to the STP (Signal Transfer Point) which accesses a local database that is updated by an LSMS (Local Service Management System) which holds all routing for all ported numbers to which the carrier is responsible for completing calls. If routing information is found, a response is sent to the "query" containing the information necessary to properly route the call. If it is not a local number, the call is passed on to the STP and routed until it gets to a local carrier who will perform the "query" mentioned earlier and route the call accordingly. The routing information necessary to complete these calls is known as an LRN (Location Routing Number). The LRN is no more than a simple 10-digit telephone number that resides in the switch of the service provider currently providing service for the ported telephone number⁴. In 1997, the US FCC mandated Location Routing Number (LRN) method for LNP implementation for fixed networks. In the US, the N-1 switch must perform the LNP queries. The N-1 switch is the switch or transit switch that handles the call right before the terminating switch.

When a provider receives a request to port a telephone number from a new customer, that provider sends an industry-standard LSR (Local Service Request) to the existing (or "old") provider. When the Old Provider receives this request, it sends back FOC (Firm Order Confirmation) and the 5-day max process of porting the number begins. Either provider can initiate the port using a SOA or LSOA (Service Order Activator) which directly edits the NPAC database mentioned before. If the new provider initiates the port, it is called a "pull," and if the old provider initiates, it is a "push." Once the number is pulled or pushed, the new provider must "activate" the number using the LRN of the switch serving the customer. At the point this is completed, the number is ported⁵.

LNP for wireless carriers was first instituted in the US on November 24, 2003⁶. This policy was originally initiated as a way to remove unnecessary obstacles for service provider companies who wished to enter the market after the Telecommunications Act of 1996 was passed⁷. At the beginning, the FCC, wireless carriers, and many industry analysts expected 30m subscribers to transfer their wireless number within the first 12 months of LNP's introduction however only 7.8m actually did. One of the fastest growing wireless carriers in the USA, T-Mobile, completed number

1 <http://www.npac.com/home/lnpoverview.shtml#451541>

2 <http://www.wisegeek.com/what-is-local-number-portability.htm>

3 <http://www.npac.com/home/lnpoverview.shtml#451541>

4 http://en.wikipedia.org/wiki/Local_number_portability

5 http://en.wikipedia.org/wiki/Local_number_portability

6 http://www.pyramidresearch.com/pa_may26_mnp.htm

7 <http://www.wisegeek.com/what-is-local-number-portability.htm>

portability agreements with its rivals AT&T Wireless, Cingular Wireless, Nextel Communications, Sprint PCS and Verizon Wireless in October 2003⁸, LNP applies to wireless phone service, so long as the area code remains the same. Wireless number portability has greatly increased the competition between wireless phone service providers, which should prove to be a benefit to consumers in the long run.

LNP in the USA allows customers to port numbers between wireless carriers, wireline carriers and between wireless and wireline and wireline and wireless carriers as long as the area code part of the number remains the same.

In 2007 the FCC made clear that the obligation to provide LNP extends to interconnected VoIP providers and the telecommunications carriers that obtain numbers for them. The action was, in part, a response to numerous complaints by consumers about their inability to port numbers to or from interconnected VoIP providers. The order clarified that telephone companies may not obstruct or delay number porting by demanding excess information from the customer's new provider, and specifically concluded that LNP validation for a simple number port should be based on no more than four fields. The FCC has also tentatively requested that it requires the industry to complete simple ports in 48 hours⁹.

5.3 Development of NP in Europe

The European Union's (EU) ONP¹⁰ Directives mandated the introduction of NP for fixed geographic numbers¹¹ by January 2000 and it has now been implemented across Europe.

The EU's Universal Service Directive of 7 March 2002, which became effective on 25 July 2003, mandated the introduction of NP for mobile networks. Under Article 30 of this Directive „Member States shall ensure that all subscribers of publicly available telephone services, including mobile services, who so request can retain their number(s) independently of the undertaking providing the service“¹².

The EU argues, "number portability is a key facilitator of consumer choice and effective competition in a competitive telecommunications environment". Accordingly, national regulatory authorities (NRAs) shall ensure that (a) charges for mobile number portability are cost-oriented and "that direct charges to subscribers, if any, do not act as a disincentive for the use of these facilities" (Art. 30 (2) Universal Service Directive), and (b) retail charges for MNP do not distort competition (Art. 30 (3) Universal Service Directive).

Both the technical and economic implementation of NP has varied considerably across the members states depending on both the existing technical infrastructure and to a large degree on the likely demand for NP, which is primarily driven by the level of access competition in the fixed network.

The recovery of the costs of implementing NP was not defined in the directives. While in some countries prices have been negotiated commercially between carriers, in many countries the allocation of costs has been extremely contentious. In the UK the introduction of NP, which was first mandated in 1992, was delayed for four years due to the incumbent carrier disputing the prices set by the NRA. The situation was referred to the Monopolies and Merger Commission for resolution.

5.4 Technical Solutions for LNP

Where there are multiple carriers with competing networks, carriers are allocated number ranges by the body responsible for national number management (in Bermuda the Ministry undertakes this function). Carriers can then allocate numbers or number ranges to individual customers. The information in the number is typically used for two purposes:

- Customer identification, and

⁸ http://www.pyramidresearch.com/pa_may26_mnp.htm

⁹ <http://www.voip-news.co.uk/2007/11/03/us-number-portability-extends-to-voip-providers/>

¹⁰ Open Network Provision

¹¹ A telephone number provided specifically for wireline networks that is allocated to a specific geographic area

¹² Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive), Official Journal of the European Communities, 24 April 2002, L108/51-77

- Call routing.

In a wireline network, if the carrier has several switches in its network then it will typically use discrete number ranges for each switch, or divide a range up between the switches, depending on the scale of its operations. The number will therefore identify the switch where the customer is hosted. The customer identification part of the number allows for billing and administration to be carried out by the carrier.

If a number is ported then it is separated from the remainder of the number range allocated to a switch and the number therefore no longer indicates the host switch from which the customer is served and thus cannot determine the call routing. The number continues to identify the customer being called but does not identify the network and the switch where the customer is located.

In order to support LNP, additional information is required to ensure that the call is routed to the correct customer. This additional information should identify that the customer's number is no longer the same as the network routing number, and therefore some form of translation needs to take place to identify the network to which the customer has moved and also where on that network the number is hosted.

In most EU states, LNP has been introduced based on an "off-switch" solution with a centralised database for all numbers allocated to carriers. The off-switch solution enables a highly streamlined and efficient porting environment with low ongoing costs, both for the porting process in itself and for the routing of calls to ported numbers across networks, particularly for countries with many licensed carriers.

In some countries, an interim solution for wireline LNP based on either advanced call forwarding techniques or other "on-switch" solutions have been used. In these countries the reason for moving to the off-switch solution has been that the on-switch solutions were inefficient and that off-switch solutions were more efficient and had lower on-going costs given the likely volume of numbers to be ported.

