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Telcordia Notes On....

Number Portability and Number Pooling

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Foreword

Technology —Webster's New Collegiate Dictionary defines it as a "technical method of achieving a practical purpose." A concise, clear definition. But for many, achieving that practical purpose can be more than just a challenge. It can be frustrating, intimidating, time-consuming, and bound to generate the question, "Where Do I Start?"

With the *Telcordia Notes On....* series, Telcordia Technologies has devised a starting point for your search through the rapidly developing world of telecommunications. Written by the authors of the successful *Notes On the Networks* document (SR-2275), this series similarly contains technical material of interest to engineering and planning groups, as well as descriptions of the characteristics and background of these subjects in laymans' terms. The difference is that *Telcordia Notes On....* zeroes in on *one* technology in each document and breaks it down into manageable terms. From the history, background, and basic elements through a discussion of what the future may bring, our subject matter experts cover the important aspects in as few words as possible.

Telcordia Notes On.... is a series of Special Reports (SRs) providing the Telcordia proposed view of *general* technical topics. It is *not* a generic requirements document. No part of the text constitutes or suggests a requirement on the part of any entity. Attempts have been made to ensure that information contained herein is recent and reliable. However, due to the constant evolution in technology and its associated documentation, the most current information available regarding topics of interest should be sought. For your convenience, this document contains a Bibliography that lists numerous sources for additional information on the topics presented. This list contains the related generic requirements documents published by Telcordia for the technology discussed in this document. Ordering information for these products is also included.

About Telcordia Technologies

Bell Communications Research, or Telcordia, was created during the divestiture of the Bell System in 1984 to serve the Bell operating companies by providing a center for technological expertise and innovation. The work we've done since that time has shaped the telecommunications industry, setting a standard for performance and quality unmatched in the industry.

Eighty percent of the U.S. telecommunications network depends on software invented, developed, implemented, or maintained by us. We hold hundreds of patents, including key patents for broadband data communications technologies such as ADSL, AIN, ATM, ISDN, Frame Relay, SMDS, SONET (see also SR-NOTES-SERIES-01), DWDM (see also SR-NOTES-SERIES-02), and video-on-demand.

We currently keep more than 100 million lines of code maintained and running efficiently, through more than 150 operations support systems. Our Capability

Maturity Model Level 3 assessment for software quality leads the industry; our ISO 9001 registration also demonstrates our insistence on quality.

We share our expertise with others, through training and consulting. As the leading consultants to the telecommunications industry, we offer a broad range of expertise, including systems integration, local number portability, unbundling and interconnection, network integrity and reliability, fraud management, and pricing and cost analysis. We are the world's largest provider of telecommunications training services; each year we train more than 30,000 students from 1300 companies. Companies and individuals come to us because we understand their businesses. We not only know how to build networks, but also how to optimize those networks for the greatest strategic efficiency and accuracy.

And we help our customers transition into the next century of telecommunications. In 1997, Telcordia was acquired by Science Applications International Corporation (SAIC), one of the world's largest providers of systems integration and program management. Our new name signals our new status. Our business strategy continues to focus on helping our customers evolve from the current to the next generation of communications technologies. The Telcordia Technologies theme line, Performance from Experience, serves as a reminder of our enormous depth of experience and talent, and our established track record for delivering an exceptional standard of quality.

As Telcordia Technologies, we can provide our traditionally high standard of service and innovation to an even wider range of customers. We help our customers anticipate how their businesses will evolve, and we give them the tools to meet the competitive challenge. In fact, our new name emphasizes the accord we have with our customers and strategic partners. We've demonstrated our ability to achieve accord in complex situations, to keep systems and companies working together efficiently and effectively, and to optimize our customers' networks and their businesses. Look for the Telcordia banner; it's a consistent symbol representing our competitive spirit and teamwork as we move forward toward our goals. We know the path to the future. We've been leading the way there for a long, long time. For more information about Telcordia Technologies, contact your local account executive or call: **1-800 521-2673** (U.S. and Canada) or **732 699-5800** (in all other countries).

1. Introduction

This Telcordia Special Report (SR) introduces Number Portability and Number Pooling. In this document, Telcordia engineers present a high-level view of these complex technologies, and discuss their evolution, present status, and some possibilities for their future. The text is based on the latest information available from Telcordia and standards organizations.

1.1 Purpose and Scope

Although numerous requirements documents have been published on the subjects of Number Portability and Number Pooling, their audience is primarily professionals already immersed in the development or operation of systems that implement these technologies, and as such these documents tend to gloss over historical context and technical basics. The focus in the *Telcordia Notes* series and in this particular document is somewhat different. The goal of Telcordia is to bring the reader with no prior experience in Number Portability or Number Pooling quickly up to speed in these areas. In addition, many of the most important emerging developments and trends in Number Portability and Number Pooling are described. This document provides:

- A history of regulatory decisions prompting the introduction of Number Portability and Number Pooling into U.S. networks
- A description of the underlying components and technologies in use to provide Service Provider Portability in domestic wireline networks
- An overview of Location Portability issues and proposed requirements, as well as factors inhibiting deployment
- An overview of other Number Portability technologies in use or proposed for use, including Wireless Number Portability and international solutions for Number Portability
- A description of the underlying components and technologies that will be used to provide “Thousands-Block” Number Pooling in domestic wireline networks
- An overview of number exhaust issues in other countries
- Call processing flows for both Number Portability and Number Pooling
- Future trends for Number Portability and Number Pooling.

Covering the areas listed above is no small task, and regulatory requirements related to these technologies change frequently. But Telcordia Technologies, as the source of a variety of “de facto” industry-standard Generic Requirements documents, the developer and administrator of Toll-Free Portability, and a leader in

the development of Number Portability and Number Pooling standards and requirements, has a unique legacy of expertise in this field. Experts involved in these activities have authored this document. What the reader has, therefore, in this *Notes on Number Portability and Number Pooling* document, is a first-hand report on activities in the Number Portability and Number Pooling fields. For the most part, this is written in a relatively non-technical manner. Little or no technical training is required to understand most of what is described herein. But the breadth of issues is also such that even specialists are sure to find useful information that they may not have had time to keep up with.

1.2 Structure and Use of This Document

The document is organized as follows:

- Section 2 covers Number Portability.
  - Section 2.1 discusses Service Provider Portability in domestic wireline networks. The Service Provider Portability architecture and service characteristics are explained, and call flows are provided to illustrate the basics.
  - Section 2.2 discusses Location Portability, including why this technology currently exists only on paper.
  - Section 2.3 discusses Service Portability.
  - Section 2.4 discusses Wireless Number Portability, describing proposed technical approaches and deployment issues.
  - Section 2.5 discusses Number Portability in other countries, including regulatory decisions, technical approaches considered, and standards activities.
- Section 3 covers Number Pooling.
  - Section 3.1 discusses the history of Number Pooling.
  - Section 3.2 discusses order processing for Thousands-Block Number Pooling in domestic wireline networks. Process flows are provided to illustrate the basics.
  - Section 3.3 discusses administration issues, including switch issues associated with providing proper call treatment in a Number Pooling environment, and other administrative responsibilities of Service Providers.
  - Section 3.4 discusses service characteristics.
  - Section 3.5 provides call flows.

— Section 3.6 discusses the current regulatory environment and trial Number Pooling deployments.

— Section 3.7 discusses Number exhaust issues in other countries.

- The Glossary contains a listing of acronyms used in this document, and definitions of technical terms. In the text of the main document, terms in bold (color) are defined in the Glossary.
- The Bibliography and References section contains detailed references for related documents and further reading material.

1.3 Document Conventions

Words or terms in bold (or color) are linked to the Glossary where they are defined in detail.

2. Number Portability

Number Portability encompasses several distinct concepts: **Service Provider Portability**, **Location Portability**, and **Service Portability**. Number Portability allows an end user in a circuit-switched network to retain the same **North American Numbering Plan (NANP)** number, even though the end user initiates one or more of the following actions:

- Chooses a new Service Provider from which to receive local service ("Service Provider Portability" [see Section 2.1])
- Chooses a new geographic location from which to receive local service ("Location Portability" [see Section 2.2])
- Orders a new type of local service, such as **Integrated Services Digital Network User Part (ISUP)** service rather than Plain Old Telephone Service (POTS) service ("Service Portability" [see Section 2.3]).

As of this publication, Service Provider Portability, born by federal mandate to support local competition, is available to most wireline end users within the U.S. Location Portability, with no corresponding federal mandate, currently exists only for limited changes of location (within the same rate center), and the technology supporting Location Portability of this type is the same as the technology that provides Service Provider Portability. Service Portability has impacts within a single service provider's network, but not across network boundaries, and as a result has not been the result of significant industry focus.

In wireless networks, Service Provider Portability is the only form of Number Portability that has meaning (wireless users are not attached to a specific location in general, and switching to wireline service is defined as Service *Provider* Portability rather than Service Portability). Within the wireless environment, Service Provider Portability comprises:

- Wireless-to-Wireless Portability - a subscriber changes Wireless Service Providers and retains the same mobile number.
- Wireless-to-Wireline Portability - with this form of Portability, a subscriber changes from a Wireless Service Provider to a Wireline Service Provider and retains the same number.
- Wireline-to-Wireless Portability- a subscriber changes from a Wireline Service Provider to a Wireless Service Provider and retains the same number.

These forms of portability are yet to be supported in the wireless network. While Wireless Service Providers are currently required to provide call completion to ported wireline phone numbers, the federal mandate for Wireless Number Portability (including all three forms described above) does not require compliance until late 2002.

This section therefore focuses on Service Provider Portability, as it is most readily available. Coverage of Location Portability, Service Portability, and Wireless Number Portability will reflect the current state of the industry, but will concentrate on their expectations for the future.

2.1 Service Provider Portability

As mentioned previously, Service Provider Portability refers to the ability of a subscriber to change from one service provider to another while retaining the same **Directory Number (DN)**. Service Provider Portability does not imply any change in the subscriber's physical location.

This section describes Service Provider Portability as it applies to the North American network. For a discussion of Number Portability in other regions, see Section 2.5.

2.1.1 History of Service Provider Portability

Prior to the 1984 breakup of AT&T, phone service was a virtual monopoly, both in local service and in long-distance service. Following the breakup, however, end users gained a choice of selecting their long-distance provider, via the **Presubscribed Interexchange Carrier (PIC)** mechanism. Still, local phone service remained a virtual monopoly. Until the mid-1990s, an end user's local phone company depended solely on which incumbent had control of the given area (whether that be a "Baby" Bell, GTE, or a smaller independent phone company) in which the end user lived.

In 1996, local phone service was required to undergo the same major overhaul that had previously occurred in long-distance service, with the passing of the "landmark" **Telecommunications Act of 1996 (TA96)**. TA96 promoted local competition, the idea that an end user should have a choice of local service providers. However, it recognized that an end user would be unlikely to take advantage of the opportunity to request service from a new service provider, even at a lower price or better quality of service, if doing so would force the end user to accept a new telephone number. TA96 therefore mandated that the telecommunications industry provide Number Portability to end users, removing a significant barrier to competition. (The FCC subsequently interpreted the law to require only Service Provider Portability, not Location Portability nor Service Portability.)

The mandate to provide Service Provider Portability to end users meant a paradigmatic shift in the meaning of telephone numbers. Traditionally, a telephone number had identified the service provider serving an end user, the switching system from which that end user was being served, and the end user's rate center

(geographic location for billing purposes). These features of a telephone number drove many processes within telephone company operations: call routing, billing, and many operations systems all relied upon the intrinsic meaning of the telephone number. With the advent of Number Portability new methods and approaches had to be developed to enable proper handling of calls.

2.1.1.1 Technical Approaches Considered

Several methods were considered to provide Number Portability. These methods generally consist of two types: database and non-database methods.

A. Database Methods

These methods depend on **Advanced Intelligent Network (AIN)** capabilities and always involve a query to an external database. The information that is returned in the database response is based on three distinct approaches: the **Location Routing Number (LRN)** approach, the **Release to Pivot (RTP)** approach, and the **Carrier Portability Code (CPC)** approach.

- **Location Routing Number (LRN).** Under the LRN approach, a unique location routing number is assigned to each switch. A service provider seeking to route a call to the correct switch queries or "dips" an external routing database, obtains the ten-digit location routing number for the ported number, and uses that LRN in place of the dialed digits to route the call to the proper end office switch that serves the called party. Initial disagreement regarding the conditions under which the query should occur led to two types of approaches within the LRN approach. These two approaches are discussed below.

  — *Query on Portable NPA-NXX*: With this approach the query is made based on the fact that the **Numbering Plan Area (NPA)**-NXX of the called number is portable (has had at least one number ported). The network that performs the database query may be the originating network, the terminating network, or an intermediate network. For example, a local service provider receiving a 7-digit local call, such as 887-1234, would examine the dialed number to determine if the NPA-NXX is a portable code. If so, the 7- digit dialed number would be prefixed with the NPA and a 10-digit query (e.g., 679-887-1234) would be launched to the routing database. The routing database would then return the LRN (e.g., 679-267-0000) associated with the switch that serves the dialed number. The local service provider uses the LRN to route the call to the appropriate switch.

> **NOTE —** The "Query on Portable NPA-NXX" is the standard approach in U.S. networks and thus has become known simply as "the LRN approach." The

next several methods of deciding whether or not to perform a query are not used in U.S. networks.

— *Query on Release (QoR):* Before querying a routing database, the switch from which the call originates reserves the appropriate call path through the **Signaling System Number 7 (SS7)** network and attempts to complete a call to the switch where the NPA-NXX of the dialed number resides. If the number is ported, the call is released back to a previous switch in the call path, which performs a query to determine the LRN of the new serving switch. The call then is routed to the serving switch. QoR (or "Look Ahead", as it is also called) differs from Query on Portable NPA-NXX in that the query is done after a complete call attempt has been made and the call is released. It also differs in that queries are only done for ported numbers. If the number is not ported, the call is completed as before (i.e., in the manner that it would have completed before Number Portability).

- **Release to Pivot (RTP)***:* With RTP, if the dialed number has not been ported, the call will be completed exactly as it was completed before Number Portability. If the dialed number has been ported from the switch (the "release" switch), the call will be released back to a previous switch (the "pivot" switch) in the call path along with Rerouting Information (RI) obtained from a database query. The pivot switch uses the RI to reroute the call to the new switch.
- **Carrier Portability Code (CPC)**. Under CPC, each local service provider within a given area would be assigned a three-digit Carrier Portability Code (CPC). The database serving that area would contain all the telephone numbers that have been transferred from one carrier to another and their corresponding CPCs. A carrier querying the database for purposes of routing a call to a customer that has transferred his or her telephone number would know from the NXX code of the dialed number that the telephone number may have been transferred to another local service provider. The carrier would query a database serving that area, which would return to the carrier a three-digit CPC corresponding to the service provider serving the dialed number. The carrier then would route the call according to the CPC and the dialed NXX code. The recipient service provider would then be responsible, upon receiving the call, to do a further translation to identify the switch serving the ported number.

B. Non-Database Methods

These methods use the routing capabilities within the switch network and do not rely on a query to an external database. They consist of finding different ways to forward the call to the correct switch that serves the called party.

- **Remote Call Forwarding (RCF)**. RCF is an existing LEC service that redirects calls in the telephone network and can be adapted to provide a semblance of Service Provider Portability. If a customer ports his or her

existing telephone number from service provider A to service provider B, any call to that customer is routed to the central office switch operated by service provider A that is designated by the NXX code of the customer's telephone number. Service provider A's switch routes that call to service provider B, translating the dialed number into a number with an NXX corresponding to a switch operated by service provider B. Service provider B then completes the routing of the call to its customer. The change in terminating carriers is transparent to the calling party. Disadvantages of RCF identified are numerous and include: (1) it requires the use of two, ten-digit telephone numbers and thus strains number plan administration and contributes to area code exhaust; (2) it generally does not support several custom CLASS[SM] services, such as Caller ID, and may degrade transmission quality, because it actually places a second call to a transparent telephone number; (3) it can handle only a limited number of calls to customers of the same competing service provider at any one time; (4) it may result in longer call set-up times; (5) it requires the use of the incumbent LEC network for routing of calls; (6) it may enable incumbents to access competitors' proprietary information; (7) it may result in more complicated resolution of customer complaints; (8) the potential for call blocking may be increased; and (9) it may impose substantial costs upon new entrants.

For these reasons RCF was never considered to be more than an interim solution for Number Portability; however, because of its early availability, it was employed as an interim solution in certain regions of the U.S. before deployment of the permanent LRN-based solution.

- **Flexible Direct Inward Dialing (DID).** DID works similarly to RCF, except the original service provider routes calls to the dialed number over a dedicated facility to the new service provider's switch instead of translating the dialed number to a new number. DID has many of the same limitations as RCF, although DID can process more simultaneous calls to a competing service provider.

2.1.1.2 Technical Requirements Development for Number Portability

In July 1995, the FCC issued a *Notice of Proposed Rulemaking*, which prompted the industry to begin work on technical requirements for Number Portability. In the 1995 to 1996 timeframe, requirements development began within two parallel efforts:

- The Illinois Commerce Commission sponsored the Illinois Number Portability Workshop (INPW), which produced technical requirements documents addressing switching systems (and associated signaling), operator services systems, and the Number Portability database and global title translation functions. The first issues of these documents appeared in late 1995.

- Telcordia Technologies (then Telcordia) produced a single generic requirements document (GR-2936-CORE, *Local Number Portability Capability Specification: Service Provider Portability*) covering the same set of topics as the Illinois suite of requirements documents, excluding the Number Portability database function (the Number Portability global title translation function was instead referred to as the Message Relay function). The first issue of GR-2936-CORE appeared in early 1996. See the References section for ordering information on that document.

While some suppliers based their Number Portability implementations on the INPW requirements, others used the GR-2936-CORE requirements. Interworking of switches based on different sets of requirements became an issue. Additionally, service providers began asking for new features not specified in either document.

Rather than maintain two sets of requirements documents and be concerned about potential inconsistencies/incompleteness, the industry agreed to begin a third requirements effort whose goal would be to unify the technical requirements for Number Portability. This requirements effort was sponsored by the Alliance for Telecommunications Industry Solutions (ATIS), within Standards Committee T1. The T1S1.6 Working Group was created in October 1997, and it declared its intent to produce technical requirements for Service Provider Portability during 1998.

In 1999, the following T1S1.6 Technical Requirements for Number Portability were published:

- Number Portability Switching Systems
- Number Portability Operator Services Switching Systems
- Number Portability Database and Global Title Translation.

This set of requirements documents is the most current set of technical requirements for Number Portability, surpassing both the INPW requirements and GR-2936-CORE (each was last modified in 1997). The T1S1.6 requirements have gained the consensus of the industry, and have had full industry participation in their creation.

2.1.1.3 Establishment of the Number Portability Administration

In parallel with the development of technical requirements to support Number Portability, the industry undertook the process of selecting a neutral party to provide Number Portability Administration and to elect an overseer of the chosen administrator(s).

A. The Role of the Limited Liability Corporations (LLCs)

The Limited Liability Corporations (LLCs) were formed with the sole purpose of creating an entity to select and manage a neutral third-party Number Portability

administrator. Eight LLCs were formed; each LLC consisted of representatives from the service providers operating in a given region. The regions represented approximate equivalents to the seven Regional Bell Operating Company (RBOC) footprints in the United States, plus Canada as the eighth region.

By recommendation of the **North American Numbering Council (NANC)** and in a Second Report and Rulemaking, FCC Docket 95-116 (August 1997), the FCC appointed the LLCs to oversee each regional Number Portability administrator on an interim basis.

Each LLC negotiated separately with companies bidding on the roles of independent, third-party Number Portability administrator and provider of the **Number Portability Administration Center (NPAC)**, the centralized database that would track all porting activity. The NPAC vendors had to be competitively neutral in pricing. It was the responsibility of each respective Regional LLC to ensure that competitively neutral pricing is consistent with FCC and state regulatory mandates. Membership in the LLC was not required for service providers to receive services from the neutral third party. This year the LLCs have been consolidating and there are now only three LLCs for the eight NPAC regions.

B. The Role of Lockheed Martin/NeuStar

The Number Portability administrator is responsible for receiving subscription information from service providers and redistributing this information to other service providers. When a recipient service provider reports a porting event to the administrator, the administrator manages the process by which the number is taken out of service by the **Donor Service Provider** and put into service by the **Recipient Service Provider**.

Ultimately, each LLC selected Lockheed Martin to serve as the Number Portability administrator and NPAC vendor in all eight regions (in some cases, after another bidder was previously selected, but could not meet the required timeframe for deployment).

The NPAC, as an administration system, is responsible for maintaining an up-to-date record of porting activity on a national basis and providing the required porting information to each service provider based on its service region. This service to the LNP industry was provided by the Communications Industry Services (CIS) group within Lockheed Martin IMS.

