Number Portability

I. Introduction

In the context of traditional circuit-switched telecommunications networks, number portability is the ability of end-users to retain their telephone numbers when changing service providers, service types or locations. It is believed that when fully and nationally implemented by both wireline and wireless service providers, number portability will remove one of the most significant switching costs for consumers and will encourage competition in the telecommunications industry.

With the Telecommunications Act of 1996, Congress addressed the issue of number portability by formally defining it, setting deadlines for implementation, and requiring all carriers to deploy it. To ensure standardization across platforms for all participants, the Federal Communication Commission (FCC) instructed the North American Numbering Council (NANC) to determine which number portability method to employ. The location routing number (LRN) method proved to be the most efficient among alternatives and is the method now widely implemented in wireline environment. The sections below discuss in detail number portability and LRN architectures.

II. Types of Number Portability

There are three types of number portability:

1) Service provider portability.
2) Location portability
3) Service portability

Service Provider Portability

Historically, all directory numbers in a given Numbering Plan Area - Central Office Code (NPA-NXX) were assigned to a single telephone switch. By owning their customers' numbers incumbent local exchange carriers (ILEC) had significant advantages over competitors. When customers wanted to switch service, they had to give up their number which imposed on them inconvenience/switching costs. With the Telecommunications Act of 1996, FCC mandated that all numbers be portable to all local exchange competitors (ILECs, CLECs, cellular, etc.). The Act defined service number portability as the ability of end users to retain existing directory numbers (DN) at the same location as they change from one service provider to another.

The introduction of service provider portability allows individual DNs in one NPA-NXX to be moved to a different switch. To ensure that calls are routable to a portable number, FCC approved the concept of location routing number. Under the number portability standard, each switch that hosts portable number is assigned a 10-digit LRN that is used to route calls to that switch. All LNP-capable network elements have to maintain a list of NPA-NXXs that are considered portable. That particular FCC mandate only refers to porting numbers within a given "portability domain" or rate center.

Location Portability

Location portability is the ability of users to retain existing DNs without impairment of quality, reliability, or convenience when moving from one physical location to another. Location portability allows a given telephone number to be associated with any network termination device, independent of location. It also allows customers to take their DNs when they move to another geographic location outside of the original rate center. Although FCC does not address location portability at this time, it leaves room for changes in the future.

Service Portability

Service portability is the ability of users to retain existing DNs without impairment of quality, reliability, or convenience when switching from one service to another provided by the same telecommunications carrier. FCC is not addressing service portability at this time and requirements for service portability are still undefined.

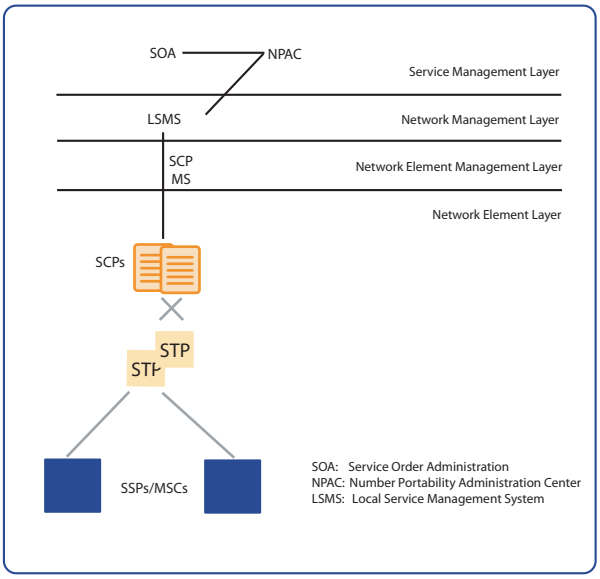
III. Wireline LNP Architecture

Service Provider Portability

There are seven basic components required to deploy local number portability:

- Service Order Administration
- Number Portability Administration Center
- Service Control Point Management Server
- Local Service Management System
- Signal Transfer Point
- Service Switching Point
- Service Control Point

Figure 1 shows a typical the network architecture.



Service Order Administration

The Service Order Administration (SOA) serves as an interface element between carriers' order and provisioning systems and the Number Portability Administration Center (NPAC). SOA's primary functions include subscription audit request/management, data administration, data transfer to the NPAC, report generation, bulk file parse and upload, subscription tracking, legacy order entry interface, and logging. Depending on the requirements of individual service providers, the SOA may interface with multiple NPACs to allow for nationwide number portability. The SOA interface to the NPAC is a common management information service element (CMISE), providing subscription-management functions as well as logging, error reporting, and alarm functions. The carrier-to-SOA connection may also be custom-designed to interface with existing order-entry systems.