Some smaller countries have not opted for the off-switch solution as it was considered unnecessary given the likely scale of porting in the country. However, recent developments have shown that commercially available hosted central database solutions can be scaled to meet the requirements of smaller jurisdictions in a cost-effective manner.

The following sections describe on-switch and off-switch solutions for LNP. The application of these solutions may depend on the networks deployed by the carriers.

5.4.1 On-Switch LNP Solutions

Simple Call Forwarding

A donor carrier¹³ can utilise its switch-based 'remote call forwarding' facility to implement LNP. This facility is usually available as a retail service for customers who wish to have their incoming calls forwarded to another number.

For LNP to be supported by simple call forwarding the recipient carrier¹⁴ would need to allocate a "shadow number" for each number ported. The call forwarding functionality then simply forwards all calls from the original number to the shadow number.

When using simple call forwarding, calls to ported numbers will typically travel all the way to the donor carrier's switch before the number is identified as ported and then routed accordingly. This means that the calls will 'trombone', see figure 1, and calls to ported numbers will therefore utilise more switching and transmission capacity than calls to non-porting numbers.

Simple call forwarding is not generally considered a suitable option for LNP due to the inefficiencies in routing and the use of switch processing capacity. However, in smaller jurisdictions with limited local infrastructure competition, it can be a suitable solution as it relies on existing switch functionality and the costs of implementing LNP are therefore limited to setting

¹³ The donor carrier is the carrier from which the number has been ported

¹⁴ The recipient carrier is the carrier to which the number has been ported

up the ordering and provisioning processes and the incremental conveyance costs due to the trombone effect.

Modified Call Forwarding

Modified call forwarding relies on functionality in the donor carrier’s switches inserting a porting prefix in the format xxxxx¹⁵ before the dialed number for numbers ported off of the donor carrier’s network. The digits can be used to identify the precise switch to which the number has been ported. The recipient carrier can then decode this information in order to complete the call in two stages. The carrier initially must use the prefix to route the call to the correct switch in its network. Then the switch processes the original dialed digits in the local look-up table so as to connect the call to the customer.

Owing to the way that networks have been built historically, it is common that the ability to perform number translation only resides in the destination switch¹⁶. Calls therefore need to be routed to the donor’s destination switch before the necessary routing prefix can be inserted. This is the switch to which the customer was previously connected. This switch identifies the called number as a number that has been ported and adds additional routing digits to the number to allow the call to be re-routed. The call is then passed from the switch to the recipient carrier using standard interconnection techniques.

This creates an additional loop in the call path. That loop remains active for the duration of the call.

The tromboning therefore requires additional capacity for calls to ported numbers. The additional capacity is required for:

- The switch processor to set up the call;
- The switch to support the call path for the duration of the call, and;
- The transmission capacity required for the duration of the call.

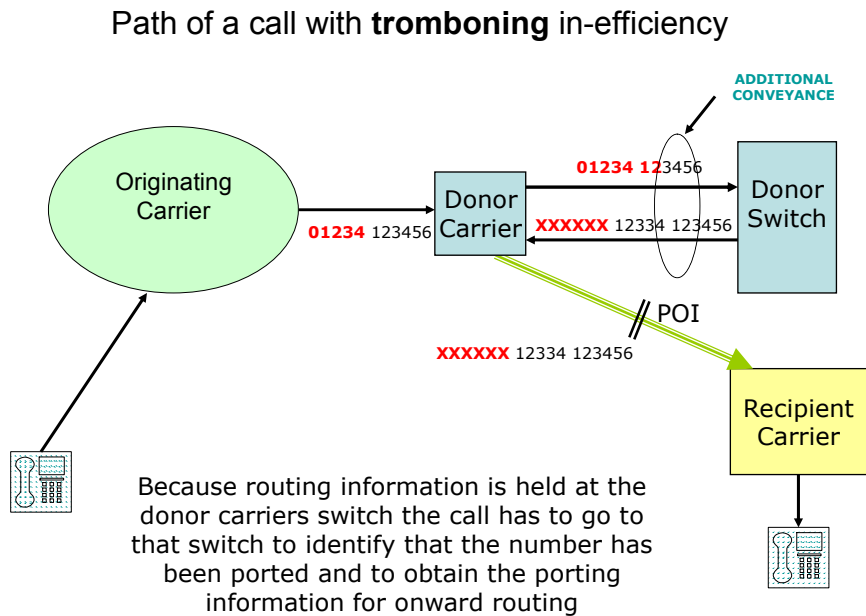


Figure 1. Path of a call with tromboning inefficiency

¹⁵ Length of porting prefix can vary between countries
¹⁶ E.g. where the number was originally hosted

Modified Call Forwarding with Call Drop-back (Call Drop-Back)

Call drop-back is an improvement on modified call forwarding which removes the tromboning inefficiency described above. All calls are routed as per the information contained in the dialled number until the call reaches the donor carrier. The donor carrier then interrogates its local switch indicated by the dialled number, asking whether the number is still resident there or if the number has been ported. If the call is to a ported number then the donor carrier routes the call in accordance with the porting prefix information received from the local donor switch, if not then the call is terminated as normal.

For the call drop-back option the local donor switch responds to the enquiry by returning the dialled number plus a prefix which identifies the network and the switch or point of interconnect to which the donor carrier should now route the call, the path to the local switch is then terminated and the donor carrier routes the call accordingly. This method reduces routing inefficiencies compared to if the call had to travel all the way to the local donor switch before it was re-routed and the connection to the local switch would remain live for the duration of the call.

Path of a call with a call-drop back solution

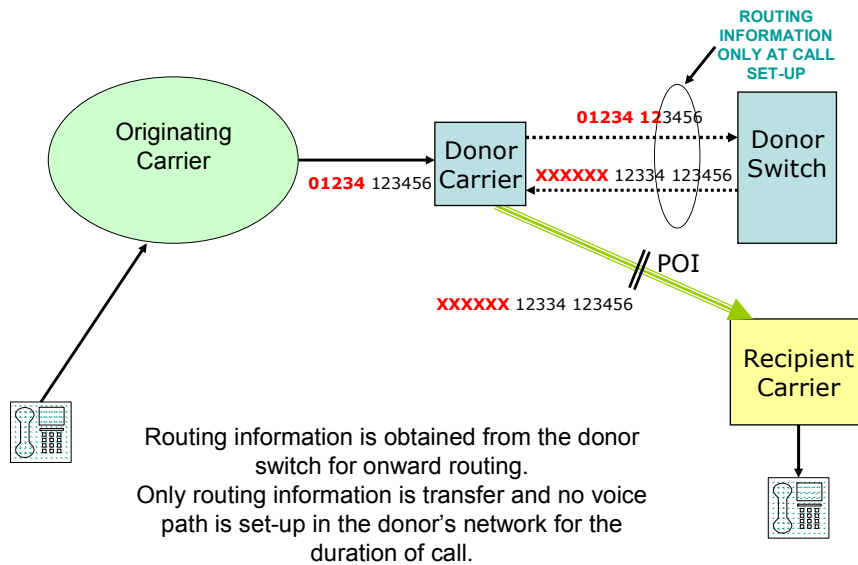


Figure 2. Path of a call with a call-drop back solution

5.4.2 Off-switch Solutions

Off-switch solutions typically use an external database where all information about the allocation of number ranges to carriers and about all ported numbers is housed. This database can be a central database or a distributed database.