On Dec. 1, 1999, the CIS business unit, which performs the NPAC and North American Numbering Plan Administrative (NANPA) functions within Lockheed Martin IMS transferred majority ownership to Warburg, Pincus & Co., a private equity investment firm, as an affiliate of Warburg, Pincus & Co., named NeuStar, Inc. This transfer was required because Lockheed's acquisition of Comsat caused it to be in violation of the FCC's neutrality rules.

2.1.1.4 Establishment of Number Portability Guidelines

The industry committees established several sets of guidelines for various procedures and processes related to Number Portability. The NANC LNPA Working Group, which reports to the FCC, created a set of inter-service provider communication flows for provisioning and order handling that all participating service providers could uniformly implement. Several of these flows appear courtesy of the NANC in Section 2.1.3 and illustrates the end-to-end provisioning process used for porting a number. The LNPA Working Group also develops the Functional Requirements Specifications (FRS) for each release of the NPAC system.

The INC produced a set of LRN Assignment Practices, recommending the procedures for assigning LRNs to Number Portability-capable switches. The document enumerated criteria that should a service provider should consider when selecting and assigning LRNs for its switches. In particular, INC specified that LRNs should not be used to identify U.S. wireline rate centers on a per-rate center basis, because this would exacerbate number exhaust. Instead, a service provider should assign an LRN for each LNP-capable switch in a **Local Access Transport Area (LATA)**.

2.1.2 Number Portability Architecture

Figure 2-1 shows the Number Portability service architecture in the U.S. The components that comprise the overall Number Portability architecture are:

- **The Number Portability Administration Center (NPAC).** Periodic downloads (approximately every 10 minutes) provide a current view of ported numbers to service providers' Number Portability databases.
- **Advanced Intelligent Network (AIN) Service Switching Points (SSPs)**. Number Portability is based on AIN and follows the AIN protocol[1]. One main difference between Number Portability and AIN is in the processing of the response message. AIN generally populates whatever is received in the response directly in an outgoing **Integrated Services Digital Network User Part (ISUP)** message. With Number Portability, the AIN SSP does additional

1. Some service providers have chosen to implement Number Portability using Intelligent Network (IN) triggers; when IN is used, the signaling follows the existing message set defined for Toll-Free Service.

processing and selects few parameters and may populate them differently in the outgoing **Initial Address Message (IAM)**.

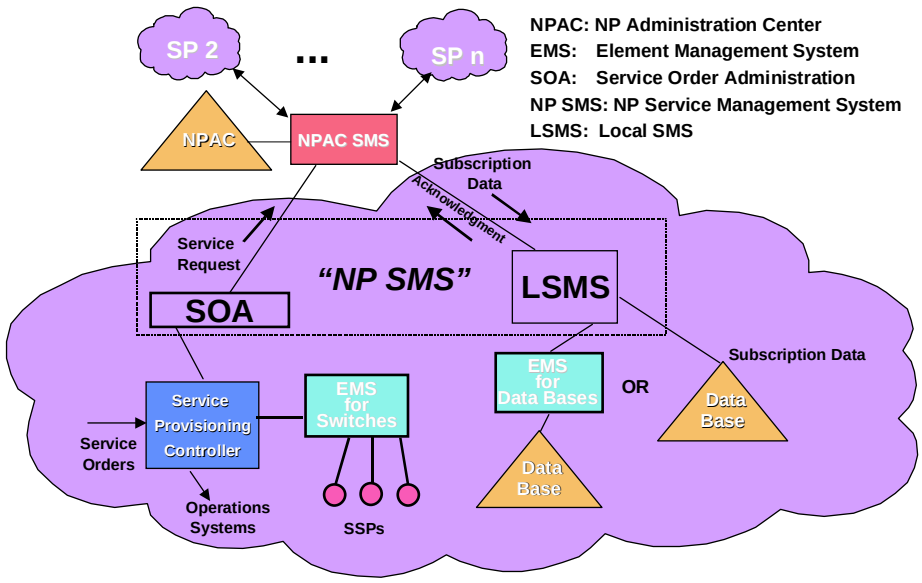

Figure 2-1. Number Portability Service Architecture in the United States

- **Number Portability Databases (NPDBs)**. Functionality that AIN **Service Control Points (SCPs)** usually provide, but sometimes that specialized SS7 **Service Transfer Points (STPs)** provide, Number Portability databases support call-by-call translation of ported numbers into routable network addresses.
- **Service Management Systems (SMSs)**. Both the NPAC and service providers' NPDBs are managed by Service Management Systems via which information can be entered into or retrieved from the databases themselves. Local SMSs are also the systems that manage the communication of information to and from the NPAC SMS.
- **The SS7 Signaling Network**. **Transaction Capabilities Application Part (TCAP)** messages are the basis for Number Portability queries. ISUP messages carry the results of these queries from switch to switch, indicating whether a call has previously been queried, and if so, how the call should be routed to reach the switch serving a ported number.

2.1.3 Number Portability Order Processing- NANC Operations Flows

This section provides the operations flows for various Number Portability provisioning tasks. These flows are reprinted courtesy of the NANC.

The text associated with each figure gives further detail and explanation of the Number Portability provisioning process. The number within each box of the flow corresponds to the number of the explanatory text that follows.

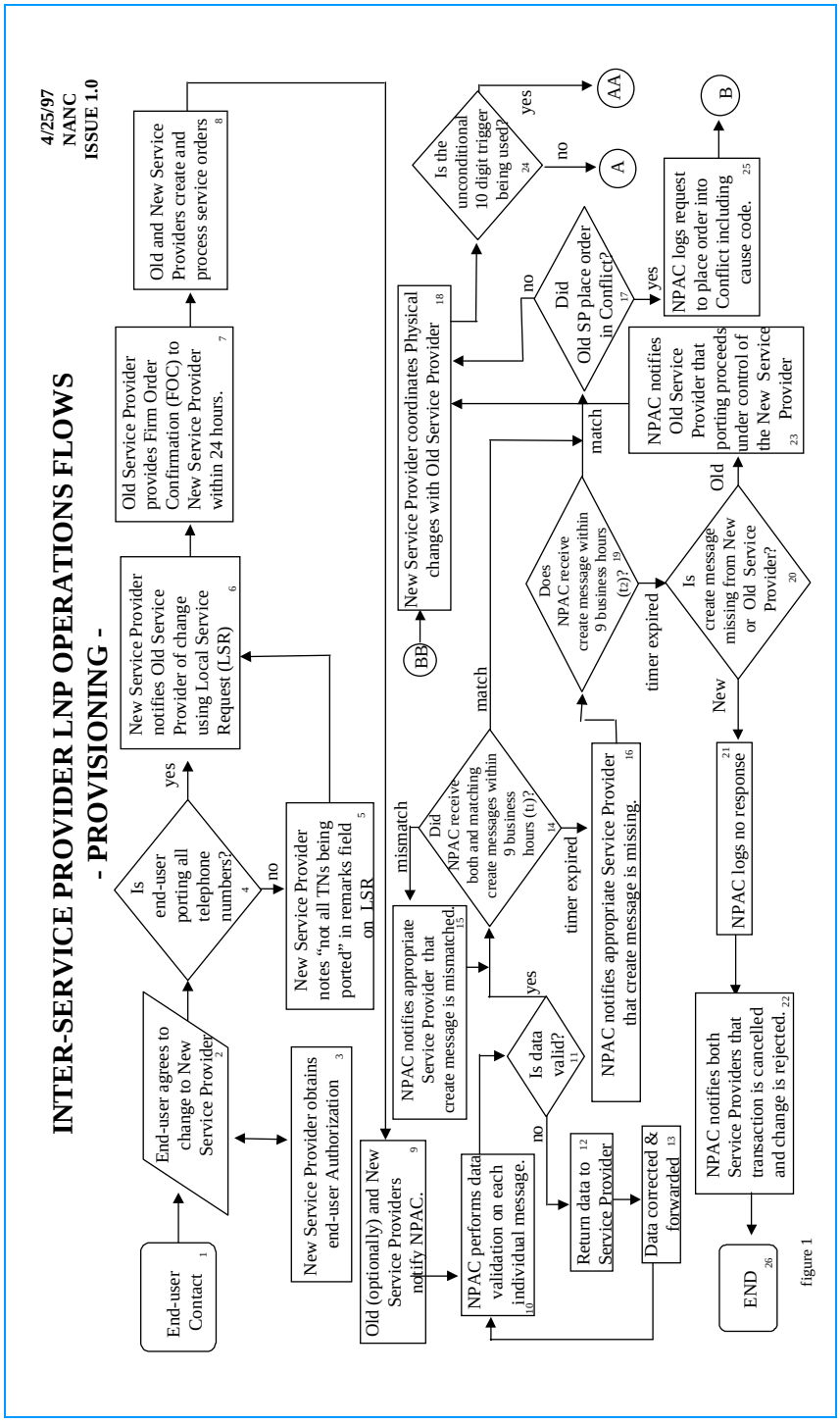

Figure 2-2. Inter-Service Provider LNP Operations Flow - Provisioning

1. End-user contact
   - The process begins with an end-user requesting service from the New Service Provider.
   - It is assumed that before entering the provisioning process the involved NPA/NXX was opened for porting.
2. End-user agrees to change to New Service Provider
   - End-user agrees to change to New Service Provider and requests retention of the current Telephone Number (TN).
3. New Service Provider obtains end-user Authorization
   - The New Service Provider obtains authority from the end-user to act as the official agent on behalf of the end-user. The New Service Provider is responsible for demonstrating necessary authority.
4. Is end-user porting all telephone numbers?
   - The New Service Provider determines if customer is porting all TNs.
   - If yes, go to Step (6).
   - If no, go to Step (5).
5. New Service Provider notes “not all TNs being ported” in remarks field on LSR.
   - The New Service Provider makes a note in the remarks section of the LSR to identify whether the end-user is not porting all TNs.
6. New Service Provider notifies Old Service Provider of change using Local Service Request (LSR).
   - The New Service Provider notifies the Old Service Provider of the porting using the LSR and sends the information via an electronic gateway, FAX, or other manual means. The Ordering and Billing Forum (OBF) defines the LSR process, and the Telecommunications Industry Forum (TCIF) defines the electronic interface.
7. Old Service Provider provides Firm Order Confirmation (FOC) to New Service Provider within 24 hours.
   - The minimum expectation is that the FOC is returned within 24 hours, excluding weekends, unless otherwise defined by inter-company agreements. It is the responsibility of the Old Service Provider to contact the New Service Provider if the Old Service Provider is unable to meet the 24-hour expectation for transmitting the FOC. If the FOC is not received by the New Service Provider within 24 hours, then the New Service Provider contacts the Old Service Provider.

- The FOC due date is no earlier than three (3) business days after the FOC receipt date. The first TN ported in an NPA-NXX is no earlier than five (5) business days after FOC receipt date. It is assumed that the porting interval is not in addition to intervals for other requested services related to the porting (e.g., unbundled loops). The interval becomes the longest single interval required for the services requested.
- The OBF defines the FOC process and the TCIF defines the electronic interface.

8. Old and New Service Providers create and process service orders.
   - The Service Providers create and process their service orders through their internal service order systems, from the information provided on the FOC and LSR.
9. Old (optionally) and New Service Providers notify NPAC.
   - The due date on the create message is the due date on the FOC. Any change of due date to the NPAC is the result of a change in the FOC due date.
   - The Service Providers enter subscription data into the NPAC SMS via the SOA interface for porting of the end-user in accordance with the NANC Functional Requirements Specification (FRS) and the NANC Interoperability Interface Specifications (IIS).
10. NPAC performs data validation on each individual message.
    - The NPAC SMS validates data to ensure value formats and consistency as defined in the FRS. This is not a comparison between Old and New Service Provider messages.
11. Is data valid?
    - If yes, go to Step (14). If this is the first valid create message, the t1 timer is started.
    - If no, go to Step (12).
12. Return data to Service Provider.
    - If the data is not valid, the NPAC returns notification to the Service Provider for correction.
13. Data corrected and forwarded.
    - The Service Provider, upon notification from the NPAC SMS, corrects the data and forwards it back to the NPAC SMS.
14. Did NPAC receive both and matching create messages within nine (9) business hours (t1)?

- If matching, go to Step (17).
- If mismatched, go to Step (15).
- If t1 timer expires, go to Step (16).
- NPAC SMS processing timers include business hours only, except where otherwise specified. Local business hours are defined as 12 daytime hours per day on Monday through Friday, except holidays. Holidays and business hours are regionally defined.

15. NPAC notifies appropriate Service Provider that information is mismatched.
    - The NPAC informs the Service Provider that sent the second create that the messages are mismatched. If necessary, the Service Provider notified coordinates the correction.
16. NPAC notifies appropriate Service Provider that create message is missing.
    - If Service Providers do not notify the NPAC SMS and/or provide matching data, the NPAC SMS sends a notification to the Service Provider who did not respond to the port.
    - The NPAC SMS provides an Initial Concurrence Window tunable parameter (t1) defined as the number of hours after the subscription version was initially created by which both Service Providers can authorize transfer of subscription service. The current default is nine (9) business hours.
    - The t2 timer starts.
17. Did Old Service Provider place order in Conflict?
    - If yes, go to Step (25).
    - If no, go to Step (18).
    - Check Concurrence Flag Yes or No. If no, a conflict cause code as defined in the FRS, is designated. The Old Service Provider makes a concerted effort to contact the New Service Provider before placing the subscription in conflict. The Old Service Provider may initiate conflict with proper conflict cause code at anytime before noon of the business day before the due date.
18. New Service Provider coordinates physical changes with Old Service Provider.
    - The New Service Provider has the option of requesting a coordinated order. This is the re-entry point from the Inter-Service Provider LNP Operations Flows - Conflict Flow for the Service Creation Provisioning Process tie point BB.
    - If coordination is requested on the LSR, an indication of yes or no for the application of a 10-digit trigger is required. If no coordination indication is given, then by default, the 10-digit trigger is applied as defined in inter-

company agreements. If the New Service Provider requests a coordinated order and specifies “no” on the application of the 10-digit trigger, the Old Service Provider uses the 10-digit trigger at its discretion.

19. Does NPAC receive information within nine (9) business hours (t2)?
    - The NPAC SMS provides a Final Concurrence Window tunable parameter (t2), defined as the number of hours after the NPAC SMS sends the concurrence request. The current default is nine (9) business hours.
    - The NPAC SMS processing timers include business hours only, except where otherwise specified. Local business hours are defined as 12 daytime hours per day on Monday through Friday, except holidays. Holidays and business hours are regionally defined.
    - If create messages match, go to Step (17).
    - If t2 timer expires, go to Step (20).
    - If create messages are mismatched, they will be processed in the same manner as Step (15).
20. Is create message missing from New or Old Service Provider?
    - If New Service Provider, go to Step (21).
    - If Old Service Provider, go to Step (23).
21. NPAC logs no response.
    - The NPAC records that no matching create message was received from the New Service Provider.
22. NPAC notifies both Service Providers that transaction is cancelled and change is rejected.
    - The NPAC SMS immediately cancels the subscription version. Both Service Providers take appropriate action related to internal work orders.
23. NPAC notifies Old Service Provider that porting proceeds under control of New Service Provider.
    - A notification message is sent to the Old Service Provider noting that the porting is proceeding in the absence of any message from the Old Service Provider.
24. Is the Unconditional 10-Digit Trigger being used?
    - If yes, go to Inter-Service Provider LNP Operations Flows - Provisioning with Unconditional 10-Digit Trigger - tie point AA (Figure 2-4).
    - If no, go to Inter-Service Provider LNP Operations Flows - Provisioning without Unconditional 10-digit Trigger - tie point A (Figure 2-3).

- The unconditional 10-digit trigger is an option assigned to a line on a **Donor Switch** during the transition period when the line is physically moved from the Donor Switch to the **Recipient Switch**. During this period it is possible for the TN to reside in both the donor and Recipient Switches at the same time.
- The New Service Provider may apply the unconditional 10-digit trigger.

25. NPAC logs request to place order into Conflict including conflict cause code.
    - Go to Inter-Service Provider LNP Operations Flows - Conflict Flow for the Service Creation Provisioning Process - tie point B (Figure 2-5).
26. END

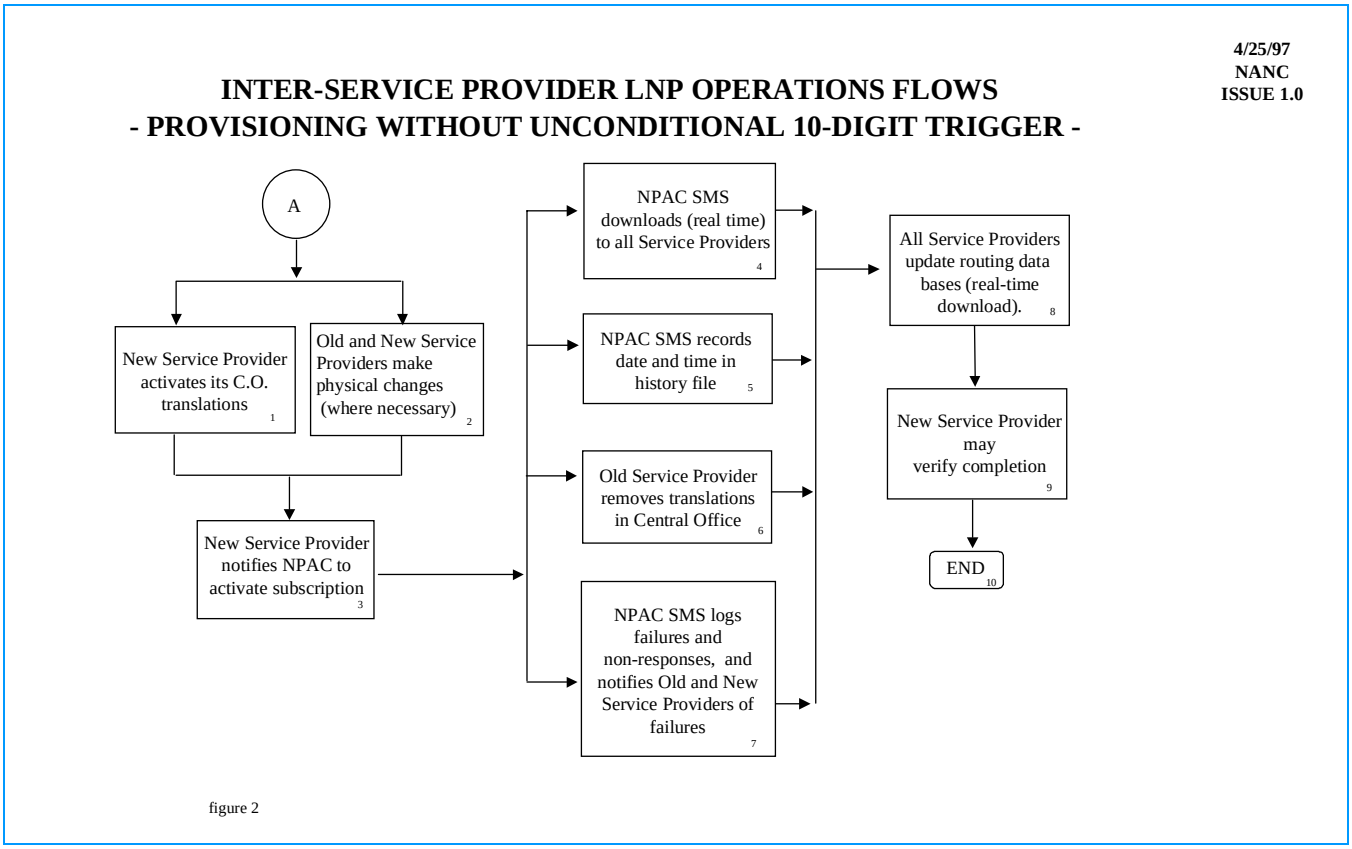

Figure 2-3. Inter-Service Provider Operations Flow - Provisioning without Transition Mechanism

NOTE — Steps 1 and 2 are worked concurrently.

1. New Service Provider activates its Central Office translations.
2. Old and New Service Providers make physical changes (where necessary).
   - The physical changes may or may not be coordinated. Coordinated physical changes are based on inter-connection agreements.
   - Following the completion of steps 1 and 2, the New Service Provider is now providing dial tone to the ported end user.
3. New Service Provider notifies NPAC to activate subscription.
   - The New Service Provider sends an activate message to the NPAC SMS via the SOA.
   - No NPAC subscription version may activate before the FOC due date.

NOTE — Steps 4, 5, 6, and 7 may be concurrent, but at a minimum should be completed ASAP.