Number Portability Administration Center

Number Portability Administration Center (NPAC) is a third-party, neutral database administration function that supports number portability. This database is designed to receive information from both incumbent and new service providers, validate that information, and download the new routing information when a customer has been physically connected to the new service provider's network. Each ported number is defined as a "subscription version" within NPAC that contains the new service provider's ID, the LRN of the new switch, and routing data associated with additional services the customer may request. The NPAC also maintains a record of all ported numbers and a history file of all transactions relating to the porting of each number. The NPAC, however, is not involved in real-time call processing.

Service Control Point Management System

The Service Control Pint Management System (SCP MS) provides interface services between the LSMS and the SCP. The SCP MS may or may not be physically integrated with the SCP.

Local Service Management System

The Local Service Management System (LSMS) is a fault-tolerant hardware and software platform that contains database with routing information to ported telephone numbers. The primary functions of the LSMS are subscription management, network data management, service provider data management, error processing and notification, transaction event logging and reporting, transmission of activation/deactivation events to the network elements, and audits.

The LSMS interface with the NPAC provides real-time activation/deactivation information upon download from the NPAC and can send responses to the NPAC once a message or subscription version is processed. Similar to the SOA, the interface between the LSMS and the NPAC is CMISE and provides capabilities for event logging, security, and alarming. The LSMS is expected to mirror NPAC ported routing information and has the functionality to request updates from the NPAC in a variety of ways to ensure database synchronization.

Number Portability Database

The Number Portability Database (NPDB) contains all ported numbers within a ported domain as well as routing information necessary to support number portability. Its function is to provide the association between the called party and the carrier LRN, identifying the switch to which the call should be routed. There are two different LNP database architectures for accessing the LRN associated with a particular DN: an integrated STP/SCP configuration and an STP with an adjunct SCP.

An LNP SCP provides the LRN for a particular DN. The correct routing information for SCP-based services, including line information database (LIDB), calling name delivery (CNAM), custom local area signaling services (CLASS), and inter-switch voice messaging (ISVM) for a ported DN is determined by 10-digit global title translation (GTT) also provided in the NPDB.

The SCP is a high-transaction-oriented server that receives intelligent network (IN) and advanced intelligent network (AIN) LNP transactional capabilities application part (TCAP) messages or number portability request (NPREQ) messages from the SSPs/MSCs using the SS7 network. As an alternative, some providers deploy an integrated STP/SCP platform, which may also provide high transaction rate capability with fewer links and ports.

Signal Transfer Point

The Signal Transfer Point (STP) receives the LRN query from the SSP/MSC, routes it to the appropriate NPDB, and returns a response to the originating SSP/MSC. While the need for a new translation type and the possible need for additional tables were previously identified by Alliance for Telecommunications Industry Standards (ATIS), the basic core functionality of the STP as a network message router has not been impacted.

Service Switching Point/Mobile Switch Center

The Service Switching Point/Mobile Switch Center (SSP/MSC) is owned and operated by the exchange carrier. These switch points must be able to generate an SS7 LNP query to the NPDB when a call is placed to a telephone number in a ported domain. A ported domain here is defined as a Metropolitan Statistical Area (MSA) that has implemented number portability. A query is generated on any call to an NPA-NXX that has been designated as portable in the local-exchange routing guide (LERG) and NPAC with at least one ported number and marked as such in the switch routing tables.

Wireline to Ported Wireline Number Call Flow

1) A wireline customer dials a wireline number that is ported. The SSP queries an internal table that identifies all NPA-NXXs that are portable.

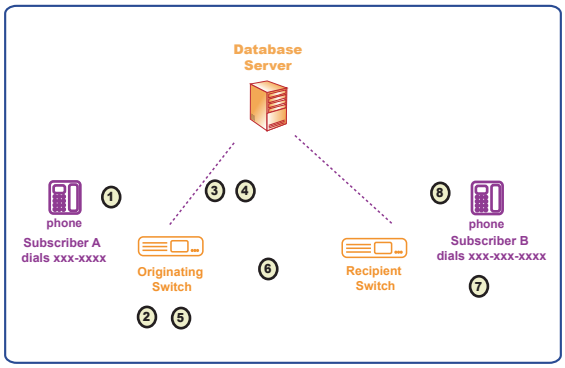
2) If the dialed NPA-NXX is marked as portable, the originating SSP determines if an SSP query needs to be launched. A query is not required if the called party DN is served by the switch, the call is routed to an operator system or interexchange carrier, an NP query was already made for the call, or if the serial triggering limit is exceeded. If none of the preceding conditions exist, the SSP launches an SS7 TCAP query to the NPDB.