Most commonly the database is used to provide the porting information to the carriers in order to allow the carrier to determine how to route the call to a ported number. This is usually referred to as a 'reference' database.

However, the database could be used to route actual calls to the switch on which the ported customer is hosted following the porting. This form of database is commonly called a 'routing' database.

Central Database

A single database is implemented and used by all carriers as a reference database. The central database for LNP is often managed by an independent third party and not by the carriers themselves. The solution can also be a hosted solution provided by the third party. A central

database is regarded as the best option in markets with several operators and it is regarded as the most effective long-term solution. The central database solution minimises the risk for disputes between operators.

Distributed Database

The distributed database model consists of separate databases that all contain subsets of the total data. In distributed database models each carrier handles its own ported numbers and exchanges porting information with each other as required.

5.4.3 Routing of Calls Using an Off-Switch Solutions

When using an off-switch LNP solution calls to a ported number require that a switch involved in the call setup interrogates a database during the call set-up process to ascertain the carrier to which the number has been ported. There are two methods of interrogating the database. Either all calls are routed by the carrier after a database enquiry is made, this is known as All Calls Query (ACQ). An alternative method is that only calls that are rejected by the donor carrier require a database enquiry; this is known as Query on Release (QoR).

The originating carrier can interrogate the database either from the originating local switch or from its trunk switch and will then route the call based on the information received. This avoids routing inefficiencies although some extra costs are incurred for all calls due to the need to interrogate the central database.

The off-switch solution requires that all networks be equipped with some form of local routing database and it requires the set-up of a reference database, either as a central database or a distributed database. This database can then be used for either providing the reference location information or to actually carry out the routing of calls for a ported number.

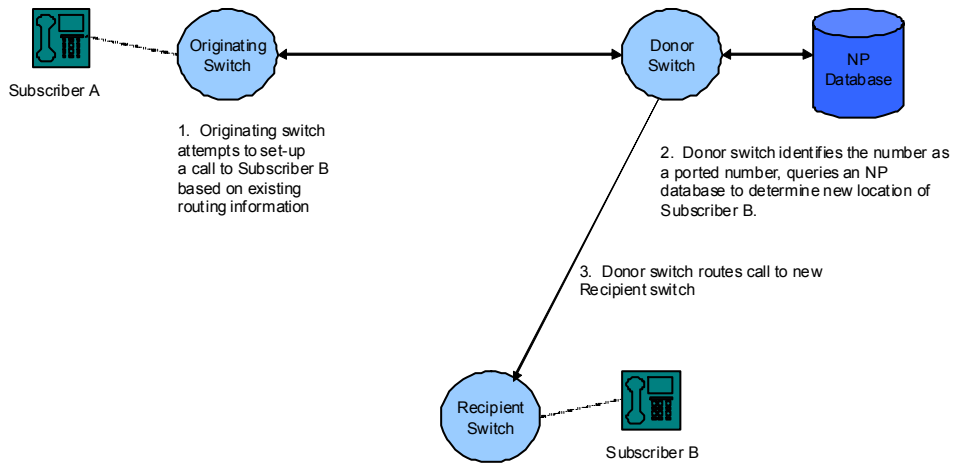
Described below are a number of examples of routing calls in an off-switch solution utilising a central database.

Onward Routing using an Off-Switch LNP Solution

This method of LNP requires that the donor carrier's switch processes the call even though the customer is no longer a customer of the carrier that is operating the donor network. The donor carrier identifies that the number is a ported number and makes a database enquiry to obtain the up to date porting information in order to allow the carrier to onward route the call.

Generally, as a solution for LNP onward routing is seen to be unfair on the donor carrier as it has a continual requirement to process calls and route calls for customers who have opted to leave its network.

However in some implementations of LNP, onward routing is used to process calls where the originating network does not have access to any centralised routing information.



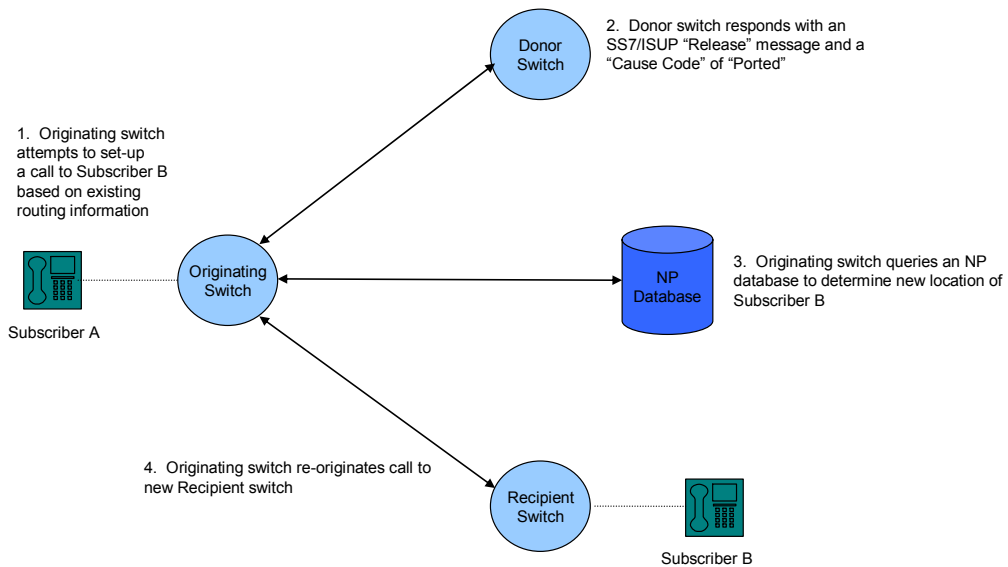
Note: for simplification this example does not include transit switching

Figure 3. Onward Routing using an Off-Switch LNP Solution

Drop Back/Query-on-Release (QoR)

In this off-switch solution the originating carrier initially attempts to route the call using existing routing information (e.g. assuming that no numbers are ported). If the number has been ported, the donor carrier responds with a "release" message. When the originating carrier receives this "release" message it then queries the central LNP database to determine the new location of the called customer. The originating carrier then routes the call to the recipient carrier using the routing information received from the central LNP database.