4. NPAC SMS Downloads (real time) to all Service Providers.
   - The NPAC SMS broadcasts new subscription data to all Service Providers in the serving area in accordance with the NANC FRS and NANC IIS. The Generic Requirements for Service Control Point (SCP) Applications and GTT Function for Number Portability document contains a reference to a target interval for SCP updates.
5. NPAC SMS records date and time in history file.
   - The NPAC SMS records the current date and time as the Activation Date and Time stamp, after all Local SMSs have successfully acknowledged receipt of new subscription version.
6. Old Service Provider removes translations in Central Office.
   - The Old Service Provider initiates the removal of translation either at the designated due date and time or, if the order was designated as coordinated, upon receipt of a call from the New Service Provider.
7. NPAC SMS logs failures and non-responses and notifies the Old and New Service Providers of failures.
   - The NPAC SMS resends the activation to a Local SMS that did not acknowledge receipt of the request. The number of NPAC SMS attempts to resend is a tunable parameter for which the current default is three (3) attempts. Once this cycle is completed, NPAC personnel investigate possible problems. In addition, the NPAC sends a notice via the SOA

interface to both the Old and New Service Providers with a list of Local SMSs that failed activation.

8. All Service Providers update routing databases (real time download).
   - This is an internal process and is performed in accordance with the Generic Requirements for SCP Applications and GTT Functions for Number Portability document.
9. New Service Provider may verify completion.
   - The New Service Provider may make test calls to verify that calls to the ported numbers complete as expected.
10. END

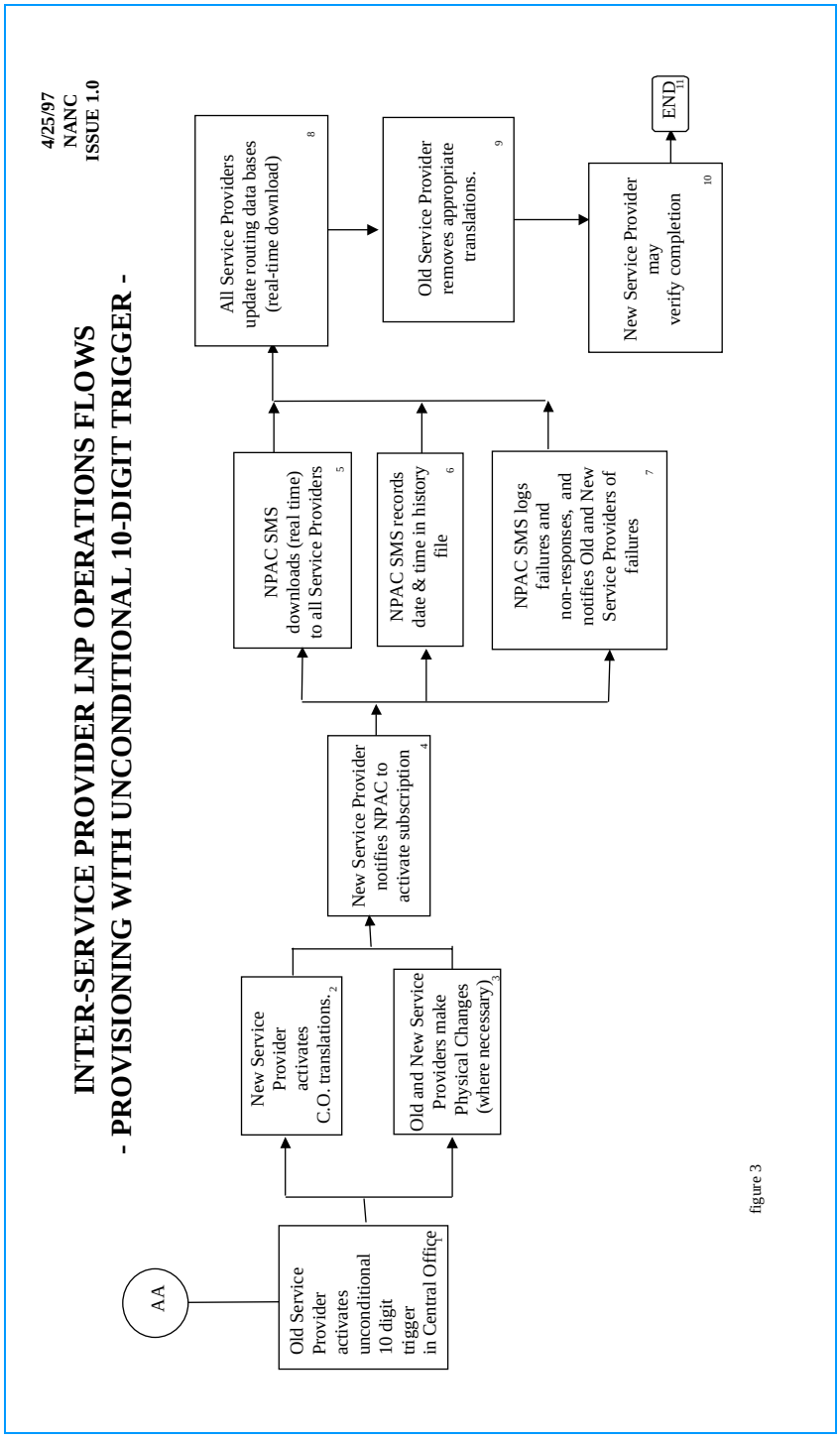

Figure 2-4. Inter-Service Provider Operations Flow - Provisioning With Transition Mechanism

1. Old Service Provider activates unconditional 10-digit trigger in Central Office.
   - The actual time for trigger activation is defined on a regional basis.
   - The New Service Provider may optionally apply the unconditional 10-digit trigger.

   NOTE — Steps 2 and 3 may be worked concurrently.

2. New Service Provider activates Central Office translations.
   - The New Service Provider activates its own Central Office translations.
3. Old and New Service Providers make physical changes (where necessary)
   - Any physical work or changes are made by either the Old or New Service Providers as necessary.
   - Physical changes may or may not be coordinated. Coordinated physical changes are based on inter-connection agreements.
4. New Service Provider notifies NPAC to activate subscription.
   - The New Service Provider sends an activate message via the SOA interface to the NPAC SMS.
   - No NPAC subscription version may activate before the FOC due date.

   NOTE — Steps 5, 6, and 7 may be concurrent, but at a minimum should be completed as soon as possible.

5. NPAC SMS Downloads (real time) to all Service Providers.
   - The NPAC SMS broadcasts new subscription data to all Service Providers in the serving area in accordance with the NANC FRS and NANC IIS. The Generic Requirements for Service Control Point (SCP) Applications and GTT Function for Number Portability document contains a reference to a target interval for SCP updates.
6. NPAC SMS records date and time in history file.
   - The NPAC SMS records the current date and time as the Activation Date and Time stamp, after all Local SMSs successfully acknowledged receipt of new subscription version.
7. NPAC SMS logs failures and non-responses and notifies the Old and New Service Providers of failures.
   - The NPAC SMS resends the activation to a Local SMS that did not acknowledge receipt of the request. The number of NPAC SMS attempts to resend is a tunable parameter for which the current default is three (3) attempts. Once this cycle is completed NPAC personnel investigate

possible problems. In addition, the NPAC sends a notice via SOA interface to both the Old and New Service Providers with a list of Local SMSs that failed activation.

8. All Service Providers update routing databases (real time download).
   - This is an internal process and is performed in accordance with the Generic Requirements for SCP Applications and GTT Functions for Number Portability document.
9. Old Service Provider removes appropriate translations.
   - After update of its databases, the Old Service Provider removes translations associated with the ported TN. The specific time for removal may be specified on a regional basis.
10. New Service Provider may verify completion.
    - The New Service Provider may make test calls to verify that calls to ported numbers complete as expected.
11. END

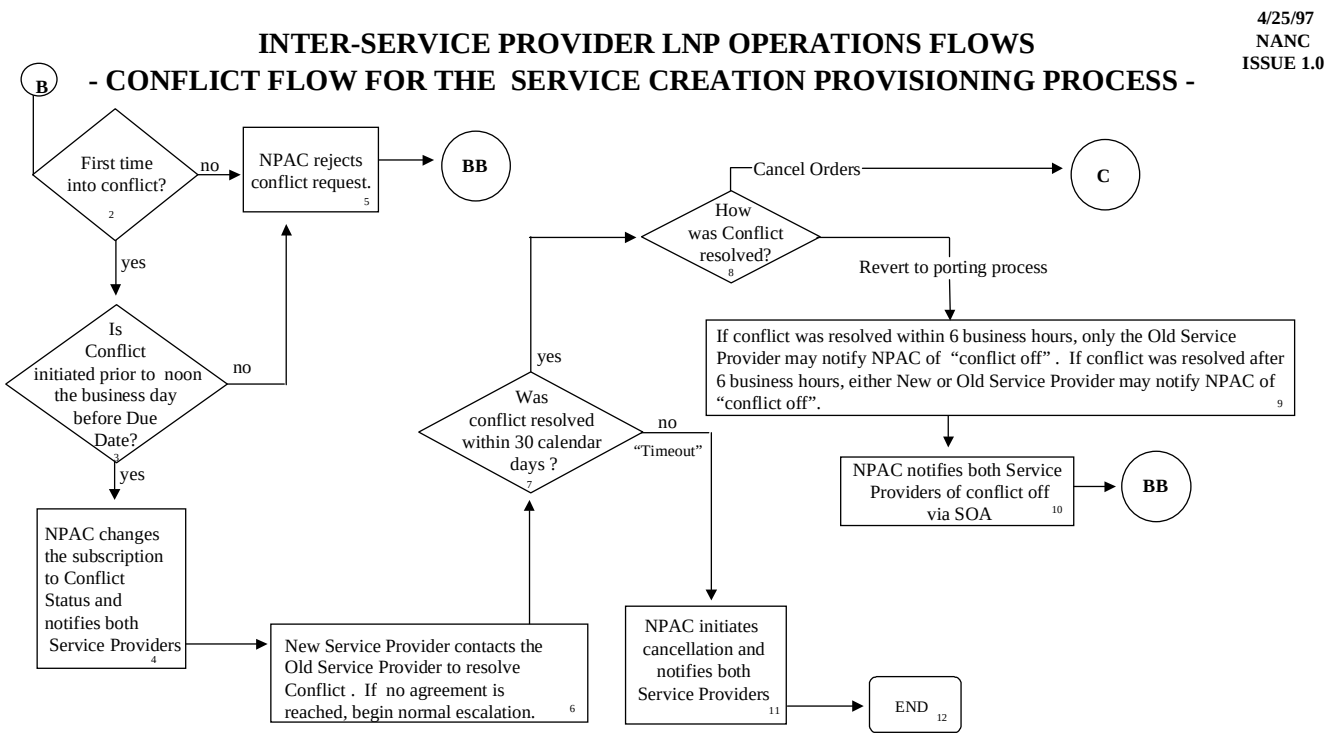

Figure 2-5. Inter-Service Provider Operations Flow - Conflict Flow for Provisioning

1. Tie-point (B)
   - The conflict flow is entered through the Provisioning process flow (Figure 2-2) through tie point (B), when the Old Service Provider enters a concurrence flag of "No", and designates a conflict cause code.
2. First time into conflict?
   - The Old Service Provider may only place the subscription into the conflict status one time. If this is the first time for the Old Service Provider to place the order into conflict, proceed to Step (3); if not, proceed to Step (5).
3. Is Conflict initiated before noon the business day before the Due Date?
   - If no, go to Step (5).
   - If yes, go to Step (4).
4. NPAC changes subscription to Conflict Status and notifies both Service Providers.
   - Both Service Providers take appropriate action related to internal work orders.
   - Subscriptions may be modified while in the conflict state (e.g., due date).
5. NPAC rejects conflict request.
   - NPAC notifies the Service Provider of the rejection.
   - Proceed to tie point BB on the Provisioning flow (Figure 2-2).
6. New Service Provider contacts the Old Service Provider to resolve Conflict. If no agreement is reached, begin normal escalation.
   - The escalation process is defined in the inter-company agreements.
7. Was conflict resolved within 30 calendar days?
   - From the time a subscription is placed in conflict, there is a 30 calendar day limit after which it is removed from the NPAC database. If it is resolved within the 30 calendar day limit, proceed to Step (8); if not, the subscription request will "time out" and proceed to Step (11).
8. How was Conflict resolved?
   - Conflict resolution initiates one of two actions: 1) cancellation of the subscription, or 2) resumption of the service creation provisioning process. If the conflict is resolved by cancellation of the subscription, then proceed to the Cancellation Flows for Provisioning Process (Figure 2-6) through tie point C. If the conflict is otherwise resolved, proceed to Step (9).

9. If conflict was resolved within six (6) business hours, only the Old Service Provider may notify NPAC of “conflict off”. If conflict was resolved after six (6) hours, either the New or Old Service Provider may notify NPAC of “conflict off”.
   - For the porting process to continue, at least one Service Provider must remove the subscription from conflict.
10. NPAC notifies both Service Providers of conflict off via SOA.
    - The NPAC notifies both Service Providers of the change in subscription status. The porting process resumes as normal, proceeding to the Provisioning process flow (Figure 2-2) at tie point BB.
11. NPAC initiates cancellation and notifies Service Providers.
    - NPAC notifies both Service Providers that the subscription version status was updated to cancelled.
    - Both Service Providers take appropriate action related to internal work orders.
12. END

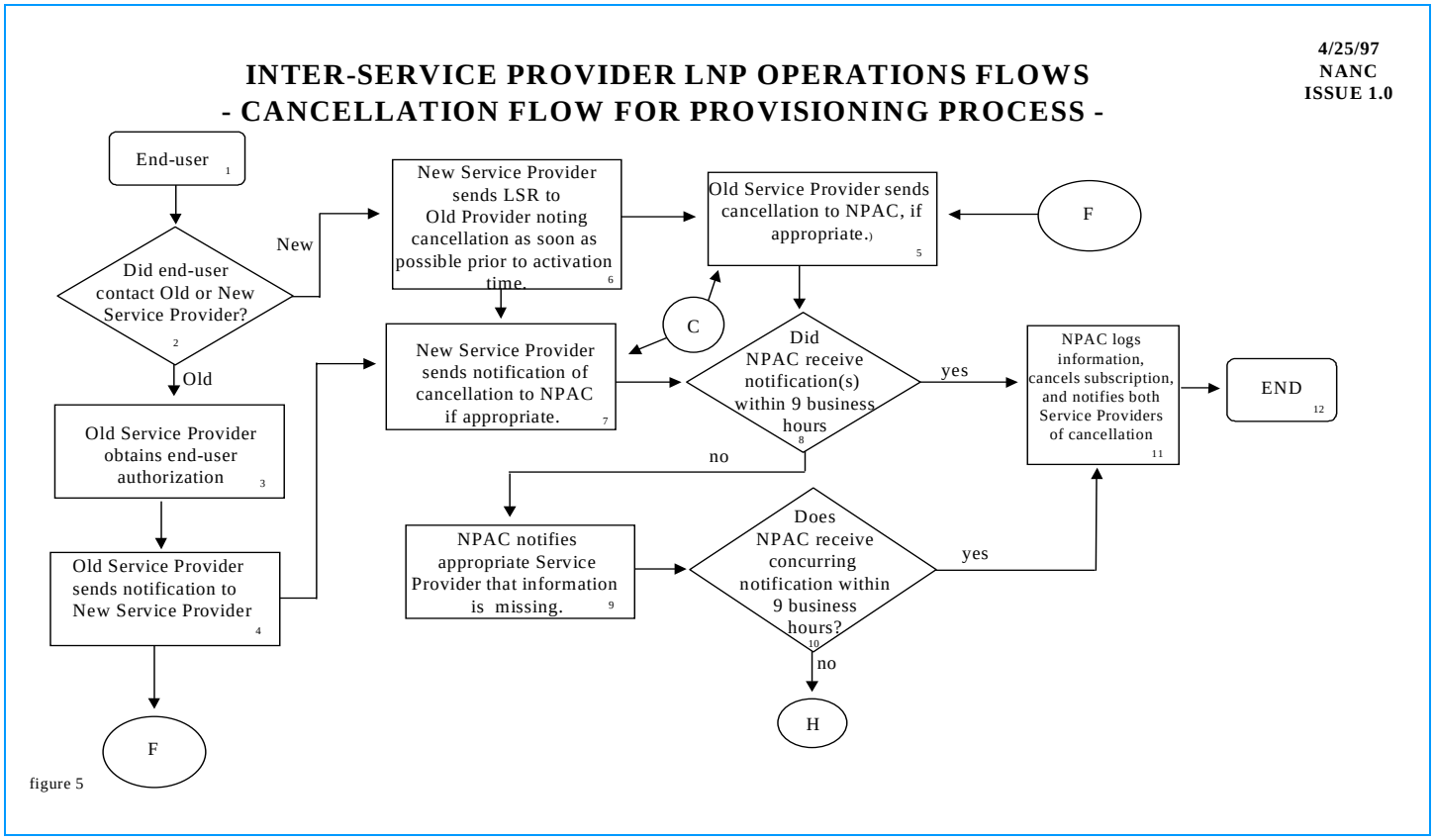

Figure 2-6. Inter-Service Provider Operations Flow - Cancellation Flow for Provisioning

A service order and/or subscription may be cancelled through the following processes:

- The end-user contacts the Old or New Service Provider and requests cancellation of its porting request.
- Conflict Flow for the Service Creation Provisioning Process - Figure 2-5: As a result of the Conflict Resolution process (at tie-point C), the Old and New Service Providers agree to cancel the subscription and applicable service orders.

1. End-user

   - The Cancellation Process may begin with an end-user requesting cancellation of its pending port. The Cancellation process flow applies only to that period of time between subscription creation, and either activation or cancellation of the porting request. If activation is completed and the end-user wishes to revert back to the former Service Provider, it is accomplished via the Provisioning Process.

2. Did end-user contact Old or New Service Provider?

   - The end-user contacts either the Old or New Service Provider to cancel the porting request. Only the Old or New Service Provider can initiate this transaction, not another Service Provider.
   - The contacted Service Provider gathers information necessary for sending the LSR to the other Service Provider noting cancellation, and for sending the cancellation request to NPAC SMS.
   - If the end-user contacted the Old Service Provider, then proceed to Step (3).
   - If the end-user contacted the New Service Provider, proceed to Step (6).

3. Old Service Provider obtains end-user authorization.

   - The Old Service Provider obtains actual authority from the end-user to act as the official agent on behalf of the end-user to cancel the porting request. The Old Service Provider is responsible for demonstrating such authority as necessary.

4. Old Service Provider sends notification to New Service Provider.

   - The Old Service Provider notifies the New Service Provider, via their inter-company interface, indicating that the porting request is to be cancelled.

5. Old Service Provider sends cancellation to NPAC, if appropriate

   - The Old Service Provider, contacted directly by the end-user or notified by the New Service Provider via their inter-company interface, sends a cancellation message to NPAC via the SOA interface. This cancellation message is accepted by NPAC SMS only if the Old Service Provider had previously uploaded during the subscription creation. If the Old Service Provider sends a cancellation message and a create message was not previously sent, the NPAC responds with a reject message. If the Old Service Provider does not upload a create message to the NPAC SMS for this subscription, it cannot subsequently send a cancellation message.
   - The Old Service Provider takes appropriate action related to internal work orders.

6. New Service Provider sends LSR to Old Service Provider noting cancellation as soon as possible before activation time.

   - The end-user contacts the New Service Provider to cancel the porting request. The New Service Provider fills out and sends the LSR form to the Old Service Provider via its inter-company interface, indicating cancellation of the porting request.

7. New Service Provider sends cancellation to NPAC, if appropriate.

   - The New Service Provider, contacted directly by the end-user or notified by the Old Service Provider via its inter-company interface, sends a cancellation message to NPAC via the SOA interface. This cancellation message is accepted by NPAC SMS only if the New Service Provider previously uploaded during the subscription creation. If the New Service Provider sends a cancellation message and a create message was not previously sent, the NPAC responds with a reject message. If the New Service Provider did not upload a create message to the NPAC SMS for this subscription, it cannot subsequently send a cancellation message.

   - The New Service Provider takes appropriate action related to internal work orders.

8. Did NPAC receive notification(s) within nine (9) business hours?

   - The NPAC applies a nine (9) business hour [tunable parameter] time limit on receiving cancellation messages from both Service Providers. This is referred to as the Initial Cancellation Window.

   - NPAC SMS processing timers include business hours only, except where otherwise specified. Local business hours are defined as 12 daytime hours per day on Monday through Friday, except holidays. Holidays and business hours are regionally defined.

   - The NPAC SMS tests for receipt of cancellation messages from the two Service Providers based on which Service Provider had previously uploaded into NPAC SMS. Since the Old Service Provider's upload is optional for subscription creation, if the Old Service Provider did not upload during the creation process, the NPAC SMS will not accept the Old Service Provider's input during cancellation. Similarly, if during the subscription creation process only the Old Service Provider uploaded, and not the New Service Provider, only the Old Service Provider's input is accepted when canceling an order.