3) The originating switch receives the NPDB response and analyzes the data. The LRN is translated in the NP routing tables and an ISUP route out of the switch is determined. The LRN is stored in the called party number (CdPN) parameter, and the dialed digits are stored in the generic address parameter (GAP) of the ISUP initial address message (IAM). In addition, the forward call indicator (FCI) or number translated indicator is set to indicate that a query has been done.

Wireline to Ported Wireline Number Call Flow (cont.)

4) The call is routed to the recipient switch based on the LRN. The recipient switch receives and processes the contents of the IAM and completes the call to the subscriber.

5) If upon initiating query and analyzing response data the originating switch determines that the number is not ported, the call is routed to a donor switch based on the original dialed digits. As with a ported TN, the dialed number is translated in the NP routing tables and an ISUP route out of the switch is determined. The dialed number is stored in the CdPN parameter and the FCI indicator is set to indicate that a query has been done. The GAP is not included in the IAM for this scenario. The donor switch receives and processes the contents of the IAM, does digit analysis on the dialed digits, finds the subscriber on the switch, and completes the call.



IV. Wireless LNP Architecture

Network Infrastructure

While the basic infrastructure for wireless and wireline NP is the same, wireless service providers face several fundamental differences associated with service and network operations design and implementation. One such difference is that the Mobile Switch Center (MSC) replaces the Signal Switching Point (SSP) from the wireline model. The MSC must be capable of terminating a call to a ported TN.

There are several ways to accomplish this, however typically the MSC should be able to generate an NP query to the NPDB when a call is placed to a telephone number in a ported domain. A query is generated on any call to an NPA-NXX that has been designated as portable in the Local Exchange Routing Guide (LERG), the NPAC and marked as such in the switch routing tables.

In order to implement Number Portability, a wireless provider's MSC must be able to process calls to ported subscribers. In Phase I (for definition see the section on implementation phases), this is strictly a wireline ported subscriber call, originating at a mobile station. In Phase II, this requirement expands to include wireless ported subscribers. Although not immediately, the provider needs to provision software to recognize the specialized trigger mechanisms required for querying capability. A trigger is defined and implemented in the MSC in order to launch the NPDB query to obtain necessary routing information for call completion.

Based on the nature of most wireless technologies (excluding GSM), the Mobile Identification Number (MIN) has been identical to the Mobile Directory Number (MDN). In order to satisfy the FCC directive to support nationwide roaming, wireless carriers using this identification assignment process will need to separate those two numbers. Within the WNP framework, mobile stations will possess two types of numbers: a Mobile Station Identifier (MSID) and a Mobile Directory Number (MDN). The MDN will be a dialable NANP directory number and will be portable. The MSID will be either an IMSI and/or NANP-like MIN and will not be portable. When a customer ports, the MDN and the MSID will become separate and distinct, with the MSID being surrendered to the donor network. The ported subscribers MDN however will remain the same. Once the MDN and MSID are separate, each switch serving a subscriber must be capable of recognizing these parameters as separate and distinct.

In addition to the MSC switching software modifications, wireless providers must ensure that global title (GT) routing is supported from the switch. Typically, this means a routing indicator in the called party address of the Service Connection Control Part (SCCP) portion of the TCAP message. Routing to the NPDB can either be done using global title (GT) or Destination Point Code/Subsystem Number. Benefits to GT routing include support of and ability to use a regionally distributed architecture as well as load balance functionality across databases and associated link sets. Previously, wireless carriers did not access 'enhanced services' databases and as a result opted to not implement GT routing.

Network Infrastructure (cont.)

During Phase II, wireless providers must also be able to port subscribers and upload information on numbers that either port to or from them, to the appropriate NPAC for access by other providers. An SOA system provides this necessary functionality to interface with the wireless provider's order and provisioning systems to update the NPAC. Other issues that wireless carriers should consider as they ramp up for full porting implementation include: NPAC certification; intercompany testing; ongoing MIN and MDN administration; network and OSS integration; directory listings; troubleshooting; interconnection agreements; host recovery and bill reconciliation, and the Intercarrier Communications pre-porting process.