When the originating carrier receives the "release" message it has to re-commence the call set-up process by making a database enquiry and then routing the call to the recipient carrier. This can result in a delay to call-set up for calls to ported number.



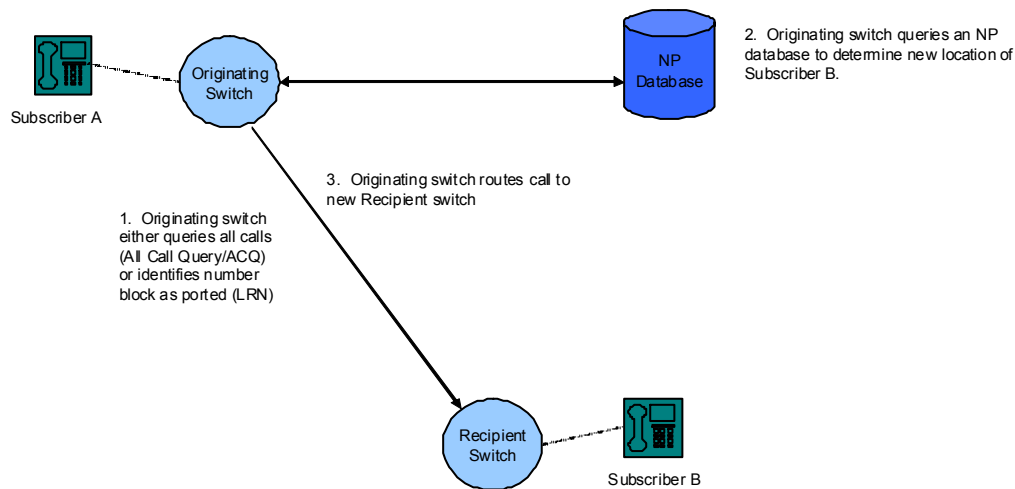
Note: for simplification this example does not include transit switching

Figure 4. Drop Back/Query-on-Release (QoR)

All Call Query (ACQ) or Network or Location Routing Number (LRN)

In this off-switch solution the originating carrier either queries all calls (All Call Query (ACQ)) or identifies a number block as a ported block (Location Routing Number (LRN)). This solution allows the originating carrier to route all calls directly to the recipient carrier.

This method requires a query for all calls to subscribers in the ported number blocks and in the USA was viewed as fair to all of the parties involved. In 1997, the US FCC mandated Location Routing Number (LRN) method for LNP implementation for fixed network. In the US, the N-1 switch must perform the LNP queries. The N-1 switch is the switch or transit switch that handles the call right before the terminating switch.



Note: for simplification this example does not include transit switching

Figure 5. All Call Query (ACQ) or Network or Location Routing Number (LRN)

5.5 NP Penetration and Success Factors in Europe

5.5.1 Fixed NP

Fixed number portability has continued to play an important role in encouraging competition. As of October 2007, almost 19 million subscribers in 23 EU¹⁷ Member States have ported their number since the introduction of NP. Apart from the countries that have introduced fixed number portability only during 2007 (Malta and Slovakia), there has been significant growth in the amount of fixed numbers ported in Greece, Spain, France, The Netherlands, Slovenia and Czech Republic.

Inter-carrier prices for fixed number portability refer to the amount charged by the donor to the recipient operators for porting one telephone geographic number (excluding VAT). This price may vary depending on a number of factors. The EU weighted average price as of October 2007 for a fixed number ported is €9.69. Prices in the Czech Republic, Ireland, Austria and Finland are significantly higher than the EU average, while in 7 Member States (Belgium, Denmark, Germany, Latvia, Italy, Slovenia and Sweden) prices are below €10. Fixed number portability is free of charge in Lithuania and in Estonia. Since October 2006 a significant decrease in the price for number portability has occurred in Ireland (-48%), Portugal (-60%), Slovenia (-50%), and Sweden (-70%). No country had significant price increase.

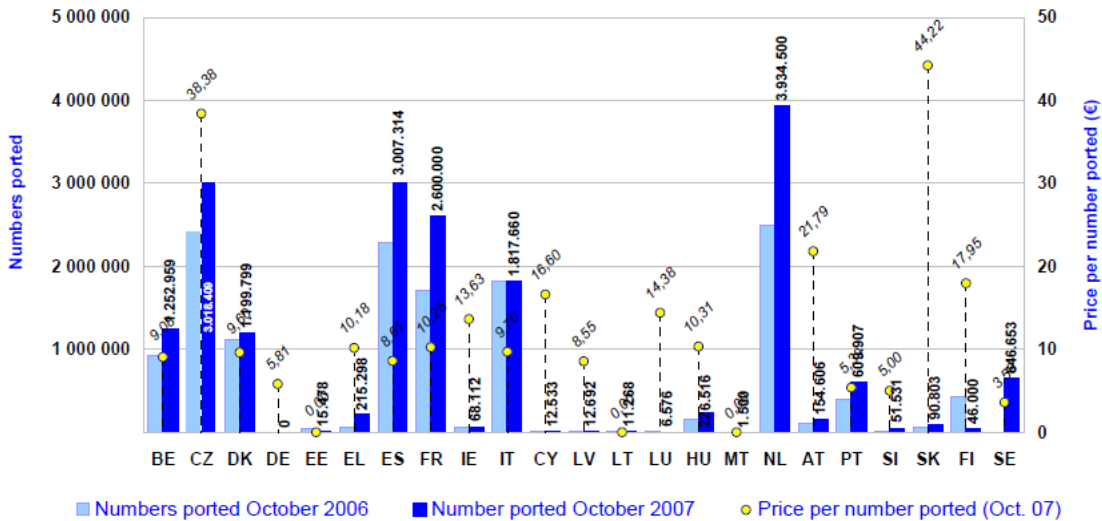
In many EU countries there is little access competition and so very few numbers have been ported. In some countries, such as the UK, Spain and the Netherlands, a high proportion of customers have a choice of access provider, typically from Cable TV operators. In some countries, such as France and Ireland, LLU is being 'bundled' with LNP successfully. The level of NP penetration can be affected by a number of factors, including:

¹⁷ European Union

- The level of infrastructure competition in the country (if most competitive carriers use CS¹⁸ or CPS¹⁹ and do not offer direct customer connections then there is little demand for NP);
- The level of charges for NP (within the EU it would appear that the highest penetration of NP correlates to the lowest per line porting charges);
- The complexity and reliability of the porting processes (NP requires inter-operator ordering, validation and implementation and this process can be very complex).