   - For a “concurred” subscription, when the first cancellation message is received, NPAC sets the subscription status to cancel-pending. Both the Old and New Service Providers are notified of this change in status via the SOA interface.

- If the second cancellation notification, from the other Service Provider, is received within nine (9) business hours, proceed to Step (11).
- If the second cancellation notification from the other Service Provider is not received within nine (9) business hours, proceed to Step (9).
- For a "non-concurred" subscription, when the first cancellation message is received, NPAC sets the subscription status directly to cancel, and proceeds to Step (11). Both the Old and New Service Providers are notified of this change in status via the SOA interface.

9. NPAC notifies appropriate Service Provider that information is missing.
   - The Initial Cancellation Window starts with receipt of the first cancellation message at NPAC. When this timer times out, the NPAC requests the missing information from the Service Provider who did not provide the cancellation message via the SOA interface. Only "concurred" subscriptions reach this point in the process flow.
10. Does NPAC receive concurring notification within nine (9) business hours?
    - The NPAC applies a nine (9) business hours [tunable parameter] time limit on receiving cancellation messages from both Service Providers. This is referred to as the Final Cancellation Window.
    - NPAC SMS processing timers include business hours only, except where otherwise specified. Local business hours are defined as 12 daytime hours per day on Monday through Friday, except holidays. Holidays and business hours are regionally defined.
    - Upon receipt of the concurring notification, proceed to Step (11).
    - If no notification is received by the time this timer times out, proceed to tie-point H, "Cancellation Conflict Process Flow."
11. NPAC logs information, cancels subscription, and notifies both Service Providers of cancellation
    - The porting request is cancelled by changing the subscription status to cancelled. Both Service Providers are notified of the cancellation via the SOA interface.
12. END

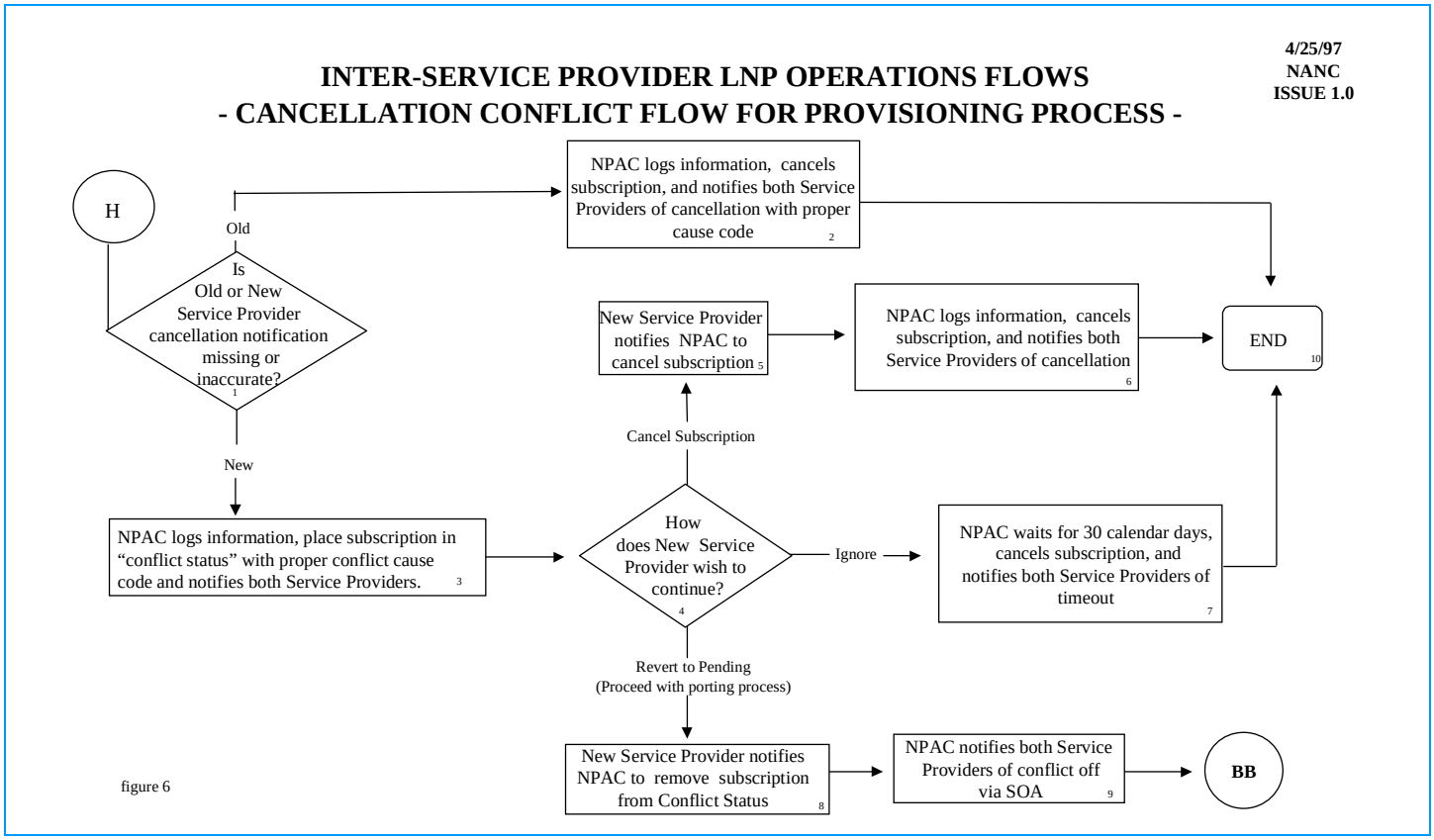

Figure 2-7. Inter-Service Provider Operations Flow - Cancellation Conflict Flow

1. Is Old or New Service Provider cancellation notification missing or inaccurate?
   - At this point in the process flow, the subscription status is cancel pending, because either the Old or New Service Provider's cancellation notification is missing or inaccurate (i.e., mismatched).
   - If the Old Service Provider's notification is at fault, then proceed to Step (2).
   - If the New Service Provider's notification is at fault, then proceed to Step (3).

Note that the Cancellation Conflict process flow is reached only for “concurred” subscriptions.

2. NPAC logs information, cancels subscription, and notifies both Service Providers of cancellation with proper cause code.
   - If the Old Service Provider does not provide a cancellation notification message to NPAC, in spite of a Cancellation LSR from the New Service Provider and two reminder messages from NPAC, the subscription is cancelled. NPAC notifies both Service Providers via the SOA interface that the subscription status is updated to cancelled, and places the proper cause code on the subscription record.
   - Both Service Providers take appropriate action related to internal work orders.
3. NPAC logs information, places subscription in “conflict status” with proper conflict cause code, and notifies both Service Providers.
   - If the New Service Provider does not provide a cancellation notification message to NPAC, in spite of a Cancellation LSR from the Old Service Provider and a reminder message from NPAC, the subscription is placed in a conflict state. NPAC also writes the proper conflict cause code to the subscription record, and notifies both Service Providers, with proper conflict cause code, of the change in status via the SOA interface.
   - Both Service Providers take appropriate action related to internal work orders.
4. How does New Service Provider wish to continue?
   - With the subscription in conflict, it is only the New Service Provider who controls the transaction. The New Service Provider makes a concerted effort to contact the Old Service Provider before proceeding.
   - If the New Service Provider decides to cancel the subscription, proceed to Step (5).
   - If the New Service Provider decides to proceed with the porting process, go to Step (8).

- If the New Service Provider decides to ignore, proceed to Step (7).

5. New Service Provider notifies NPAC to cancel subscription.
   - The New Service Provider may decide to cancel the subscription. If so, they notify NPAC of this decision via the SOA interface.
6. NPAC logs information, cancels subscription, and notifies both Service Providers of cancellation.
   - Following notification by the New Service Provider to cancel the subscription, NPAC logs this information, and changes the subscription status to cancelled. Both Service Providers are notified of the change in the subscription status via the SOA interface.
   - Both Service Providers take appropriate action related to internal work orders
7. NPAC waits for 30 calendar days, cancels subscription, and notifies both Service Providers of time-out.
   - After no response from the New Service Provider for 30 calendar days regarding this particular subscription, NPAC changes the status to cancelled and notifies both Service Providers of the change in status via the SOA interface.
   - Both Service Providers take appropriate action related to internal work orders.
8. New Service Provider notifies NPAC to remove subscription from Conflict status.
   - The New Service Provider may choose to proceed with the porting process, in spite of a cancellation message from the Old Service Provider. As both Service Providers are presumably basing their actions on the end-user's request, and each is apparently getting a different request from that end-user, each should ensure the accuracy of the request.
   - If the New Service Provider decides to proceed with the porting, they update the status of the subscription to pending via the SOA interface.
   - It is the responsibility of the New Service Provider to contact the Old Service Provider, to request that related work orders which support the porting process are performed. The Old Service Provider must support the porting process.
9. NPAC notifies both Service Providers of conflict off via SOA.
   - NPAC notifies both Service Providers of the change in subscription status. The porting process resumes as normal, at tie-point BB.

10. END

2.1.4 Service Switching Point (SSP) Provisioning

A switch that supports Number Portability requires certain provisioning tasks to be accomplished. Some of these are completed at the time a switch becomes Number Portability capable; others are completed periodically as new NPA-NXXs become portable. This section describes the various provisioning tasks associated with Number Portability.

2.1.4.1 Establishing the Trigger for a Given NPA-NXX

The Number Portability trigger is a six-digit trigger, and is set for a given NPA-NXX on each switch in the LATA within which that NPA-NXX resides. In this manner, all switches that can originate calls to that NPA-NXX without routing to an Interexchange Carrier (IXC) will be able to perform the Number Portability query and retrieve the correct LRN corresponding to ported numbers within that NPA-NXX.

2.1.4.2 Default Routing

Number Portability routing tables in a Number Portability-capable switch must designate the switch to which calls are routed for a given NPA-NXX when the NPDB is not accessible. In a Number Portability environment, the switch to which default routing occurs is the Donor Switch. (As described in Section 3, the Code Holder Switch plays the role of the Donor Switch when number pooling is involved.)

2.1.4.3 Assigning LRNs to Switches

A switch that can receive ported numbers must be assigned at least one LRN for calls to ported numbers to be successfully routed to that switch. The INC has established LRN assignment guidelines in the LRN Assignment Practices, as Section 2.1.1.4 notes.

2.1.4.4 Ported-Out and Number Portability-Reserved Markings

When a number is ported and subsequently disconnects, calls to that number while it is still being aged by the recipient service provider can result in an unexpected generation of ISUP RELease Cause Code 26. Issues associated with Cause Code 26,

while germane to the scenario just described, become more significant in a Number Pooling environment. Discussion of **Cause Code** issues is therefore deferred to Section 3.3.

2.1.4.5 Billing-Related Provisioning

Several items that must be provisioned in a Number Portability environment are related to characteristics of the billing information that must be captured in usage records. This section addresses these.

A. LNP Module Type

A Number Portability-capable switch generates usage records that contain information about queries performed, LRNs used for routing, the source of LRN information (whether it be the NPDB, incoming signaling, or provisioned switch data), and about which party (calling, called, billed number, etc.) the data is being collected. One provisioned data element is the format used for recording such information. Two formats are in general use; both of these use the Telcordia Billing Automatic Message Accounting (AMA) Format (BAF). BAF Module 719, which excludes additional fields related to Service Provider Identification and Location, and BAF Module 720, which includes these fields (note that current requirements do not provide source data for the population of these fields, and so they are recorded but not used), are both defined in Telcordia GR-1100-CORE, *Billing AMA Format Generic Requirements*.

Number Portability-capable switches must be provisioned with the service provider's preferred format for recording NP information.

B. CNA Trunks

A Number Portability-capable switch permits the designation of incoming trunk groups as **Connecting Network Access (CNA)** trunk groups. Special AMA records are recorded for calls received over such trunk groups, and capture information used to bill an interconnecting network for services performed. While such records were initially intended for the purpose of billing an interconnecting network for Number Portability queries performed on behalf of the other network, usage of CNA records has grown to include other forms of interconnection billing, such as mutual compensation for acceptance and termination of internetwork traffic.

CNA trunk groups must be specially provisioned to generate the proper usage recordings. In particular, recording options available with CNA trunk groups include the generation of other BAF Modules (one or two copies of BAF Module 164) to capture the Automatic Number Identification (ANI) and/or Calling Party Number (CPN) associated with the incoming call.

C. Other Options

A Number Portability-capable switch can also be provisioned to:

- Generate records for flat-rate calls that typically would not generate any AMA records (BAF Call Type Code 721)
- Generate records for calls to busy or unanswered lines.

Section 2.1.8 describes the capabilities associated with these provisioning options.

2.1.5 Service Characteristics of Service Provider Portability

This section describes some of the service characteristics associated with Service Provider Portability.

2.1.5.1 Service Switching Point (SSP)

At a Number Portability-capable SSP (i.e., an SSP that supports Number Portability), a trigger can be encountered on a portable NPA-NXX. This is referred to as the "Number Portability trigger," or **NP trigger**. The NP trigger is considered as part of the AIN call model, although some properties of the NP trigger are unique, and vary from the typical AIN:

- The NP trigger is encountered based on analysis of the dialed/received digits; however, additional conditions are checked before launching the **NP query**. Such conditions include whether the dialed digits indicate a DN that is resident on the switch, and the type of destination for the call (e.g., for some calls requiring operator services or IXC routing, the NP query might be omitted even though the trigger is encountered).
- The **Specific_Digit_String (SDS) trigger** has precedence over the NP trigger, regardless of the number of specific digits the SDS trigger specifies.

When the NP trigger is encountered, the SSP sends an Info_Analyzed message to the NPDB. The **Parameters** within the Info_Analyzed message that are pertinent to Number Portability are:

- The CalledPartyID parameter - contains the 10-digit called party number.
- The TriggerCriteriaType - indicates the type of trigger encountered and is populated as *numberPortability*.

The SSP can send a query message based on digits that are dialed or received in the prior AIN response or, in the case of an SSP performing tandem functions, digits received in an incoming ISUP IAM message.

Following a NP query, as with other AIN queries, the SSP awaits a response from the NPDB before proceeding with call processing. Upon receiving the NPDB response, the SSP examines the CalledPartyID in the response message and compares it to the dialed digits. If the CalledPartyID matches the dialed digits (i.e., the called party is not ported), the switch will route the call based on the dialed digits. If the CalledPartyID is different from the dialed digits, then the SSP will compare the CalledPartyID to its own LRN. If there is a match with its own LRN this implies that the number is ported and resides on the querying switch or a switch subtending the querying switch. The call is then routed based on the dialed digits. If the CalledPartyID does not match the LRN of the switch, then the called party number is a ported number that resides on another SSP. The SSP will perform the following task to prepare the call to be routed out of the switch:

- Populate the Ported Number Generic Address Parameter (GAP) with the dialed digits
- Update the appropriate field in the Forward Call Indicator parameter to indicate “translated number”. This field indicates that an NP query has been performed.

The SSP will route the call, taking the following into account:

- The type of call (i.e., local, intraLATA toll, interLATA), determined before the query based on the dialed digits (the LRN is not used in determining the type of call)
- The NPA-NXX of the dialed digits (for a non-ported number), or the NPA-NXX of the LRN (for a ported number), to select an appropriate route toward the next switch.

The SSP that will be the final destination of the routed call in the case where the called number is ported is called the **Recipient Switch**. This is the switch that serves the ported number. The switch from which the number has been ported is called the **Donor Switch**.

2.1.5.2 Common Channel Signaling (CCS) Network

Number Portability requires the addition of specific functions to the **Common Channel Signaling (CCS)** network. In particular, there is the need for the mapping of ported numbers to LRNs, which the NPDB application does, and for 10-digit **Global TItle Translation (GTT)** or the NP GTT function, as it is called. When call routing or SS7 message routing relies on using a DN that is possibly ported (e.g., to reach the correct switch or database), these functions must be invoked. If a database translation is needed, changes in the routing table of the STP ensure that the query is directed to the correct application [e.g., the NPDB application or perhaps a **Line Information Database (LIDB)**]. The NP GTT

function may be required when routing messages related to CLASS, LIDB, or CNAM, among other potential uses.

The SS7 signaling associated with Number Portability principally involves the following parameters:

- TCAP CalledPartyID
- ISUP Called Party Number
- ISUP Generic Address Parameter (GAP)
- ISUP Forward Call Indicator (FCI) [Ported Number Translation bit]

When an Number Portability response message results in the population of the TCAP CalledPartyID field with an LRN value (indicating that the dialed number is ported), and the dialed number resides on another switch, the Called Party Number parameter in the ISUP Initial Address Message (IAM) will be populated with the LRN, and a GAP parameter will be populated with the actual dialed digits (plus derived NPA when necessary). The FCI parameter in the ISUP IAM will be used to indicate whether an NP query has been performed. This is used to prevent more than one NP query from being launched on a call.

Additionally, the ISUP Jurisdiction Information Parameter (JIP) is used to carry information about the **Originating Switch**. Typically, this information is the first six digits of an LRN associated with the originating switch. The information is not used during call processing, but provides critical information for billing and settlements.

Number Portability does not change existing **Message Transfer Part (MTP)** and **Signaling Connection Control Part (SCCP)** routing procedures; however, a new translation type, Translation Type 11, is used for internetwork NP queries.

2.1.5.3 Number Portability Database (NPDB)

The NPDB contains an entry for each ported number. The entry indicates the LRN corresponding to the ported number.

The NPDB responds to a received NP query (Info_Analyzed message) with an Analyze_Route message. If the dialed number has been ported, the Analyze_Route message contains the LRN of the Recipient Switch, which is then used to route the call to its correct destination. Queries for non-ported DNs will cause the NPDB to return the actual dialed DN and not the LRN.

The NPDB application can receive either of two different NP query messages. The different messages are the result of different triggers being used in the switch to support Number Portability (see Section 2.1.5.1). A given NPDB application may need to support one or both of the different NP query messages, depending on the

NP trigger mechanisms that the switches use and other systems the NPDB application serves. If the AIN-based trigger is used (i.e., the NP trigger), then the NPDB application will expect the *Info_Analyzed message*. If the IN-based trigger is used, then the NPDB application will expect the *ProvideInstruction:Start message*.

From a protocol perspective, the NPDB will expect a few mandatory parameters in each message. For example, in the Info_Analyzed message the UserID and BearerCapability parameters are mandatory and in the ProvideInstruction:Start message the mandatory parameters are Called Party Number, Calling Party Number, LATA, and Originating Station Type. But while the other parameters in these two messages may be optional, some are required for the proper operation of the application and the NPDB. If the Info_Analyzed is received, the NPDB application will be expecting the following parameters for proper operation:

- CalledPartyID parameter - contains the DN of the called number that caused the query to the generated.
- TriggerCriteriaType parameter - indicates the type of trigger encountered.

The acgEncountered parameter (used for network traffic management control) may also be present and can be treated as a required parameter.

Within the ProvideInstruction:Start message the expected parameter for the NPDB application is:

- Service Key parameter - contains the dialed digits with the NPA (i.e., ten digits).

In general, if the NPDB requires a parameter and the parameter is not present an application error message is returned.

Upon receiving the NP query the NPDB application will determine whether there is a portability subscription entry in its database for the ten-digit DN received in the AIN CalledPartyID parameter or IN Called Party Number field. If there is a match for the ten-digit DN, the NPDB application shall determine the LRN associated with the called number from its database. The NPDB application will proceed with assembling a response message that will be either an *Analyze_Route message* for the AIN case or a *ConnectionControl:Connect message* for the IN case. The parameter values sent in the response depends on whether the dialed DN was found to be ported on non-ported. If the number is ported, the critical value that is sent in both types of response is the LRN. This value is sent within the CalledPartyID parameter in the Analyze_Route response and within the Digits parameter in the ConnectionControl:Connect response.

For numbers that are not ported, the NPDB application simply returns the same called party number in the response that was received in the query message. This is true for both the AIN and the IN response.

2.1.5.4 N-1 Networks

On a call traversing multiple networks, the most common occurrence is that the NP query will be launched in the **N-1 network**. The designation of "N-1" refers to the service provider that handles a call immediately before delivering it to the network serving the called party. So, for example, on a long-distance call, the IXC is the "N-1" network. That is, following the NP query, the IXC will be able to deliver the call to the terminating network, either using the dialed number to reach the switch serving a non-ported subscriber, or using the LRN to reach the switch serving a ported subscriber in the recipient network.

Although NP queries are the "responsibility" of the "N-1" network, some service providers may choose to enter into contracts with other service providers to perform NP queries on their behalf. If a call reaches the donor network unqueried, the donor network must perform a query to ensure successful call completion; however, if no previous business agreement for performing queries is in place, the donor network may be entitled to relief from the "N-1" carrier.