Intercarrier Communications (ICC) Requirements and Specifications

Intercarrier Communications (ICC) encompasses the standards, technologies, and processes of exchanging data among wireless service providers. The operational requirements and technical specifications for Intercarrier Communications regarding wireless Number Portability are defined by the Cellular Telecommunications Industry Association (CTIA). In its August 1998 report on wireless Number Portability, the CTIA specified a modified version of the wireline Local Service Request (LSR) for Intercarrier Communications for the initial phase of wireless LNP rollout. It suggested that the second phase of such rollout eliminate the wireline LSR method from the wireless porting process and consider enhancements or alternatives enabling wireless carriers to exchange porting information through third party communication process.

The current wireline pre-porting process, using the LSR method, takes 24 hours for completion. However, in recognition of the unique requirements of CMRS providers, experts agreed that wireless carriers should complete the entire wireless-to-wireless port within two and a half hours, of which only 30 minutes is allotted for the Intercarrier Communications portion. The CTIA Report defines the requirements to achieve the 30-minute interval, as recommended to the FCC by the NANC.

Implementation Phases

It is recommended that wireless local number portability be implemented in two phases:

Phase I: Wireless to Wireline

Phase I involves delivering calls to ported wireline telephone numbers. Wireless carriers capable of launching NPREQ messages and equipped with switch trigger capabilities may participate in this initial phase of WNP. Capability is contingent upon the following:

1) Wireless service provider must have an LRN switch software upgrade implemented for call delivery.

2) The MSC must also have the capability to launch queries using global title data, i.e., launching queries to an alias point code (APC) and translation type (TT) rather than routing on destination point code and subsystem number (DPC/SSN).

Phase II: Wireless to Wireless

Phase II implementation encompasses the process of porting a customer from wireless to wireless service providers, as well as the complete integration of the wireline and wireless porting process. In this phase, all pieces of the NP functional architecture are required.

1) A mobile subscriber dials a wireline number that is ported. The MSC queries an internal table that identifies all portable NPA-NXXs.

2) If the NPA-NXX is marked as portable, the MSC queries the NPDB using the IS-756 NPREQ message containing the DN derived from the dialed digits.

3) If the dialed number is found in the NPDB, the LRN of the recipient switch is returned in the response of the NPREQ message. The routing digits (ROUTDGTS) parameter includes the LRN associated with the ported DN.

4) The MSC selects the appropriate trunk group based upon LRN. If the call is routed using ISUP signaling, the LRN is populated in the CdPN and the ported number translation indication (FCI) bit is set to "number translated," identifying that the LRN query has been performed.

5) The call is handed off to the appropriate network and the recipient switch terminates the call.

6) If the destination DN has not been ported, the NPREQ response message would not contain any parameters.

V. Number Pooling

It is widely recognized that the current method of allocating NPA-NXXs in blocks of 10,000 is inefficient and contributing to shortages of numbering resources. In an effort to find a more efficient method of allocation, FCC had approved a National Number Pooling plan for network resource optimization. Number pooling is defined as the ability to share an NPA-NXX among several facilities-based carriers within the same rate center. The concept of pooling is based on the fact that whole blocks of telephone numbers, held by some service providers, are not assigned or in service. Pooling allows these currently unassigned blocks of numbers to be reassigned to other service providers in need of numbers, as they request and show need. With pooling, service providers can maintain a small supply of numbers for expected subscriber assignment. As that supply depletes, service providers will request additional numbering resources from the industry inventory maintained by the Pooling Administrator.

When a "pooled" block of numbers is transferred from one service provider to another, there is some critical information that needs to be broadcast across the region to ensure effective data provisioning for call routing. To facilitate the broadcasting of "pooled" blocks and associated routing data, the Location Routing Method, the same platform used for LNP could be used for implementation of national number pooling. This method of resource allocation allows NXXs within a given NPA to be shared among entities that offer service to subscribers within a defined geographic area (rate center). Specifically, it allows the assignment of numbers to competitive service providers in blocks of 1000.

While wireless carriers are not currently required to participate in number pooling, the September 1999 ruling by the FCC did dictate that the Number Administrator will ensure that 10,000 number blocks are available for assignment to wireless carriers. This safeguard will guarantee that wireless carriers are not prevented or disabled from operating in a pooled environment in which they are not currently participating. However, as the wireless industry implements full number portability, it will inevitably also become subject to pooling standards.

VI. Conclusion

Number portability removes the most important barrier to increased competition in the telecommunications sector. As such, it brings challenges and opportunities for old and new telecommunications providers. To be successful in the competitive telecommunications environment, carriers have to carefully analyze their network and administrative infrastructures, select the best number portability solution for their needs and exploit the benefits of increased customer choice that NP provides.

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