Below is an overview of NP charges and penetration levels in The EU. The graphs are taken from the EU's 13th Implementation Report

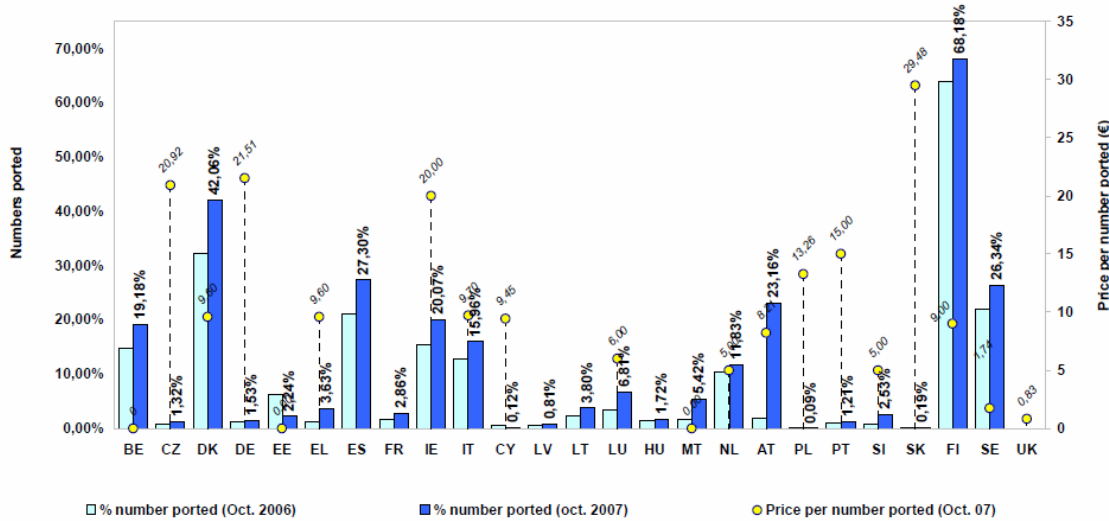
Fixed ported numbers and price per number ported, October 2007



The above graph shows the number of fixed ported numbers by EU country. Also the graph shows the price per number ported (in Euros).

5.5.2 Mobile NP

Mobile ported numbers and price of mobile number portability, October 2007

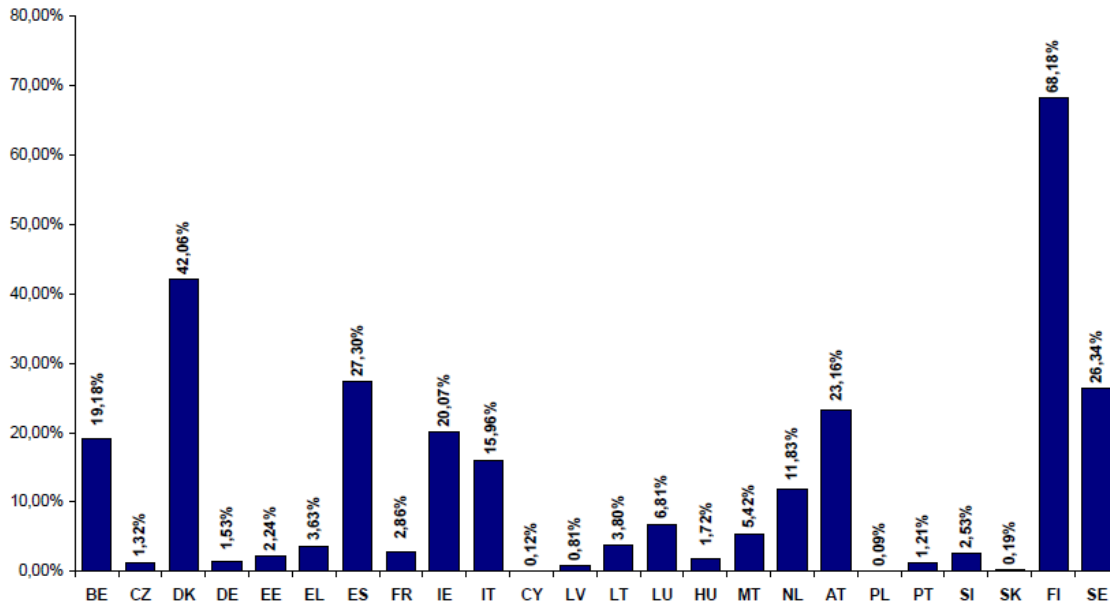


The above graph shows the number of mobile ported numbers by EU country. Also the graph shows the price per number ported (in Euros).

¹⁸ Carrier Selection

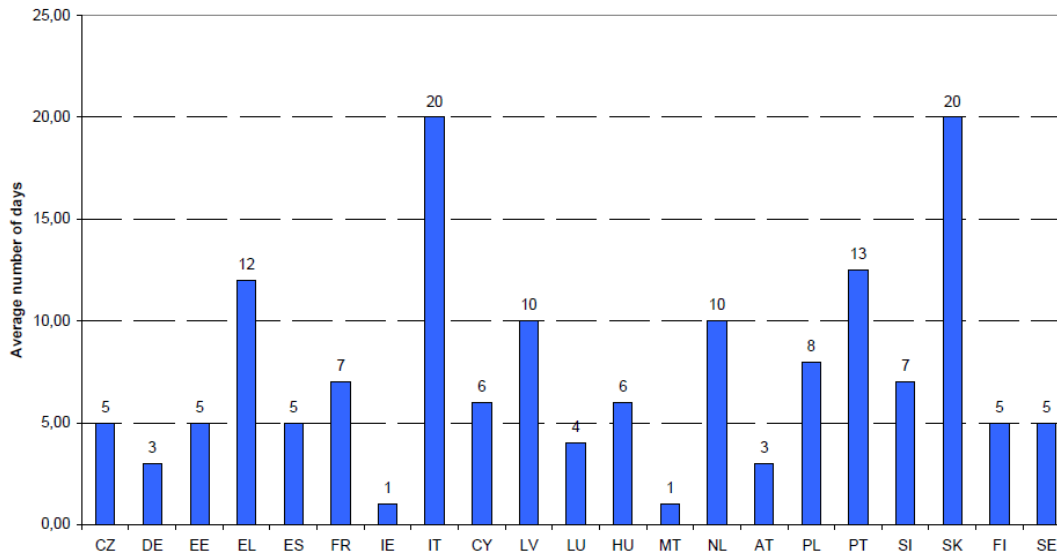
¹⁹ Carrier Pre-Selection

% of mobile numbers ported over total mobile subscribers (Oct. 2007)



The above graph shows the percentage of mobile numbers ported over the total number of mobile subscribers by EU country. The highest percentage of ported numbers are in Finland and Denmark.