2.1.5.5 Default Routing

When a call requires a NP query but the query is not successfully completed (e.g., because of an unavailable NPDB or fatal signaling error), Default Routing occurs. Default routing is intended to operate the way routing did before Number Portability. The call is routed toward the Donor Switch using the Dialed Number, and the Ported Number Translation indicator in the FCI parameter will be set to "number not translated." The Donor Switch will determine whether the call can be completed to a DN that it currently serves. If the Donor Switch is unable to complete the call (e.g., if the DN was ported out), it should attempt to query an NPDB and route the call based on the LRN received in the response to the query.

The donor network is generally entitled to relief from the N-1 network in the absence of a contractual arrangement. However, in the case where the donor network delivers the call directly to the recipient network an issue can arise as to which network should in fact receive relief. The service provider for the recipient network may contend that it should be compensated for the delivery of the call directly to its network by the donor network. On the other hand, the service provider of the donor network may claim that it is entitled to relief from the IXC because it performed the NP query. As of this writing, the issue is still unresolved among the service providers.

2.1.5.6 Transition Mechanism

Typically, a switch does not launch an NP query for a call to a DN that resides on that switch (even though the DN resides in a portable NPA-NXX). An exception to this rule is needed during the porting process when the number is being transferred from the Donor Switch to the Recipient Switch and the NPDB is being updated. During the porting process, but while the DN is still provisioned on the Donor Switch, the Donor Switch needs to be able to query on the DN being ported. Similarly, the DN may be pre-provisioned on the Recipient Switch, and the Recipient Switch needs to be able to query on the DN being ported into the switch. Numerous terms, but all synonymous, can be used for the mechanism for providing this exception:

- The “transition mechanism”
- The “unconditional (non-conditional) trigger”
- The “10-digit trigger (while NP triggers are typically set on a 6-digit basis, this mechanism is set in place by provisioning a trigger on a 10-digit basis [on the DN undergoing porting]).

The “official” time when a DN is considered to have ported from the Donor Switch to the Recipient Switch is when an NPDB entry is created specifying the appropriate LRN for the DN. To ensure that the NPDB is consulted during the porting process, both the Donor Switch and the Recipient Switch will query the NPDB if the transition mechanism is set for that DN.

After the NPDB record has been created/updated with the Recipient Switch’s LRN, a service order would result in the deactivation of the mechanism at the Recipient Switch; when the DN is disconnected at the Donor Switch, the mechanism would be deactivated there as well. At that time, normal NP processing would begin for successful call completion.

Table 2-1 summarizes the switch operation for both the switch receiving a DN (recipient) and for the switch losing the DN (donor). In this table, both of the switches are using the transition mechanism to cause a query even if the DN exists on the switch.

Table 2-1. Transition Mechanism

	Old Service Provider		New Service Provider	
Cases	Prior to NPDB Update	After NPDB Update	Prior to NPDB Update	After NPDB Update
Porting the first time	Dialed # returned - terminate on the switch	LRN returned - route to the new service provider	Dialed # returned - route to the donor	Home LRN returned - terminate on this switch.
Previously ported and porting again	Home LRN returned - terminate on the switch.	New LRN returned - route to new service provider	Old LRN returned - routed to the old service provider	Home LRN returned - terminate on this switch
Previously ported and porting back to donor	Home LRN returned - terminate on the switch.	Dialed # returned - routed to the donor.	Old LRN returned - route to the old service provider.	Dialed # returned - terminate on the switch.

2.1.5.7 Message Relay Function / Number Portability (NP)Global Title Translation (GTT)

Consider the scenario in which a caller whose number has been ported from one network to another originates a call to a customer in another network. Consider that the caller has been ported from Network A to Network B and that the called party is in Network C (see Figure 2-8). The called party has Calling Name Delivery service (assume the appropriate business arrangements allow this service to be offered on an inter-network basis). When the calling party originates the call, ISUP Call Associated signaling is used to route the call to the switch in network C that serves the called party (i.e., switch C). When the call arrives, switch C must now originate a **Non-Call-Associated Signaling (NCAS)** TCAP query to retrieve calling name information for the calling party. Before Number Portability, switch C would route the query to STP C, which would do a six-digit GTT on the NPA NXX of the calling number and know which network (i.e., which service provider) to send the query to receive the calling name information to be displayed to the called party. With the advent of Number Portability, a ported NPA NXX can no longer be used to point directly to the destination network. Hence the NP GTT function is used to perform ten-digit GTT to alleviate this problem.

The NP-GTT can be implemented either at an SCP or a STP. This decision is usually left to the service providers. If, however, the implementation is done at the SCP then changes will be made at the STP to direct the Non-Call Associated messages to the NP-GTT function at the SCP. As illustrated in Figure 2-8, to advance the NCAS query

from Switch C, STP C would perform six-digit GTT on the NPA-NXX of the calling number (i.e., 201 667) and route the query to the NP-GTT at the SCP.

Note, the digits 201-667 point to Network A (i.e., switch A) and before Number Portability the query would have been sent to Network A. With Number Portability, this is no longer the correct network to send the query.

The NP-GTT function performs ten-digit Global Title Translation on 201-667 2134. The translation produces a new translation type and routes the query back to STP C. This new translation type causes a new table lookup at STP C, which points to the network. The query message is then routed to the LIDB database in Network B for calling name information.

The translation that is done at the SCP that houses the NP-GTT is called non-final GTT. Final GTT is done at STP B in Network B when the Subsystem Number (SSN) and Destination Point Code (DPC) of the LIDB database is determined. The LIDB database responds to the query using MTP routing instead of GTT routing. The response is MTP-routed to the querying switch (i.e., switch C).

If the NP-GTT function was implemented at the STP, then the ten-digit GTT would have been performed at STP C based on Figure 2-8.

Some service providers can have multiple LIDB databases and an NP-GTT node would need to be provisioned to determine the correct database to query. For example, in Network B of Figure 2-8, if there were two or more LIDB databases then STP B would pass the incoming NCAS queries to an NP-GTT that resides within Network B to determine the correct LIDB to which the NCAS query should be sent.

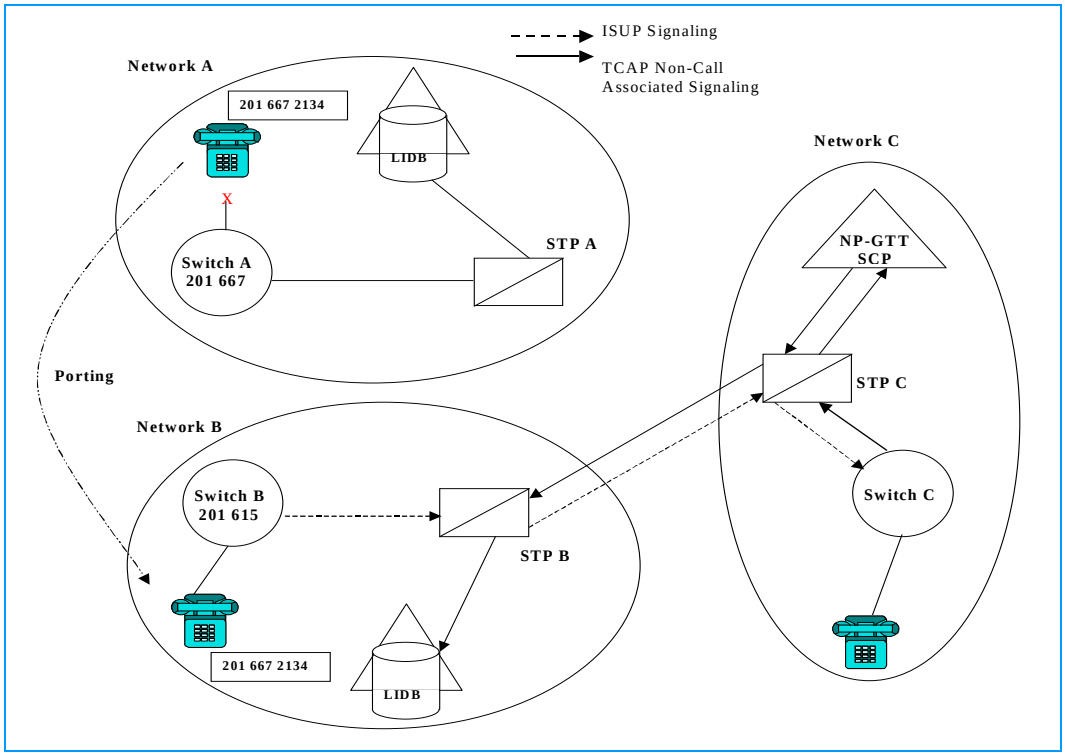

Figure 2-8. NP GTT Function in Support of Calling Name Delivery

2.1.6 Number Portability Call Processing - Call Flows

The following are some call flows that illustrate Number Portability call processing.

2.1.6.1 Direct Call Completion - Originating Switch to the Recipient Switch

In Figure 2-9, Subscriber A calls Subscriber B, who has a ported number and receives local service within the same LATA as Subscriber A. The call flow proceeds as follows.

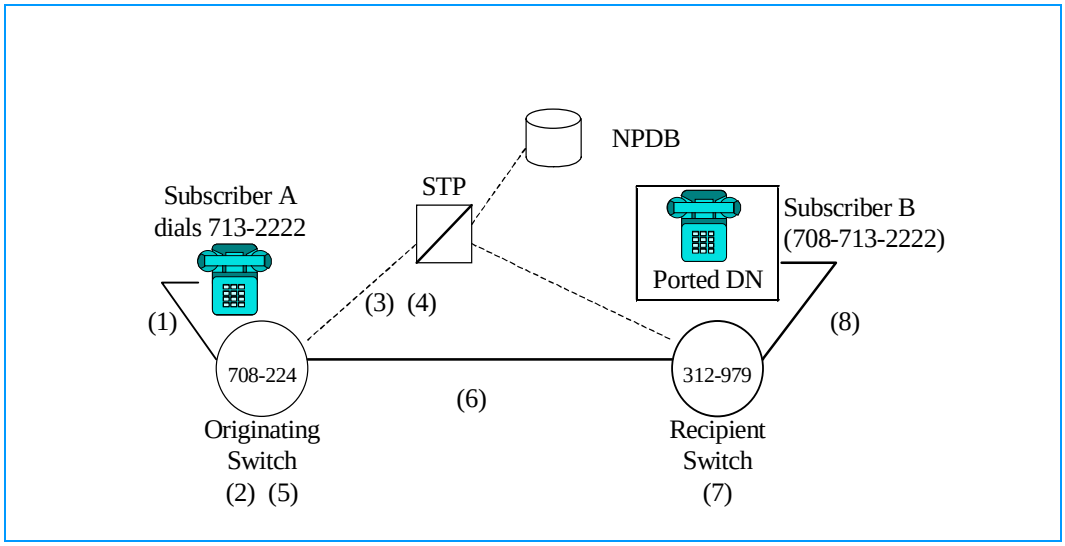

Figure 2-9. Originating Switch NP Processing with Direct Call Completion to the Recipient Switch

1. Subscriber A (708-224-1111) dials Subscriber B (708-713-2222).
2. The Originating Switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that Subscriber B is in a portable NPA-NXX (708-713) and the DN does not reside on the switch.
3. The switch sends an Info_Analyzed query based on the dialed digits to the NPDB.
4. The NPDB sends an Analyze_Route response containing the LRN (312-979-xxxx) of the Recipient Switch.
5. The Originating Switch receives the NPDB response and selects a route out of the switch. The LRN is stored in the CdPN parameter and the dialed digits are stored in the GAP parameter of the ISUP IAM message. The FCI Ported Number Translation Indicator is set to indicate a query has been done (set to "translated number").
6. The call is routed to the Recipient Switch based on the LRN.
7. The Recipient Switch receives and processes the contents of the IAM message. The switch determines that an LRN is received and that it is the switch's LRN. Since the LRN identifies this switch, the switch uses the contents of the GAP rather than the Called Party Number parameter to identify the subscriber.
8. The Recipient Switch completes the call to the subscriber.

A. Call Completion via the Donor Switch, with a Donor Switch NP Query

In Figure 2-10, the Originating Switch is not NP-capable and therefore does not recognize the dialed number as a ported number. The Originating Switch thus routes the call to the Donor Switch. The Donor Switch recognizes the ported number. The Donor Switch performs the query and directs the call to the Recipient Switch. The call flow proceeds as follows.

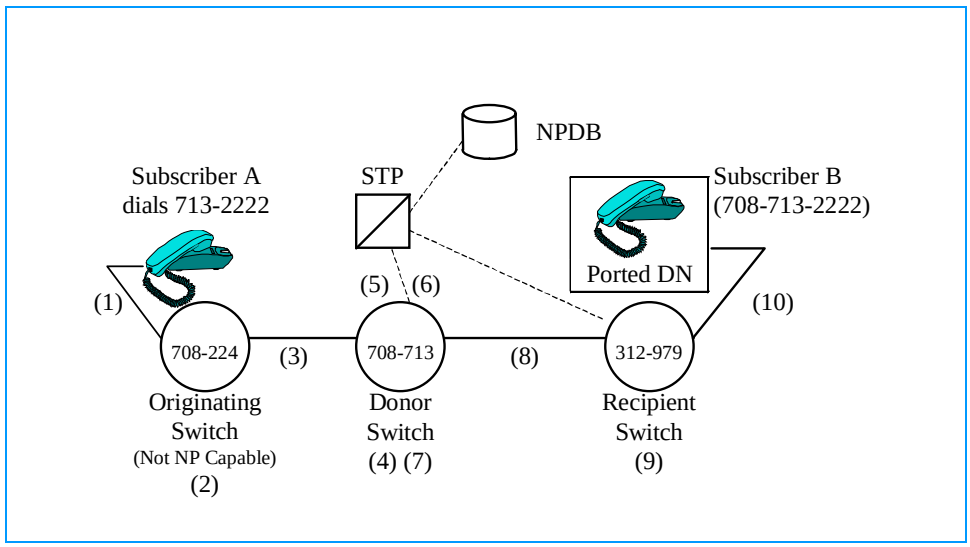

Figure 2-10. Call Completion via the Donor Switch, with a Donor Switch NP Query

1. Subscriber A (708-224-1111) dials Subscriber B (708-713-2222).
2. The Originating Switch performs digit analysis on the dialed digits to determine how to route the call.
3. The call is routed to the Donor Switch based on the dialed number (Originating Switch is not involved in Number Portability).
4. The Donor Switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that Subscriber B is in a portable NPA-NXX (708-713) and verifies that conditions have been met for a query to be sent.
5. The Donor Switch sends a query based on the dialed digits to the NPDB.
6. The NPDB sends a response back to the Donor Switch containing the LRN (312-979-xxxx) of the Recipient Switch.
7. The Donor Switch receives the NPDB response and selects a route out of the switch. The LRN is stored in the CdPN parameter and the dialed digits are stored in the GAP parameter of the ISUP IAM message. The FCI Ported Number Translation Indicator is set to indicate a query has been done (set to "translated number").
8. The call is routed to the Recipient Switch based on the LRN.
9. The Recipient Switch receives and processes the contents of the IAM message. The switch determines that the LRN is its LRN. Since the LRN identifies this switch, the switch uses the contents of the GAP rather than the Called Party Number parameter to identify the subscriber.
10. The Recipient Switch completes the call to the subscriber.

B. IXC-Routed Call; NP Query at IXC (N-1) Switch

In Figure 2-11, the Originating Switch determines that the call is to be routed to an IXC, and does not perform the NP query. The NP query is performed at the IXC switch, and the call is routed onward to the Recipient Switch.

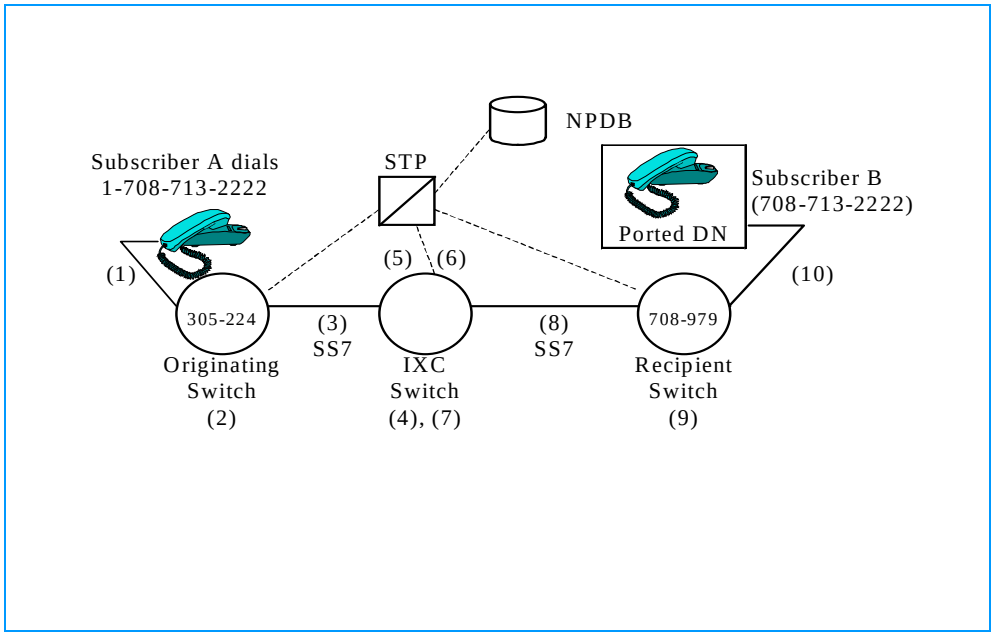

Figure 2-11. IIXC-Routed Call; NP Query at IXC (N-1) Switch

1. Subscriber A (305-224-1111) dials Subscriber B (1-708-713-2222).
2. The Originating Switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that routing to the called DN (Subscriber B) requires routing to an IXC and does not perform the NP query.
3. The Originating Switch signals the dialed number to the IXC Switch.
4. The IXC Switch performs digit analysis on the incoming digits to determine how to route the call. The switch determines that the called DN (Subscriber B) is in a portable NPA-NXX (708-713) and verifies that conditions have been met for a query to be sent.
5. The switch sends a query based on the dialed digits to the NPDB.
6. The NPDB sends a response containing the LRN (708-979-xxxx) of the Recipient Switch.
7. The IXC Switch receives the NPDB response and selects a route out of the switch.
8. The IXC Switch signals, using SS7 signaling, the LRN in the IAM CdPN to the Recipient Switch. The IAM will include a “Ported Number” GAP containing the dialed digits and the FCI Ported Number Translation indicator will be set.
9. The Recipient Switch performs digit analysis on the incoming digits to determine how to route the call and determines that the DN is on the switch.
10. The Recipient Switch completes the call to the terminating subscriber.

2.1.7 Operator Services and Number Portability

Number Portability affects the way numbers are translated and signaled, and it creates a need for additional information when they are used in billing records. As a result, Number Portability particularly affects **Alternate Billing Services (ABS)** and **Busy Line Verification (BLV)**. ABS calls (e.g. Collect, Person-to-Person, Third Party Billed, Calling Card) are impacted because of the verifications required on the alternative billing information and the additional information required for billing (e.g., who is the service provider). BLV calls are impacted because of the special routing requirements of these calls.

For ABS calls, there can be up to three different DNs of interest: Calling Party Number (CgPN), Called Party Number (CdPN), and Billing Number (BN). There are three functions of these calls to consider: routing, billing, and verification.

- The Called Party Number is used to route a call. For ported DNs, the LRN of the terminating switch is inserted into the CdPN parameter, with the dialed digits saved in the Generic Address Parameter (GAP).

- The LRNs of all three numbers (CgPN, CdPN, BN) may be included in AMA billing records.
- The requested alternate billing can be verified by querying a LIDB or other validation database for information using any of the three numbers (e.g., validating a calling card, or checking if third number billing is permitted for a DN). These LIDBs are typically geographically dispersed, and do not contain data for all regions or all service providers.

Each Number Portability-capable network element (switch, STP, NPDB, or Operator Services System [OSS]) will maintain a list of NPA-NXXs that are considered portable, at least for its own zone of portability. An NPDB provides the LRNs for ported DNs. The correct LIDB for a DN is determined by ten-digit Global Title Translation, performed by a GTT function, which may be implemented on the NPDB, STP, or STP adjunct.

2.1.8 Usage Measurements and Billing Considerations

Number Portability Information is appended to switch-generated AMA records when Number Portability is involved in a given call. Number Portability Information may be recorded for more than one party of a call (e.g., calling party, called party, aggregate/feature user, or alternatively billed party). In the U.S., Number Portability Information is captured in AMA records using the Billing AMA Format (BAF) defined and maintained by Telcordia in GR-1100-CORE mentioned earlier in this section. Specifically, an element of the format referred to as a Module is appended to each record requiring Number Portability Information. An **Originating Party LNP Module** refers to Number Portability Information related to the caller (i.e., for a caller that has a ported number). A **Terminating Party LNP Module** refers to Number Portability Information related to the called party, and is generally appended whenever an NP query is performed.

Local service providers bill access charges to IXCs for calls that transit the local provider's network. A portion of this access charge is based on a distance component commonly known as the "airline mileage element." This element is based on the distance between the V&H coordinates of the wire-center serving the calling (originating access) or called (terminating access) party and the V&H coordinates of the carrier's "point of presence" in the originating or terminating LATA. While a ported user does not change rate centers with Service Provider Portability, they can change wire centers. A wire center is usually defined as a switch or switch building. Since current billing systems derive the wire center V&H from the NPA-NXX of the calling (originating access) or called (terminating access) number recorded in the switch-generated AMA record, additional information needs to be recorded in switch-generated AMA records used for access charges to ensure that the correct wire center location is used for users that port their

numbers. Thus, the serving switch's LRN is recorded in an appended LNP Module for this purpose.

2.1.8.1 Connecting Network Access (CNA) and AMA Recordings

Calls between multiple local service providers (e.g., from an Incumbent Local Exchange Carrier [ILEC] to Competitive Local Exchange Carrier [CLEC]) are generally subject to intercarrier compensation. Because service providers previously were able to use the NPA-NXX of calling and called numbers to identify the companies with which they must exchange compensation, a modification to these procedures was required with the introduction of Number Portability. Out of this need came the CNA trunk type and associated AMA recording.

As a concept, CNA has grown far beyond its origin as a type of recording associated with Number Portability. Local service providers have adopted CNA as a catch-all type of AMA recording for any local interconnection scenarios.

2.1.8.2 Default Flat Rate Recordings

Certain flat rate calls that did not require any AMA recordings before Number Portability were seen to require recordings after the introduction of Number Portability, either to capture the fact that an NP query was performed (which could imply that compensation is owed between service providers), or to identify a service provider with which record exchange was necessary. These new recordings are referred to as "Default Flat Rate" AMA recordings.

2.1.8.3 Jurisdiction Information Parameter (JIP)

The ISUP **Jurisdiction Information Parameter (JIP)** has been the subject of much controversy during the development of technical requirements for Number Portability. As its name implies, its general purpose is to provide information regarding the jurisdiction of a call, since a call's origination point impacts the type of billing that occurs for the call. In particular, the bills local service providers render to interexchange service providers purchasing exchange access services are based on the mileage between switching offices used in carrying the call. Additionally, determination of applicable taxes that should be assessed to an end user may rely on identifying the particular switching office from which a call originates. In a Number Portability environment, the JIP is signaled forward in every IAM.

The controversy stems from differing interpretations regarding what information should actually be included in the JIP. Identification of a switching office in a

Number Portability environment can be interpreted as identifying an LRN that is assigned to the office. However, a switch may have multiple LRNs assigned, especially when the switch serves multiple LATAs. Though some service providers have argued for the JIP to represent not only the switch, but the LATA of origination, others have argued that simply identifying the switch itself is sufficient. The T1S1.6 requirements tend to support the latter view.

The best way to think of the JIP is as a parameter that carries LRN information about the switch that originated a particular call (or call leg). When an intermediate or terminating switch receives the JIP, its value can be captured in AMA records created at that switch.

One other point of interest regarding the JIP is that the parameter existed before the introduction of Number Portability. Other applications for the JIP may include identification of the mobile switching center from which a roaming wireless subscriber originated a call.

2.1.9 Deployment Status of Number Portability in the United States

Table 2-2 provides statistics on the extent of Number Portability usage in the U.S. as of May 1, 2000. This information is updated periodically on the World Wide Web at **http://www.ported.com**.

Table 2-2. Service Provider Portability Deployment Statistics in the U.S.

Region	Ported Numbers during 1998	Ported Numbers during 1999	Ported Numbers during first four months of 2000	Total Ported Numbers
Mid-Atlantic	72509	418066	227818	**718393**
Midwest	101406 (includes 2991 due to pooling)	1160893 (includes 305193 due to pooling)	547936 (includes 139762 due to pooling)	**1810235**
Northeast	60430	416661	302331	**779422**
Southwest	107882	640918	226475	**975275**
Southeast	34502	640567	249810	**924879**
West Coast	102727	562552	461998	**1127277**
Western	62995	620025	271646	**954666**
California	14659	202403	93584	**310646**
Total	**557110**	**4662085**	**2381598**	**7600793**

Implementation of Service Provider Portability is well underway, having already been implemented in the top 100 Metropolitan Statistical Areas (MSAs).

2.2 Location Portability

Location Portability is a circuit-switched network capability that allows an end user to maintain the same North American Numbering Plan (NANP) number even though the end user chooses a new geographic location from which to receive local service.

The technology supporting limited changes of location (within the same rate center) is the same as the technology that provides Service Provider Portability. However, when Location Portability beyond the boundaries of traditional rate centers is considered, the technology involved becomes considerably more complex. To date, Location Portability beyond rate center boundaries is not mandated in the U.S., nor has the capability been deployed.

This section provides a survey of the status of Location Portability, including requirements development efforts, factors inhibiting deployment, deployment status, and the expected industry path forward.

2.2.1 History of Location Portability

In the existing telephone network, every DN, i.e., NPA-NXX-XXXX, conveys unambiguous geographic information. In particular, each NPA-NXX maps to one rate center. Each rate center has a unique set of **Vertical and Horizontal (V&H)** coordinates that correspond to a fixed geographic location within the NANP area.[2] In addition, each NPA-NXX traditionally corresponded to a specific switch and **Local Exchange Carrier (LEC)**.[3] This rigid mapping of an NPA-NXX to a unique LEC, switch, rate center, and set of V&H coordinates the LECs maintained under the guidelines the NANP Administrator established.

Because the geographic location of each DN is unambiguous, switches can properly process calls. This includes:

- Determining the type of call (local, intraLATA toll, interLATA toll)
- Based on the type of call, determining the type of transport carrier that is entitled to transport the call. Transport carriers include LECs, intraLATA Toll Providers, and IXCs.
- Based on the type of transport carrier, routing the call to the specific carrier the end user selected (e.g., a presubscribed IXC for an interLATA toll call)
- Generating the proper AMA data for the call.

Additionally, because the rate center and location applicable to each DN is unambiguous (even in the presence of Service Provider Portability), the billing system can properly rate calls. This includes:

- Performing point-to-point distance-sensitive rating based on V&H coordinates
- Displaying the PLACE name on the bill (both “to” and “from,” when applicable)
- Determining the accounting classification for the revenues associated with the call (e.g., intra-state or inter-state).

Finally, many other network and operations systems rely on this rigid mapping of each NPA-NXX to a unique LEC, switch, rate center, and set of V&H coordinates. For example, Operator Services Systems (OSSs) use the NPA-NXX for real-time rating. Switches and Service Control Points (SCPs) also use the NPA-NXX to do location-based screening for a variety of services, including toll restriction services and calls to toll-free numbers.

The advent of competition within the local exchange network has begun to affect the traditional administration of DNs. In particular, the rigid mapping of an NPA-

2. The rate centers and V&H coordinates described in this document apply to end user billing. The V& H coordinates used for exchange access billing apply to wire centers, not rate centers.

3. As described on the next page, correspondence of an NPA-NXX to a specific switch and LEC is no longer universal because of factors such as Service Provider Portability and Number Pooling.

NXX to a unique LEC and switch is no longer wholly true, because of the influence of the following two factors:

- **Service Provider Portability.** Service Provider Portability (see Section 2.1) allows customers to retain their DNs even when choosing to receive local service from a different LEC. With Service Provider Portability, the NPA-NXX of a DN does not necessarily identify the specific LEC or switch that supports that DN. Switches therefore need additional information (the LRN) to properly route calls, and LECs have deployed software enabling the translation of a DN into an LRN. However, because Service Provider Portability does not affect the geographic location of a DN, the NPA-NXX of the DN can still be used to perform carrier selection and to properly rate calls.
- **Number Pooling.** Number Pooling (see Section 3) allows the LECs providing service in a local area to share a "pool" of DNs without requiring each LEC to obtain a unique NPA-NXX for each switch and rate center. Recent FCC decisions have mandated the implementation of Thousand Block Number Pooling (covered in detail in Section 3) for the industry, a method of allocating blocks of 1000 DNs within an NPA-NXX so that all carriers can properly route and bill calls.

However, these factors do not provide specific motivation for Location Portability, because each capability can be implemented without affecting the mapping of an NPA-NXX to a unique rate center and set of V&H coordinates. In fact, it is precisely the industry's historical desire to maintain this mapping (because of the complexities of not maintaining it) that provides a constraint on the "area of portability." Both Service Provider Portability and Number Pooling are currently restricted from being implemented over areas larger than existing rate centers to maintain the association between a DN and its geographic location.

The specific motivation for Location Portability, when requirements development was first being considered, was the potential for LECs to offer Location Portability as a service to customers. It was believed that both residential and business customers would recognize value from being able to take their telephone number with them if they moved to a new residence or business location. Indeed, many consumers still define the term "Number Portability" to mean exactly that. However, this motivation has receded in the past few years, and none of the LECs has taken steps to offer this service to its customers. Nevertheless, the requirements Telcordia developed in 1996 and 1997 were written with this capability in mind.

Over the past few years, several additional factors have kept discussions of Location Portability solutions "on the table." These are discussed in Section 2.2.4.

2.2.2 Technical Requirements Development for Location Portability

As mentioned above, Telcordia has produced a set of generic requirements providing a technical solution for Location Portability beyond traditional rate center boundaries. The requirements document, GR-2982-CORE, *Local Number Portability (LNP) Capability Specification: Location Portability* (December 1997), is believed to be the only existing set of generic requirements addressing this subject.

The foundation for the Location Portability technical solution GR-2982-CORE describes was a new identifier that would convey the geographic significance of a DN. This identifier, referred to as a **Geographic Unit Building Block (GUBB)**, was intended for the switch to route calls (i.e., perform carrier selection) and for billing systems to rate calls.

GUBBs were proposed as the means to accomplish the following:

1. The identification of a geographic area to which a DN is *location-ported*
2. The classification of a call as local, EAS, toll-intraLATA, or toll-interLATA based on the geographic area of the called party from the geographic perspective of the calling party (and the calling party's class of service) at the originating switch
3. Carrier selection and appropriate routing of the call to the destination switch
4. Proper AMA and rating of calls to/from location-ported DNs.

For more information on GUBBs, please refer to GR-2982-CORE.

2.2.3 Factors Inhibiting Deployment of GUBB Solution

The GUBB solution did not catch on among service providers, and has not been deployed. Complexity of the solution was cited as the main reason for discarding it, because massive changes would have been required throughout the network, in call processing, signaling, and rating. LECs were also generally concerned about customer confusion, for the following reason: because calls would be rated based on the actual geographic location of the called party (as represented by the GUBB), not on the geographic location "traditionally" associated with the dialed digits, customers would not be able to infer based on the dialed number whether they would be assessed toll charges.

2.2.4 Expected Industry Path Forward

It is expected that the industry will keep discussions of Location Portability solutions alive, due to several currently existing drivers. These are recognized to require similar types of technical solutions as would be required to implement the Location Portability capability (should the issues with which they are concerned be resolved on a technical basis rather than on a business or political basis), and include:

- **Number Conservation**. As described earlier, Number Pooling is currently restricted from being implemented over areas larger than existing rate centers to maintain the association between a DN and its geographic location. With tremendous industry interest in number conservation, however, it is expected that LECs may be asked in the near future to implement number pooling over larger geographic areas. To accomplish this, LECs will either need to develop a method of determining the geographic location of a DN without using the NPA-NXX, or find alternate DN administration techniques that do not rely on identifying the geographic location of a DN. The existence of a Location

Portability solution would be such a method, and would enable more effective number conservation.

- **Inconsistent Rate Centers.** Switching and signaling requirements for Service Provider Portability are sufficient to support Location Portability within a rate center (with or without service provider change). This allows end users to retain their DNs when changing their physical location within a limited geographic area. For ILECs this geographic area must be limited to the smallest area (e.g., a rate district) used for distance-sensitive rating under the existing local service tariffs. However, different service providers may wish to define different rate center boundaries. Many jurisdictions have defined rules for CLECs, including how they can assign DNs and how the potential movement of their customers impacts the rating and billing of other carriers (including the ILEC, other CLECs, and toll carriers).
- **Wireless.** According to the Order on Reconsideration of the FCC, wireless service providers must provide Service Provider Portability by November 24, 2002. Wireless-to-Wireline (and vice versa) Portability is included. Because rating and billing for wireless calls does not use the same model as rating and billing for wireline calls (i.e., wireline rate center definitions do not carry over for wireless rating and billing), porting between wireless and wireline service providers may also affect the mapping of NPA-NXXs to specific geographic locations.

Telcordia continues to examine Location Portability and related issues, and expects a solution of some type (whether technical or not) within the next several years.

2.3 Service Portability

Service Portability is a circuit-switched network capability that allows an end user to maintain the same North American Numbering Plan (NANP) number, even though the end user chooses to change from one type of local service to another type of local service provided by the same service provider. An example of such a change would be to switch from the POTS service to the ISDN service.

In the absence of Service Portability, subscribers may be required to change their phone numbers when they change telephone service because a particular service may only be available through a particular switch. However, because the demand for and benefits of Service Portability were unclear, the FCC did not include Service Portability in the Number Portability mandate.

2.3.1 Deployment Status of Service Portability

To date, Service Portability has not been mandated and has not been deployed in the US. Whereas Service Provider Portability was mandated in an effort to improve the competitive environment in the telephone industry, Service Portability was not deemed to be very important to competition. In fact, it was felt by many in the industry, and the FCC agreed, that requiring service providers to make the necessary switch and network modifications to accommodate both Service Portability and Service Provider Portability may delay implementation of the latter.

2.4 Wireless Number Portability

Wireless Number Portability is considered a form of Service *Provider* Portability. It is defined as the ability of a subscriber to change to or from a wireless service provider while retaining the same mobile DN. Because Wireless Number Portability involves a change of service provider, it is not considered a form of Service Portability (even though the customer is changing the type of service received). A wireless subscriber is generally not associated with a physical location, and therefore the concerns associated with Location Portability in a wireline environment do not apply to the wireless environment.

As previously indicated, Wireless Number Portability consists of the following:

- Wireless-to-Wireless Portability - a subscriber changes wireless service providers and retains the same mobile number.
- Wireless-to-Wireline Portability - with this form of portability, a subscriber changes from a wireless service provider to a wireline service provider and retains the same number.
- Wireline-to-Wireless Portability- a subscriber changes from a wireline service provider to a wireless service provider and retains the same number.

This section examines the progress that has already been made in the wireless environment concerning Wireless Number Portability and also discusses its expectations for the future.

2.4.1 History of Wireless Number Portability

Wireline and Wireless Number Portability began on different schedules based on the initial mandates. Whereas Wireline Service Provider Portability needed to be fully implemented in major metropolitan areas by the end of 1998, Wireless Number Portability was treated with less urgency. The complexity involved in Wireless Number Portability was one of the factors that prompted the FCC to exclude

wireless carriers from the initial schedule. Also, many of the players in the wireless industry perceived a different (smaller) need for Wireless Number Portability than for Wireline Portability, arguing that the wireless market was already fully competitive. This eventually led to the requests for further deployment postponements.

2.4.1.1 Establishment of Mandates

The FCC first ruled that wireless service providers were required to complete calls to wireline numbers that were portable. This initial request was considered the first phase of the deployment of Wireless Number Portability and was scheduled for completion on December 31st 1998. The full capabilities of Wireless Number Portability (i.e., portability between wireless and wireline and portability between wireless and wireless) was initially mandated for completion on June 30th 1999. However, petitions from members of the wireless community resulted in an extension of the implementation deadline first to March 31st 2000 and then eventually to November 24th 2002, which is the current deadline as of this writing. Some of the major factors that prompted the extensions are discussed below:

- Complexity: A main factor that caused the extension of the FCC mandate on Wireless Number Portability is the complexities of the operational processes and intercarrier communication involved in it. The wireless service providers began by using a modified version of the wireline Local Service Request (LSR) process. Within Wireline Portability the pre-porting process that uses the LSR forms takes about 24 hours to complete. To support the unique requirements of the CMRS providers (as well as the possibility of a larger porting volume compared to wireline), a business case was developed that required a wireless-to-wireless port to complete within 2 1/2 hours and in addition the NANC recommended to the FCC that the intercarrier communication process take 30 minutes for a complete wireless to wireless port. There were also other technical complexities involved in implementing Wireless Number Portability. Because wireless users are not confined to one specific geographic position, the effects on roaming, and especially on nationwide roaming, of Wireless Number Portability had to be considered. Also the determination of which numbers were allowed to be portable and which numbers were not was another issue that added to the complexity [the Mobile Directory Number (MDN) is portable, but not the Mobile Identification Number (MIN) - the MDN and MIN are numbers used in CDMA technology to identify a mobile handset and had identical values in most cases before Wireless Number Portability]. For MNP, the MIN will have to be separated. For Global System for Mobile Telecommunications (GSM) technology, an International Mobile Station Identifier (IMSI) is used instead of a MIN and that number is already separate from the MDN. There is still work in progress concerning the interaction

between Wireless Number Portability and other wireless features such as the Short Message Service (SMS) and paging services.

- Competition: The reason for the FCC Number Portability mandate was to foster competition between service providers. Wireless service providers contended that a significant number (there could be as many as six in some areas) of service providers currently offer services within a given area and hence competition already exists in the wireless industry. They argued that the burden of implementing Wireless Number Portability would not significantly increase competition.
- Perceived Need: The wireless providers also argued that wireless users are not as attached to their MDNs as wireline users are to their DNs. Therefore the need to change MDNs when changing wireless service providers is not a major concern among wireless users.

2.4.1.2 Technical Requirements Development for Wireless Number Portability

In January 1997, the Cellular Telecommunications Industry Association (CTIA) developed a "Standards Requirements Document" focusing on Service Provider Portability. It also proposed the LRN approach for Wireless Number Portability. The CTIA also created a Number Advisory Group to further the work of Wireless Number Portability standards development. This group produced the document "CTIA Report on WNP," April 1997, which gave more details concerning the Wireless Number Portability solution and the difference issues. TIA TR-45.2 also produced a TIA/EIA-41 Addendum for Wireless Number Portability in the fourth quarter of 1997. The current standards for Wireless Number Portability Phase 1 (completion of wireless calls to a ported wireline subscriber) and Phase 2 (Full Wireless Number Portability) the TIA also developed. Phase 1WNP Standard, IS-756, *Number Portability Network Support*, was published in March of 1998 and Phase 2, IS-756 A, *TIA/EIA-41-D Enhancements for Wireless Number Portability Phase II*, was published in December of 1998. The effect of Wireless Number Portability on wireless services such as Short Message Service (SMS) and paging has not been addressed in the current IS-756 A requirements. These capabilities fall within Phase 3 of the Wireless Number Portability Standard and it is believed that IS-756 A will be expanded to include these capabilities (work is currently being done under the PN-4411 Working Group). The Wireless Number Portability Sub-Committee of the NANC LNPA Working group has developed two reports on Wireless Number Portability Implementation. *WIRELESS NUMBER PORTABILITY Technical, Operational, and Implementation Requirements* (Version 1.3) is currently being developed as the latest version of those documents.

2.4.1.3 Establishment of Number Portability Administration

The same infrastructure in the wireline environment supports the Number Portability Administration in a wireless environment. The NPAC is used to maintain Number Portability information regarding ported wireless subscribers. See Section 2.1.1.3 for the history of the establishment of the Number Portability Administration.

2.4.2 Proposed Architecture for Full Wireless Number Portability

Figure 2-12 depicts a local view of a proposed wireless architecture for Wireless Number Portability. The architecture is for illustrative purposes and does not preclude different implementation variations. Each element in the proposed architecture is defined below.