Time needed in number of days for mobile number portability. October 2007
(european average: 8.41 days)



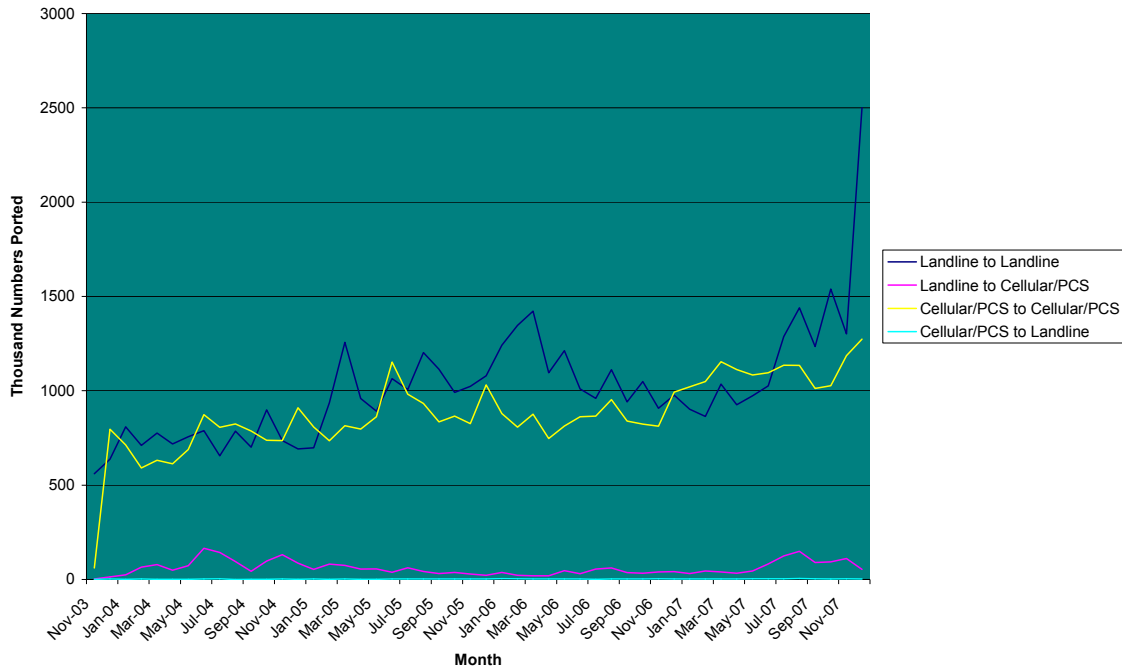
There are some general correlations between the success of porting in a country and the porting cost and the time taken to port a number. Where porting takes place in a period of less than 5 days and where porting costs (in the EU) are less than €10 in general porting is more successful.

5.6 NP Penetration and Success Factors in USA

There are four forms of portability that are reported by the FCC in the USA, these are:

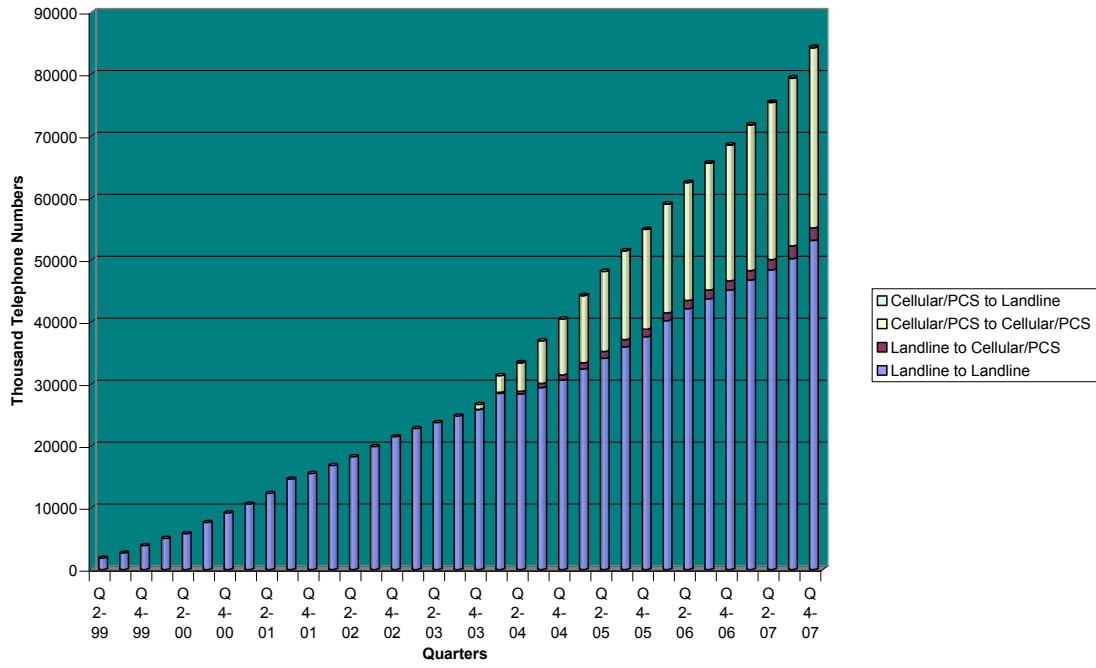
- Porting of numbers from landline to landline;
- Porting of numbers from landline to cellular/PCS;
- Porting of numbers from cellular/PCS to cellular/PCS; and,
- Porting of numbers from cellular/PCS to landline.

The chart below shows²⁰, on a monthly basis, the quantities of telephone numbers that have been ported since LNP porting started on in the USA on November 24, 2003. It clearly shows that most porting activity is intramodal, that is between two landline carriers or between two wireless carriers. Since introduction of LNP in November 2003 there has been a steady but not significant increase in the volume of numbers being ported per month.



The chart below shows the quantity of telephone numbers in the porting database at the end of each quarter. The graph shows a steady increase in the total number of cellular/PCS to cellular/PCS and landline to landline portings on a quarterly basis. Portings between landline and cellular/PCS has not shown a significant volume of monthly ports (see graph above) nor does the total number of ported numbers in the porting database show any significant volume.

²⁰ Source - FCC



6 Number Portability in Bermuda

6.1 The Bermuda Context

Bermuda's economy, as with all modern economies, is increasingly dependent on up-to-date, resilient and affordable telecommunications facilities and services.

Although the current regulations and legislation have served Bermuda well and has encouraged investment and competition across the different sectors of the industry, it is now (and has been for some time) struggling to accommodate the pace of convergence between different industry sectors and technology platforms.

Bermuda's current regulatory structure, codified in the Telecommunications Act of 1986 and its amendments, established market segments by issuing licences which explicitly limited the types of service a carrier could offer. This eventually resulted in the three licence categories that exist today:

- Class A for international telephone services;
- Class B covers a range of domestic telecommunications services, both wireline and wireless;
- Class C for Internet service provision.

At the time the market segments were originally devised, the licences reflected in part the nature of the facilities or technology deployed, and sought to constrain the ability of a firm to leverage a dominant position from one market segment into another. Because existing firms did not have the licences necessary to enter each other's market segment there was no direct competition amongst firms in different licence classes and the Ministry monitored the reasonableness of retail rates.