- **The Mobile Switching Center (MSC).** There are interfaces on the MSC that

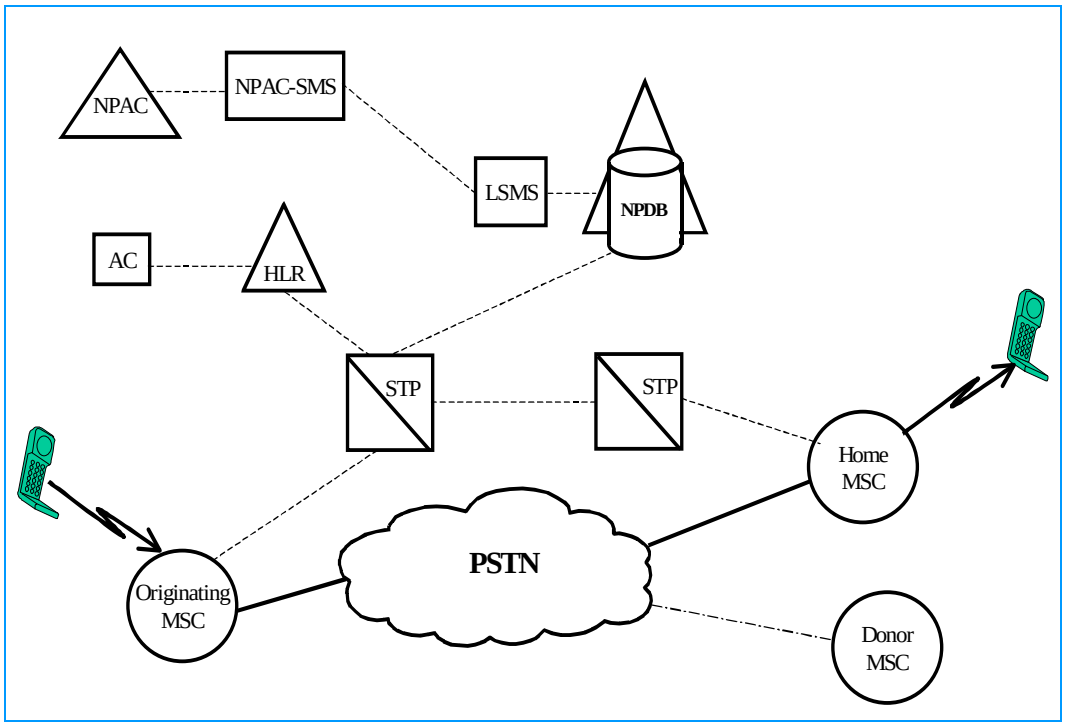

Figure 2-12. Proposed Wireless Number Portability Architecture

are involved in Wireless Number Portability. First, the ISUP interface must be modified so as to support and properly populate the Calling Party Number, Called Party Number, GAP, and FCI parameters. This modification must allow the parameters to be passed in either direction. The second interface is between the MSC and NPDB. The MSC must be able to send a Wireless Number Portability query and receive the LRN value back from the NPDB. The MSC-NPDB interface is specified in IS-756 A. It is based on the TIA/EIA-41 protocol.

- **Service Transfer Point (STP).** The STP routes the Wireless Number Portability query and response messages between the MSC and the NPDB. The STP may need to support the same Translation Type (TT) used in wireline NP queries for performing GTT for Wireless Number Portability queries. This TT has a value of 11.

- **Number Portability Databases (NPDBs).** The NPDB contains routing information regarding ported numbers. The SCP usually provides this functionality. The SCP may or may not be shared with a wireline and/or wireless network.
- **Home Location Register (HLR).** The HLR contains subscriber information, some of which (e.g., MSID, MDN) are pertinent to the operation of Wireless Number Portability.
- **Local Service Management System (LSMS).** The LSMS receives information updates regarding ported subscribers from the NPAC-SMS.
- **NPAC Service Management System (NPAC-SMS).** This is the regional clearinghouse of information regarding ported numbers. It is anticipated that a single NPAC-SMS may serve both wireline and wireless subscribers.
- **The Number Portability Administration Center (NPAC).** Periodic downloads (approximately every ten minutes) provide a current view of ported numbers to service providers' Number Portability databases.

2.4.3 Proposed Service Characteristics for Wireless Number Portability

This section describes some of the service characteristics associated with Wireless Number Portability.

2.4.3.1 Mobile Identification Number (MIN)/Mobile Directory Number (MDN) Split

As previously noted, the mobile handset has two identifiers: the Mobile Identification Number (MIN) and the Mobile Directory Number (MDN). Before porting, these two identifiers are likely to be the same, but after porting they will have to be different. The MIN is the identifier wireless systems use to perform registration and authentication, call processing, provisioning, customer care, and billing. The MDN is the 10-digit NANP number that is dialed to reach a specific wireless handset. Traditionally, service providers within the NANP serving area have programmed the MIN as the 10-digit MDN.

The MIN is the identifier wireless systems use for a mobile handset. The MDN is the 10-digit NANP number that is dialed to reach a specific wireless handset. Before the separation of MIN and MDN, most service providers perform registration, call processing, provisioning, customer care, and billing based on a single number - the MIN.

In a Number Portability environment, existing subscribers not yet ported will most likely have the same number for both the MIN and MDN. When a subscriber ports,

the MDN and MIN become separate and distinct. The ported subscriber's MDN will remain unchanged and port with the subscriber. The ported subscriber will surrender the MIN to the donor network and receive a new MIN from the recipient network. In other words, the MDN is portable, but the MIN is not portable. The donor network can reuse the relinquished MIN for another subscriber. It is possible that the same number may be used for a MDN in one network and a MIN in another network.

The MIN is used in the manner described above in the CDMA/TDMA technology, which is generally used in North America. The IMSI is used instead of the MIN in GSM technology, which is used mostly in Europe. It is the intention of the industry in the long term to migrate to the IMSI (to support global roaming, etc.). This change, however, is not expected to be a flash-cut and in the interim the industry has created the Mobile Station Identifier (MSID), which represents the MIN and the IMSI.

2.4.3.2 Mobile Station (MS)

Wireless Number Portability requires that the MDN and the MIN be different values; before Number Portability they were the same values. This in turn requires that the Mobile Station (MS) no longer assume that the MIN and MDN are the same and must now store both the MDN and the MIN. The MDN is used for call delivery to the mobile handset, i.e., callers dial the MDN to reach the mobile handset. The network performs MDN to MIN association when addressing the mobile in the network.

The MS will register with the MIN and will display the MDN when the user powers on his/her mobile phone.

2.4.3.3 Home Location Register (HLR)

To support Wireless Number Portability, the Home Location Register (HLR) can no longer assume that the MIN and MDN are the same and will therefore need to be able to separate the MDN and the MIN, using either value (e.g., MDN for call delivery and MIN for registration) to select a particular subscriber profile that the HLR maintains. The HLR must also support enhancements to the IS-41 messages required to accommodate the MIN and MDN, as appropriate.

2.4.3.4 Mobile Switching Center (MSC)

The Mobile Switching Center (MSC) must support the IS-41 Revision C (or equivalent) protocol for the Mobile Application Part if the MSC is to perform Number Portability functions.

A. Registration/Validation

- The MSC must be able to differentiate between MIN and MDN and to store them in the call register i.e., the MSC can no longer assume that the MIN and MDN are the same.
- The MSC should also be able to query the HLR and receive registration/ validation messages from the HLR.

B. Call Origination

If the Called Party Number belongs to a portable NPA-NXX:

- The MSC must have a new trigger for the NPDB query when the MSC determines that the call is to a portable number. The MSC will send a *npreq* message to obtain the LRN of the entry switch of the ported number
- The MSC must be able to interpret the response received from the NPDB. The response contains the LRN for ported MDNs and the dialed digits are returned for non-ported MDNs.
- Upon receiving the LRN, the MSC sends an ISUP IAM message to the switch currently serving the called party with the Translation Called Party Number (TCPN) being set in FCI, the Called Party Number set to the LRN, the Calling Party Number set to the MDN of the calling party, and the GAP parameters set to the dialed MDN.
- If the MSC determines that it is an interLATA call, it must route the call to the appropriate IXC.

C. Call Delivery

- The MSC must receive and process the IAM, replacing the Called Party Number with the GAP and processing the Called Party Number as usual.
- The MSC sends a query to the HLR based on the MDN received in the IAM. Since the MSC may support multiple HLRs, the correct HLR is chosen by performing GTT on the MDN. This GTT is performed at the STP with a TT value of 14 for portable MDNs.

2.4.3.5 N-1 Network

The concept of the N-1 network applies to the wireless environment in the same way as it does to the wireline environment. When a call origination attempt occurs at the MSC, the digits are examined to determine whether the call is an intraLATA or an interLATA call. If the call is intraLATA, then the wireless network originating the call is the N-1 network and therefore the originating MSC is responsible for the query. If the call is interLATA, then the IXC is the N-1 network and the wireless network hands the call over to the IXC for query processing.

2.4.3.6 CCS/IS-41 C Network

The IS-41-based wireless networks perform call and non-call associated processing functions in a seamless fashion. The wireless subscriber may or may not be in his/her home system and still be able to receive wireless service from a wireless service provider. These functions are referred to as **Automatic Roaming Functions.** The network and the subscriber unit perform various functions to provide service to the subscriber. These functions are registration, authentication, call origination, call termination, and vertical feature support. When Wireless Number Portability is implemented in the wireless network, a call terminating to the wireless network will require the network to determine the new network routing address of the called party to complete the call if the called party has a ported number. If the call originates in the wireless network, the Serving System may need to validate/authenticate the calling party, which requires communication with the calling party's home system. This function is unique to the wireless network.

The IS-41-based network will have to perform the function of determining the home MSC of the wireless customer through the LRN instead of the mobiles station's MIN for the purpose of routing signal messages and calls. During validation/authentication of a mobile station as part of a call origination attempt, if the mobile station has a ported number the serving system triggers on the NPA-NXX of the number and queries a Number Portability database. The serving system uses the LRN received in the response (i.e., MSC/VLR) to perform Global Title Translation to determine the correct HLR address associated with the calling party. The HLR will retrieve the necessary validation/authentication information from the home system. If the call terminates on the wireless network, then the IS-41 based query is sent to the NPDB to determine the LRN of the home MSC.

2.4.4 Proposed Call Processing / Call Flows

Wireless service providers were first required to deliver calls to ported wireline DNs. Subsequently, they will be required to port numbers from their wireless environment to the wireline network and vice versa, as well as port the mobile number of customers between themselves and other wireless service providers. Therefore, wireless service providers must eventually be able to

- Accept calls from a wireline network to a ported wireless number
- Place calls to a ported wireline number
- Place calls to other ported wireless numbers.

The sections that follow give example call flows of calls within these three typical categories. Figure 2-13 shows an example of a call from a wireline network to a ported wireless number, Figure 2-14 shows call completion to a ported wireline number, and Figure 2-15 is an example of a wireless to ported wireless call. Figure

2-16 also falls within the wireless to wireless category and is intended to show a possible outcome when the wireless provider chooses the option of querying the HLR before the NPDB. In many call scenarios involving Wireless Number Portability, the wireless service provider often has a choice as to whether to query to the HLR or the NPDB first (see IS-756-A).

2.4.4.1 Call Completion from a Wireline to Ported Wireless Number

A wireless provider accepting a call to a ported wireless number must ensure that the call is accurately delivered. Assuming that the wireline network is the N-1 network, the Number Portability query would be performed in the wireline network and the resulting ISUP message will be routed to MSC for the corresponding LRN. Figure 2-13 shows the call flow.

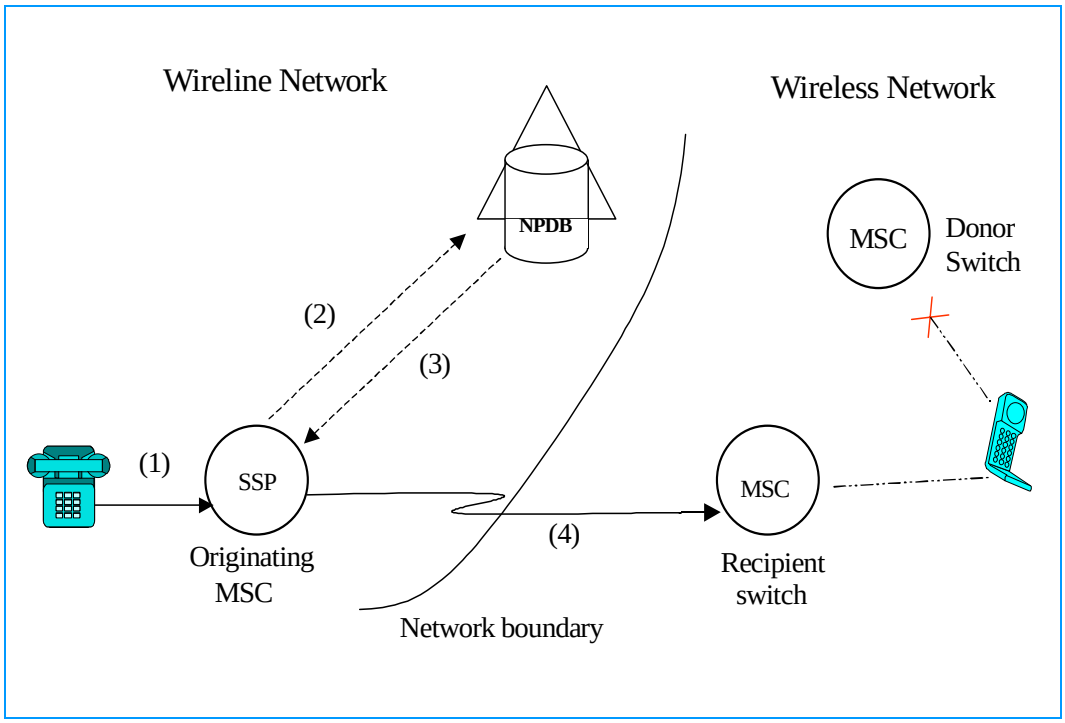

Figure 2-13. Call Completion from Wireline to Ported Wireless

1. The calling party initiates a call to the SSP with a mobile MDN as the called number.
2. The SSP recognizes the number as a portable number and launches an Info_Analyzed query to the NPDB with the MDN in the CalledPartyID parameter.
3. The MDN is ported and therefore the NPDB returns an Analyze_Route with an LRN in the CalledPartyID parameter.
4. Using the LRN, the SSP selects an outgoing trunk group and sets up the call to the Recipient MSC. Using ISUP signaling, the called DN is populated in the Generic Address Parameter (GAP), with the Type of Address Indicator set to Ported Number. The LRN is populated in the Called Party Number parameter. The Ported Number Translation Indicator is set to number translated. The Recipient MSC must now deliver the call to the ported user. Assuming that the Recipient MSC currently serves the called party (i.e., the called party is not roaming) the call is delivered directly to the called party. If the called party is roaming, then the steps taken to locate the called party are identical to steps 5 through 11 of Figure 2-15.

2.4.4.2 Call Completion from Wireless to Ported Wireline Number

The task of routing a call to a ported wireline destination required that a query be made to a Number Portability database. The query can either be made by an MSC in the wireless service provider's network (assuming that the wireless service provider is the N-1 network in the completion of a call), or the call can be passed to a wireline LEC carrier who performs the query on behalf of the wireless service provider as a business arrangement. Figure 2-14 shows a call flow in which the MSC of the wireless network does the query. The scenario involves a wireless user placing a call to a wireline-ported DN.

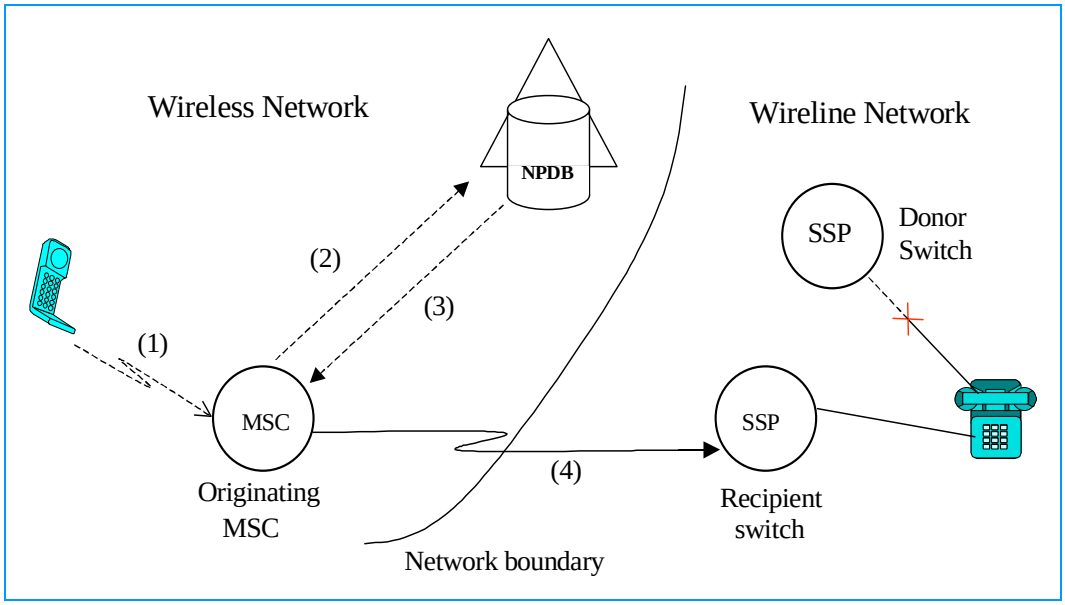

Figure 2-14. Call Completion to Ported Wireline Number

1. A wireless user initiates a call with a called DN to the MSC.
2. In this case, the called DN is a portable number and a Number Portability translation has not been done. The MSC sends a NumberPortabilityRequest (NPREQ) to the NPDB.
3. The NPDB sends a *npreq* message back to the MSC. The RoutingDigits parameter includes the LRN associated with the ported called DN.
4. Using the LRN, the MSC selects an outgoing trunk group and sets up the call. If the call is routed using ISUP signaling, the called DN is populated in the Generic Address Parameter (GAP), with the Type of Address Indicator set to Ported Number. The LRN is populated in the Called Party Number parameter. The Ported Number Translation Indicator is set to number translated.

2.4.4.3 Call Completion to a Roaming Ported Wireless User

In the scenario illustrated in Figure 2-15, a wireless user originates a call to a ported wireless user who also is roaming at the time. Once the wireless provider recognizes the dialed number as a portable number and an MDN (i.e., a wireless user), the service provider has the option to attempt to complete the call by doing a look-up in the HLR or by querying the NPDB. The service provider chose to perform a query to the NPDB first.

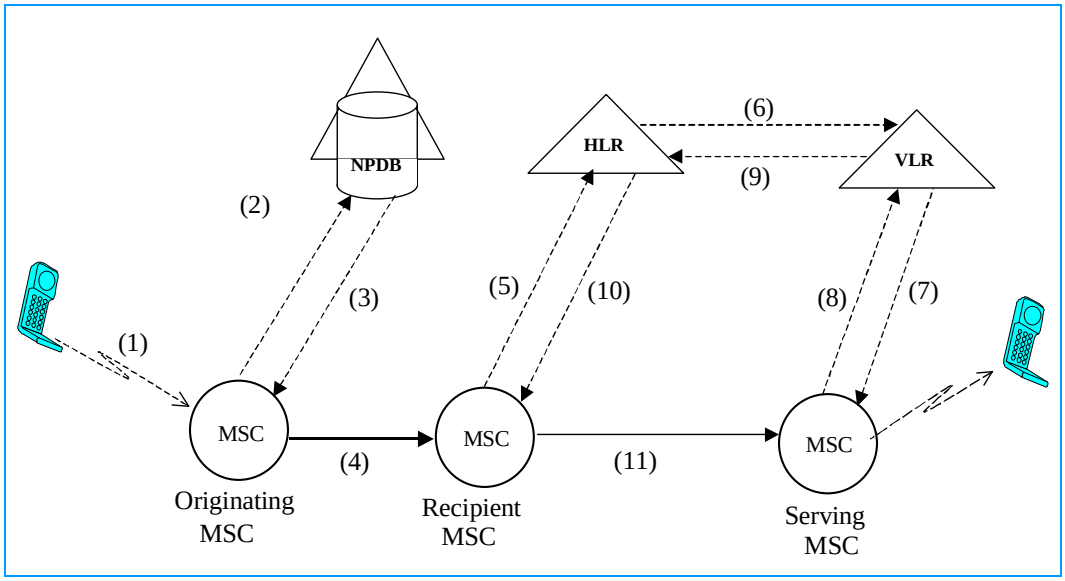

Figure 2-15. Call Completion to Roaming Ported Wireless User

1. A wireless user initiates a call with a called MDN to the MSC.
2. In this case, the called MDN is a portable number and a Number Portability translation has not been done. The MSC sends a NumberPortabilityRequest (NPREQ) to the NPDB.
3. The NPDB sends a *npreq* back to the MSC. The RoutingDigits parameter includes the LRN associated with the ported called MDN. This LRN points to the MSC in the home network of the called user.
4. Using the LRN, the MSC selects an outgoing trunk group to route the call to the Recipient MSC. At this point the Number Portability aspect of the call is complete. Because the called party is roaming, however, the Recipient MSC must launch a query to the HLR to local the called party.
5. The Recipient MSC sends a Location Request (LOCREQ) to the HLR associated with the MDN.
6. If the called DN is assigned to a legitimate subscriber, the HLR sends a Rote Request (ROUTREQ) to the VLR where the MS is registered.
7. The VLR then forwards the ROUTREQ to the Serving MSC.
8. The Serving MSC allocates a Temporary Local Directory Number (TLDN) and returns this information to the VLR in the *routreq*.
9. The VLR sends the *routreq* containing the TLDN to the HLR.
10. The HLR sends the TLDN information back to the Originating MSC in the *locreq*. The *locreq* includes routing information in the form of the TerminationList parameter, with the IntersystemTermination parameter used to indicate that this is a TLDN.
11. The Originating MSC establishes a voice path to the Serving MSC. The Ported Number Translation Indicator is set to number translated.