In the mid-1990s, developments in the wireless market brought to Bermuda two additional Class B wireless carriers. These new wireless carriers entered the market by advertising better coverage and service quality, and most importantly, improved roaming arrangements relative to what was available at the time from Mobility, the incumbent provider. Accordingly, consumers have benefited from price competition and the introduction of a wide-range of new services.

Convergence of technologies and service platforms is driving innovation and efficiency in telecommunications across the world. Bermuda's fragmented telecommunications industry is presently unable to fully participate in these developments due to the current licensing structure which prevents carriers from offering service bundles outside their authorized class. Carriers are largely restricted to one of three classes of service, international, ISP, or domestic telephone provider. This makes little economic sense today as digital technology allows for large efficiencies when multiple services are provided over one network. The licensing restriction could cause Bermuda to fall behind other countries on innovation as investment required for innovation could be prohibitive if a wider range of services cannot be offered by individual carriers.

In June 2008 the Cabinet approved the Minister's regulatory reform proposal that includes reform of the licensing structure, removing the current structure of separate licence categories, based on services provided and to introduce a single standard communications licence available to all qualifying licensees.

Bermuda is in a leading position with regards to its telecommunications facilities and the proposed reform is intended to further strengthen that position by creating an evolutionary framework, based on international best practice but adjusted to reflect Bermuda's specific needs and characteristics. The proposed reform is imperative if Bermuda is to maintain its enviable position because the regulatory structure must be modified to reflect the evolving technology and marketing practices of telecommunications firms.

The regulatory reform proposed for Bermuda should significantly increase competition in the market place. There is however already competition in the Bermuda market in terms of 'access competition' in the wireless market and specifically in Hamilton there is 'access competition' for fixed business customers being provided by Quantum Communications.

Consumer competition is also increasing in Bermuda as alternative access network providers are increasing the deployment of alternative and innovative access technologies such as wireless.

For competition to deliver benefits in a telecommunications market place it is necessary for consumers to be able to freely choose the services of an alternative carrier should they wish. One mechanism that may assist in enabling choice is Local Number Portability (LNP). LNP may help to promote competition and maximise the benefits of a competitive telecommunications market for consumers. The lack of LNP in the Bermuda market can be considered to be a “barrier to switching” and thus can limit the effect of competition.

Question 1: Does the respondent agree with the comments above that the lack of LNP in the Bermuda market can be considered to be a “barrier to switching” and thus limit the effect of competition. If the respondent does not agree then they are requested to provide their reasoning for this.

Question 2: Can the respondent describe the problems that it believes the lack of LNP causes in the Bermuda market.

Question 3: Can the respondent describe what difference it believes the introduction of LNP will make for consumers and carriers in the Bermuda market.

Question 4: Can the respondent describe, what difference it believes the introduction of LNP will make to its own business in terms of offering services and attracting customers for different market segments?

Note: The respondent is reminded that any information provided to METEC specifically marked “IN COMMERCIAL CONFIDENCE” will be respected as such and will not be made publicly available.

The introduction of LNP must be considered in the Bermuda context. Any LNP solution for Bermuda should be scaled to meet potential demand and scoped to meet anticipated customer requirements²¹. Therefore, for the Bermuda market the potential technical solutions need to be considered in the context of a small market size.

Question 5: Can the respondent quantify what it believes to be the potential demand for LNP in Bermuda?

6.2 Technical Solutions in Bermuda

Although on-switch solutions have some routing inefficiencies METEC considers it useful to consider these as well as off-switch solutions as due to the small market size of Bermuda and the amount of numbers ported may be limited the impact of the routing inefficiencies to ported numbers may not be significant. In addition, given the potentially lower up-front implementation costs and shortened time to market of these solutions they should be included in the review by carriers to ensure that Bermuda gets the ‘right’ solution to meet its needs at the lowest cost.

6.2.1 On- Switch Solutions

Simple Call Forwarding

Many carriers currently offer a call forwarding service to its retail customers. This implies that these carrier’s switches are equipped with call forwarding functionality.

METEC considers that the demand for LNP in Bermuda, whilst potentially critical for certain market segments, is likely to be limited in scale. This could mean that the drawbacks of the call forwarding options, which are primarily related to routing inefficiencies and increased network capacity requirements, may be limited for Bermuda. When compared to other smaller jurisdictions, however, Bermuda has a relatively large number of carriers and therefore it is important that when the on-switch solutions are considered the need for the solution to work effectively and efficiently in a multi-operator environment is also taken into consideration.

²¹ For example in fixed NP the solution may be required to include the option to port hunt groups.

METEC has identified a number of potential disadvantages with the simple call forwarding solution, these disadvantages can include:

- Increase in routing inefficiency
- Requirement for shadow/dummy numbers
- Increased processor capacity requirements on switch
- Increased interconnection capacity requirements
- possible restriction to some current services i.e. CLI

However, METEC has also identified some potential advantages of this solution these include:

- Solution readily available (existing implementation or from vendor)
- Low cost of implementation
- Suitable solution where only a small volume of numbers might be ported
- Quick to market

Based on its initial assessment METEC considers that simple call forwarding may provide a workable solution for LNP for Bermuda and it therefore warrants further consideration along with the other options described.

Question 6: Does the respondent agree that simple call forwarding could constitute a suitable LNP platform for Bermuda? The respondent is requested to confirm that its own switches are capable of supporting this solution. If the respondent disagrees that simple call forwarding could constitute a suitable LNP platform for Bermuda, then the respondent is requested to provide reasoning for its position.

NOTE – METEC suggests that if carriers are unable to answer questions relating to their own switches that they consult with their switch vendors to obtain a detailed overview of the suitability of their switches for the selection of solutions described in this consultation document.

Modified Call Forwarding with Tromboning Inefficiency

The impact of the tromboning inefficiency may affect different carriers in different ways and will vary based on a number of factors including the availability of spare switch port capacity and processing capacity to support the tromboning as well as the availability of interconnection capacity between carriers

METEC has identified a number of potential disadvantages with this solution for LNP, these disadvantages can include:

- Increase in routing inefficiency
- Increased processor requirements on switch
- Increased interconnect capacity requirements
- Increase in conveyance charges

However, METEC believes that a key advantages of this solution is that it is likely to be easily implemented on most switches in use.

Based on its initial assessment METEC considers that modified call forwarding with tromboning inefficiency may provide a solution for LNP for Bermuda and warrants further consideration along with the other options described.

Question 7: Does the respondent agree that modified call forwarding with tromboning inefficiency could constitute a suitable LNP platform for Bermuda? The respondent is requested to confirm whether its own switches are capable of supporting this solution. If the respondent disagrees that this solution could constitute a suitable LNP platform for Bermuda, then it is requested to provide reasoning for its position.

Call Drop-Back

This solution was used as an interim NP platform in the UK. It is tried and tested and can provide a sustainable permanent platform for LNP in markets where the number of operators requiring LNP is limited and where the proportion of numbers to be ported is relatively low.

Call drop-back is mainly implemented in two-tier networks (with trunk and local switches) to reduce the costs of additional conveyance described above. However, carriers in Bermuda only operate a small number of switches and these switches may have both trunk and local functionality. Therefore consideration needs to be given to whether the introduction of call drop-back would provide an increased benefit over the introduction of modified call forwarding for the carriers in Bermuda.

METEC has identified a number of potential advantages with the call drop back solution, these advantages can include:

- Reduced routing inefficiency
- Reduced interconnection capacity requirement
- Potentially reduced processor capacity requirements
- The donor operator is released from being part of the call path

However, the main disadvantage identified by METEC is that there are potentially more hardware/software changes required to switches to implement the call drop back solution.

METEC considers that the call drop-back option could be a suitable solution for Bermuda, if it decides that LNP should be introduced and believes that this option should be investigated in more detail with particular reference to the conditions in Bermuda.

Question 8: Does the respondent agree that the call drop-back option could be a suitable LNP platform for Bermuda? If the respondent disagrees, then it is requested to provide reasoning for its position. The Respondent is requested to confirm that its own switches are capable of supporting this solution.

6.2.2 Off- Switch Solutions

The off-switch solution was primarily developed to cope with large scale LNP operations in larger countries and where significant local infrastructure competition could be anticipated. In recent years, however, there have been a number of deployments of hosted central database solutions. These hosted solutions can be adapted to meet the requirements of smaller markets and can prove to be a cost effective solution to the introduction of LNP in smaller countries as well. In addition, hosted solutions for smaller jurisdictions can be implemented in a period of between 6 and 12 months.

As described early an off-switch solution can be implemented as a central reference database or as a distributed database. METEC believes that a central reference database has the advantage of:

- Acting as a reference database of ported numbers for all operators,
- Provides synchronisation and broadcasting of porting information,
- Treating all carriers equally'
- Can be managed by one party.

However, METEC believes that a central reference database solution potentially has the following disadvantages:

- Relatively high cost of implementation
- Ongoing operational costs
- Management of central database issues
- Carriers are required to update their own routing databases from reference database and keep this information up to date.

Whilst historically off-switch solutions have proven to be complex and costly to implement, METEC considers that it is appropriate to consider some of the emerging hosted central reference database solutions as a potential off-switch solution for Bermuda.

Question 9: Does the respondent agree that an off-switch solution using a central database should be investigated as a potential LNP solution for Bermuda. If the respondent disagrees then it is requested to present reasoning for its position. The respondent is requested to confirm that its own switches are capable of supporting this solution.

With regards to the distributed database METEC believes that this solution has the following advantage:

- No third party required to operate database

The disadvantages of the distributed database solution are considered to be:

- No single reference database
- Duplication of resources for implementation of the database.

METEC considers that it is appropriate to consider a distributed database as a potential off-switch solution for Bermuda.

Question 10: Does the respondent agree that an off-switch solution using a distributed database should be investigated as a potential LNP solution for Bermuda. If the respondent disagrees then it is requested to present reasoning for its position. The respondent is requested to confirm that its own switches are capable of supporting this solution.

6.2.3 Summary of Potential LNP Solutions for Bermuda

METEC has proposed above a short-list of five potential LNP Solutions for further consideration in light of the Bermudian market place.

Question 11: Does the respondent agree that the five proposed LNP solutions should form the short-list of potential LNP solutions for LNP? If the respondent disagrees then it is requested to present reasoning for its position and propose alternative potential LNP solutions.

Question 12: Does the respondent has a favoured solution for the provision of LNP taking into consideration the Bermudian market condition and the its own network capability for implementing an LNP solution. If the respondent has a favoured LNP solution then it is requested to present reasoning for this position.

6.3 Proposed Inter-Carrier Working Group for Bermuda

METEC proposes that an industry working group be set up to evaluate the possible technical LNP platforms for Bermuda as described in this document. A suggested mandate of this Working Group could be as follows:

- Investigation and documentation of the technical options for implementing LNP in Bermuda;
- Review of the pros and cons of each technical options covered;
- Estimated approximate costs of implementing each technical option; and,
- Recommendation of technical LNP solution for Bermuda.

While the proposed mandate above would appear to be appropriate METEC, believes that should the establishment of such a group be the outcome from this consultation. METEC believes that this group should run for a maximum of 3 months and its outputs would form a part of METEC's further consideration.

Question 13: Does the respondent agree that an Industry Working Group is the most useful means of evaluating the technical options for implementing LNP in Bermuda? If the respondent disagrees, then it is requested to provide reasons for this and to offer alternative means of evaluating the technical LNP options for Bermuda.

7 Conclusion

The measures described in this consultation paper are designed, and have been implanted in other jurisdictions, to promote and facilitate the development of competition by increasing customer choice and reducing barriers or costs to customers of switching carriers. This in turn encourages carriers to compete for a wider range of customers, bringing benefits directly to those who switch operators and indirectly by promoting price competition.

This consultation paper considers the experience of implementing LNP and asks whether they are useful and appropriate measures to consider implementing in Bermuda. The paper proposes that there is more examination needed of the various technically feasible options before more detailed consideration of the overall costs and benefits to an island economy like Bermuda can be concluded.

It is suggested that the players in the Bermudian market, with their specific knowledge and technical expertise in the operation and running of telecommunications networks and the provision of associated services, are best placed to consider the technical solutions available and the establishment of working groups to consider these issues is proposed.

Respondents are invited to engage positively in the discussion on the introduction of competition enhancing measures so as to ensure that the outcome is viable and suitable for Bermuda and that any implementation programme can be realistic, achievable and ultimately of benefit to the end users and Bermuda as a whole.

Annex 1: List of Questions asked in this Consultation Paper

Question 1: Does the respondent agree with the comments above that the lack of LNP in the Bermuda market can be considered to be a “barrier to switching” and thus limit the effect of competition. If the respondent does not agree then they are requested to provide their reasoning for this.

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Question 7: Does the respondent agree that modified call forwarding with tromboning inefficiency could constitute a suitable LNP platform for Bermuda? The respondent is requested to confirm whether its own switches are capable of supporting this solution. If the respondent disagrees that this solution could constitute a suitable LNP platform for Bermuda, then it is requested to provide reasoning for its position.

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Question 13: Does the respondent agree that an Industry Working Group is the most useful means of evaluating the technical options for implementing LNP in Bermuda? If the respondent disagrees, then it is requested to provide reasons for this and to offer alternative means of evaluating the technical LNP options for Bermuda.