2.4.4.4 Call Completion to Wireless User after MIN/HLR Mismatch

The scenario in Figure 2-16 describes a call setup to a MDN when the call arrives at the Originating MSC without having been subjected to a NP query (or when no indication exists that a query has been attempted). The called DN is a portable (and potential) MDN. In this case, the MSC has the option of attempting to deliver the call issuing a LOCREQ or issuing a NumberPortabilityRequest (NPREQ). In this scenario, the MSC issues a LOCREQ, but the HLR returns “MIN/HLR Mismatch” because the MDN is out of range. The MDN, which had previously ported in, has ported out. The MSC then sends a NPREQ to the NPDB to obtain a LRN.

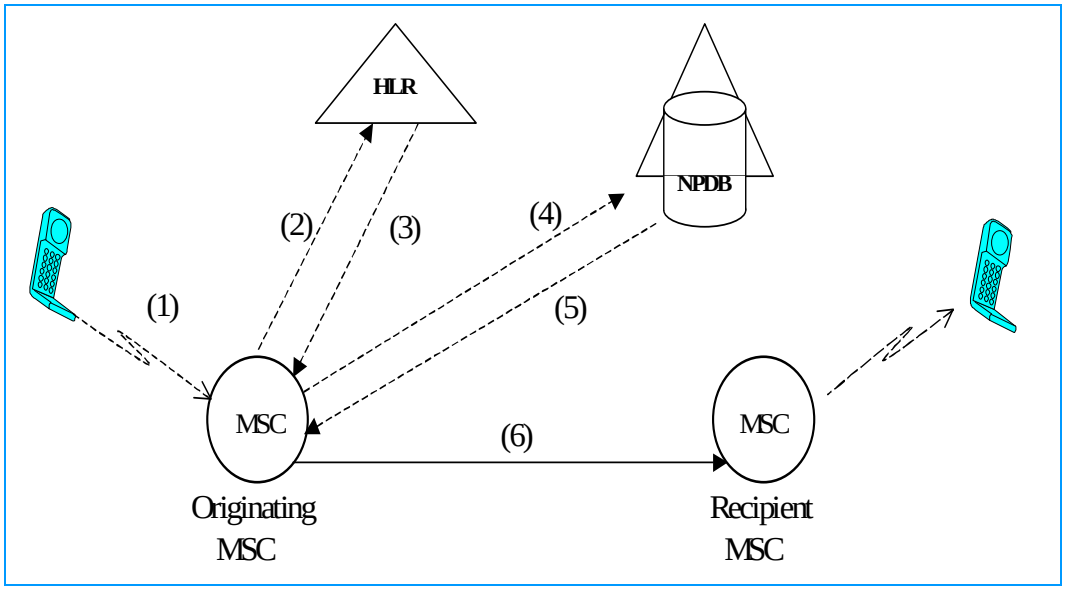

Figure 2-16. Call Completion after MIN/HLR Mismatch

1. The MSC receives a call origination. The called DN is a portable number that corresponds to a potential MDN. No indication is received that a NP query has already been attempted for this call.
2. The Originating MSC sends a LOCREQ to the HLR associated with the MS.
3. The HLR does not have a subscription record for this MDN, a LocationRequest RETURN ERROR with Error Code MIN/HLR Mismatch is returned indicating that the MDN is not within its supported ranges.
4. In this case, the dialed DN is a portable number, and the MSC sends an NPREQ to the NPDB. The Digits (Dialed) parameter includes the dialed DN.
5. The NPDB sends a *npreq* back to the MSC. The RoutingDigits parameter includes the LRN associated with the ported dialed DN.
6. The MSC sets up the call to the recipient MSC using the received LRN. If the call is routed using ISUP signaling, the called DN is populated in the Generic Address Parameter (GAP), with the type of Address Indicator set to Ported Dialed Number, the LRN is populated in the Called Party Number parameter, and the Ported Number Translation Indicator is set to number translated.

2.5 Number Portability in Other Countries

A growing worldwide trend is the privatization of once-nationalized telecommunications carriers. As national governments have divested themselves of ownership in incumbent service providers, they have generally seen fit to open telecommunications markets to competition to provide the greatest benefits to the population. As a result, Number Portability is gaining worldwide interest.

This section examines regulatory attitudes toward Number Portability in some other countries that have already taken steps toward deployment, describes some of the technical approaches considered for use in providing Number Portability, and surveys international standards activity.

2.5.1 Other Regulatory Decisions Outside the U.S.

Regulators generally have the greatest say over the manner in which Number Portability is implemented in their countries. In the U.S., for example, the FCC has taken a very strong role in interpreting the Telecommunications Act of 1996, which specified that Number Portability was a necessary step for service providers to take in opening markets to competition. The FCC's rulings have set timetables for deployment, identified criteria by which technical solutions should be judged, and established mechanisms by which service providers could recover the costs of infrastructure upgrades needed to provide the Service Provider Portability capability. The following is an overview of decisions the FCC's counterparts in other countries have made.

2.5.1.1 European Union

The regulators in many European countries implement the Directives of the European Union, whose authority spans 15 countries ("Member States"). In its Numbering Directive (98/61/EC), the European Parliament and Council of the European Union (institutions within the European Union) said:

> "National regulatory authorities shall encourage the earliest possible introduction of operator Number Portability whereby subscribers who so request can retain their number(s) on the fixed public telephone network and the integrated services digital network (ISDN) independent of the organisation providing service, in the case of geographic numbers at a specific location and in the case of other than geographic numbers at any location, and shall ensure that this facility is available by 1 January 2000 at the latest or, in those countries which have been granted an additional transition period, as soon as possible after, but no later than two years after any later date agreed for full liberalisation of voice telephony services."[4]

As an example of the implementation of this Directive, in October 1999 the United Kingdom Office of Telecommunications (OFTEL) issued a consultation document setting out the draft legislation they considered necessary to implement the Number Portability requirements in the Numbering Directive.[5]

2.5.1.2 Australia

On March 27, 1998, the ACA announced it had fixed May 1, 1998, as the date by which limited Number Portability for local telephone services must be provided, and that equivalent service Local Number Portability (LNP) must be provided by 1 January 2000.[6] Equivalent service means that customers with ported numbers receive the same quality and reliability, and the same services and features, as customers with non-ported numbers.

The ACA also set out technical criteria for Number Portability solutions specifying (1) no more than 1 second additional post-dial delay for calls to ported numbers as compared with calls to non-ported numbers, and (2) a maximum allowable increase in rates of call failure for calls to ported numbers as compared with calls to non-ported numbers of 1 in 100 additional call failures.

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4. *Directive 98/61/EC of the European Parliament and of the Council*, September 24, 1998.

5. *"Numbering Directive: Number Portability Requirements": A Statement Issued by OFTEL*, January 2000, obtained from **http://www.oftel.gov.uk/numbers/port0100.htm**.

6. *"Equivalent Service Criteria And Assessment for Local Number Portability"*, Australian Communications Authority, obtained from **http://www.aca.gov.au/number/final.htm**.

2.5.1.3 Interest in Other Countries

Many other countries are considering the introduction of Number Portability and are at various stages of regulatory analysis or initial public inquiries. In Europe, countries that are not part of the European Union are observing its activity closely, because Number Portability regulation adopted for European Union members could become a factor in other countries' attempts to be admitted to the European Union (e.g., a country that cannot meet the competitive goals of the European Union might be at a disadvantage in applying for admission).

2.5.2 Technical Approaches Considered in International Standards

A variety of technical approaches to Number Portability are being considered for use in international standards.

- *Number Portability - Scope and Capability Set 1 Requirements for Service Provider Portability* was published by the ITU in May 1998, and contained specifications for two technical approaches:
  - **— Onward Routing**
  - **— All Call Query.**
- *Number Portability - Scope and Capability Set 2 Requirements for Service Provider Portability* was published by the ITU in March 1999 and contained specifications for two additional technical approaches:
  - **— Dropback**
  - **— Query on Release.**

This section provides a brief overview of the four approaches. The ETSI supports all of these methods except for Dropback.

2.5.2.1 Onward Routing

In Onward Routing, the Donor Switch receives a call to a ported number and then forwards the call to the Recipient Switch. With Onward Routing, the Donor network maintains Number Portability information, and no query to a Number Portability database is required. This approach is analogous to Remote Call Forwarding (one of the historical approaches considered in the U.S.).

Routing information identifying the recipient exchange (analogous to the LRN used in the U.S.) is sent in the forward direction, from the Donor network through any transit networks (if necessary) to the Recipient network.

Onward Routing is in use in the UK as an interim Number Portability solution.

Figure 2-17 illustrates the ITU onward routing concept.

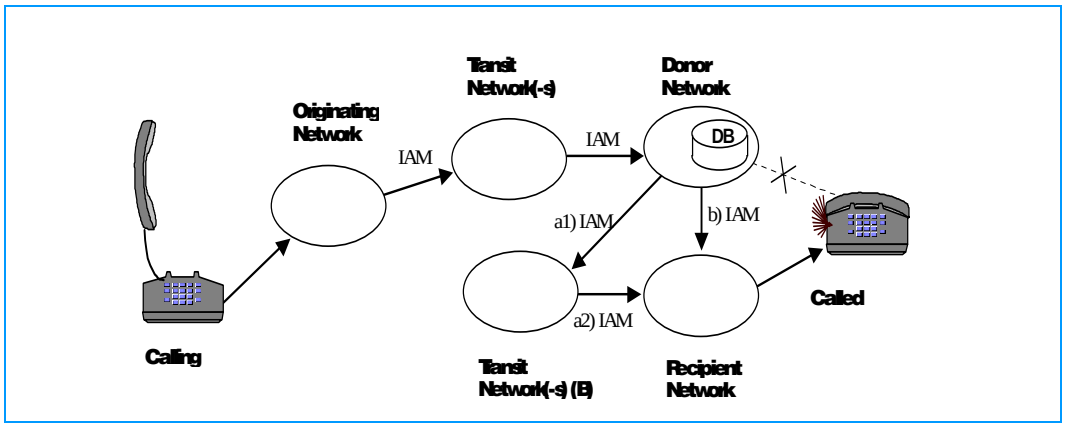

Figure 2-17. ITU Illustration of Onward Routing

2.5.2.2 All Call Query

In All Call Query, a network prior to the Donor network is responsible for performing a NP query to retrieve routing information for the ported number. The ITU defines two flavors of this approach:

- **All Call Query "One Step"** - Recipient network and exchange information are provided in the initial query
- **All Call Query "Two Step"** - Only Recipient network information is provided in the initial query; once the call is routed to the Recipient network, a further translation must occur to route the call to the Recipient exchange.

Figure 2-18 illustrates the All Call Query "One Step" concept.

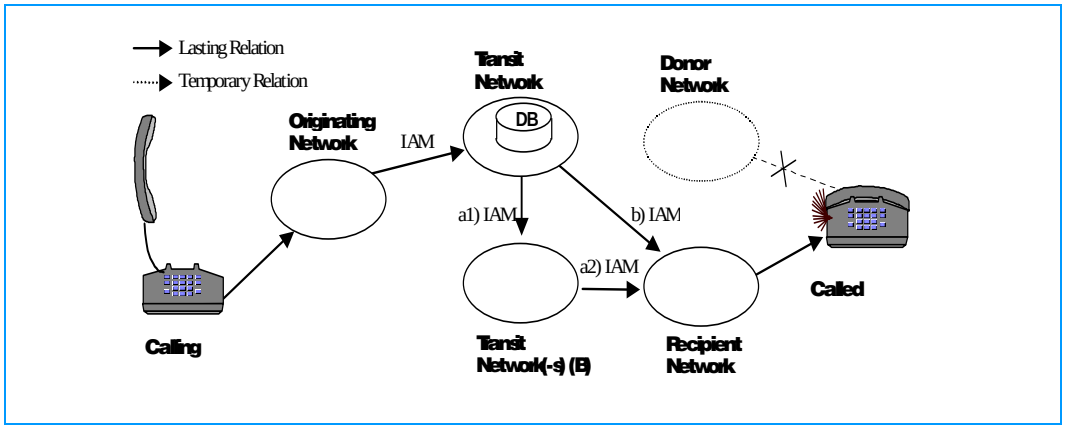

Figure 2-18. ITU Illustration of All Call Query "One Step" by a Transit Network

All Call Query is analogous to the U.S. method of querying in either the originating or "N-1" network before determining whether the dialed number is actually ported.

2.5.2.3 Dropback

Dropback (analogous to the Release to Pivot approach discussed earlier) is similar to Onward Routing, in that only the Donor network maintains Number Portability information. However, unlike Onward Routing, the Donor network does not route directly on to the Recipient network. Rather, the Donor network returns both an indication that the called number is ported-out and a Rerouting Number to a preceding network that is capable of handling Dropback requests. The preceding network reroutes the call onward toward the Recipient network using received "backward" information (i.e., information received in signaling from a subsequent network to a previous network). The initial call to the Donor network is then released, removing the donor network from the call path.

Figure 2-19 illustrates the ITU principle of Dropback.

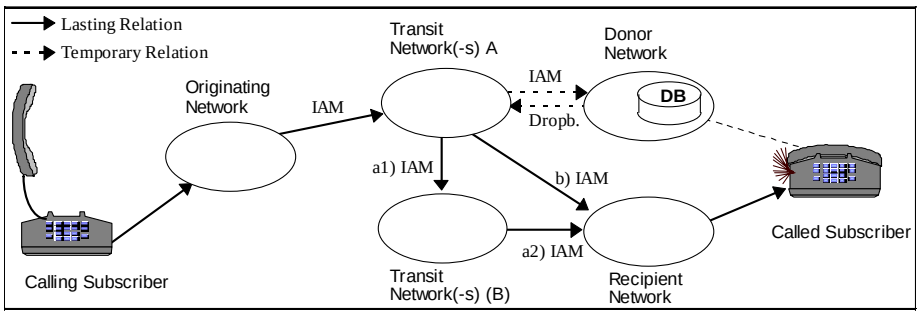

Figure 2-19. ITU Illustration of Dropback

2.5.2.4 Query on Release

In Query on Release (QoR), the Donor network does not perform a NPDB query for ported-out numbers. However, a preceding network initiates an NP query at the reception of a ISUP RELease message.

The RELease message contains an indication (e.g., special Cause Code value) that the called number is ported-out. Upon receipt of this information, a preceding network must initiate an NP query and redirect the call to the recipient network.

Figure 2-20 illustrates QoR for the case in which the network that does the NP query is the RELease message.

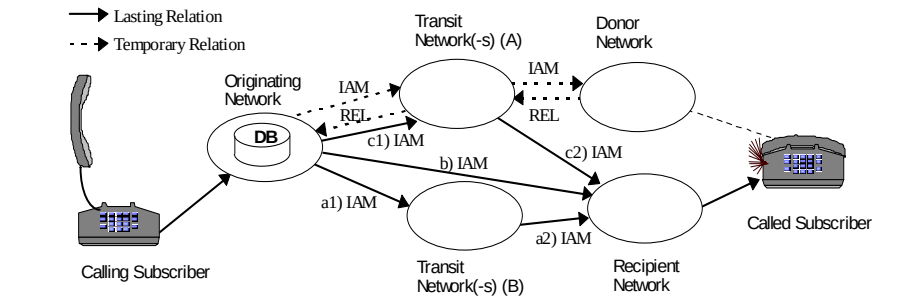

Figure 2-20. ITU Illustration of Query on Release (Originating Network Query)

3. Number Pooling

The pooling of geographic numbers in a Number Portability environment is a number administration and assignment process that allocates numbering resources to a shared pool associated with a designated geographic area. Considerable attention is currently being given to Number Pooling because of concerns regarding number exhaust and the potential expiration of the **North American Numbering Plan (NANP)**.

In particular, the solution most of the industry supports, and recently mandated by the FCC[1], is called **Thousands-Block**[2] Number Pooling. Thousands-Block Number Pooling makes the numbering resource in the shared pool available in blocks of one thousand numbers. These numbers are then available for assignment to competing service providers participating in Number Pooling for providing services to customers in that area.

As described earlier, existing network routing mechanisms are based on the understanding that geographic numbers are assigned on a Central Office (NXX) basis and associated with a specific switch and rate center[3], and recognition of the network address to which the call must be routed is embedded in the first six digits (NPA-NXX) of the called number. The use of Number Pooling eliminates this exclusive association of the NXX to the end office and demands an alternative routing mechanism for call completion. Such a mechanism is provided with the infrastructure associated with the **Location Routing Number (LRN)** method for Number Portability. The Number Portability-based architecture to support Thousands-Block Number Pooling is described in detail in Section 2.1.2.

This section reviews Number Pooling and the role it is expected to play in number conservation.

3.1 History of Number Pooling

Industry consideration of Number Pooling has only become significant during the latter half of the 1990s. In particular, number conservation concerns have been brought into the public eye because of the increasing rate of **Numbering Plan Area (NPA)** splits nationwide. To illustrate this point, consider that during the years 1991 to 1994, there were 11 new NPAs introduced in the United States; while during

1. FCC 00-104, *Report and Order and Notice of Further Proposed Rule Making, In the Matter of Telephone Number Conservation* (CC Docket No. 99-200), March 2000.
2. The term “thousand block” is also in use and has the same meaning.
3. A rate center denotes a geographic area used to distinguish rate boundaries. {Note: In this document “rate center” denotes the smallest geographic area used to distinguish rate boundaries. In other contexts, rate centers may contain even smaller geographic areas used for rating (e.g., rate districts, wire centers, rate areas).}

the years 1995 to 1998, the number of new NPAs introduced jumped to 80.[4] Currently, an estimated 30 new NPAs are introduced per year.

The rash of NPA splits does not stem entirely from the demand for new telephone numbers, although increased demand is certainly a contributing factor. It is true that the last several years have seen a sharp rise in consumer demand for telephone numbers because of consumer requests for multiple lines to support fax machines, modems, pagers, cellular phones, and other devices. Demand alone, however, would not have caused NPA exhaust to be as widespread a concern as it is, especially considering industry statistics that indicate many NPAs are considered to be exhausted well before the number of lines that could be supported within those NPAs are assigned. Indeed, there is another contributing factor.

The other contributing factor is that the traditional method by which telephone numbers are assigned to service providers in blocks of 10,000 (i.e., by assigning an entire NPA-NXX to a service provider at one time) becomes a hindrance in the presence of local competition. Because of certain idiosyncrasies of the processes in place for billing and settlements, a service provider must obtain a separate block of numbers from which to assign customer phone numbers in each traditional [i.e., incumbent **Local Exchange Carrier (LEC)**] rate center in which that service provider wishes to offer service. As a result, in the absence of Number Pooling, a competitive service provider might need to acquire 10,000 numbers in each of the Incumbent LEC (ILEC) rate centers in a given area (for some major metropolitan areas, the number of rate centers can be on the order of 20 to 50) before signing up a single customer. Thus several hundred thousand numbers might lie dormant in such a situation, exacerbating the rate of number "exhaust." Number pooling can be of tremendous assistance in achieving number conservation goals in situations such as those described above because it reduces the size of the blocks of numbers that service providers must acquire to compete. In fact, Number Pooling does not provide any relief from demand for new numbers, regardless of the size of telephone number blocks that are assigned to service providers, so it is in the reduction of the number of "idle" telephone numbers that Number Pooling can reap its greatest rewards.

Thousands-Block Number Pooling in combination with rate center consolidation is considered one effective approach to optimization. Thousands-Block Number Pooling in NPAs already nearing exhaust will likely have little benefit in that NPA, especially without rate center consolidation.

4. "North American Numbering Plan Exhaust Study," NANPA, April 1999.

3.1.1 Technical Approaches Considered

While today's approach to Number Pooling uses the **Service Provider Portability** (see Section 2.1) architecture and assigns numbers in blocks of 1000 at a time, the industry has also considered various other approaches to Number Pooling.

3.1.1.1 Number Pooling without Number Portability

Seven-digit routing has been suggested as a method for establishing Number Pooling without Number Portability. Under this approach, switch routing tables could need to undergo significant modifications, because digit analysis for switch-to-switch routing typically is concerned only with the first six digits of the called number [ten-digit **Advanced Intelligent Network (AIN)** triggers being one exception].

The industry technical requirements for Number Pooling include the following statement regarding seven-digit routing:

> "Although switch-based seven-digit analysis and translation can conceivably be supported in many switches and could, therefore, be used to route calls in some **Pooled Number** environments, this capability is administratively burdensome and inefficient in its use of switch memory. Therefore, this document defines a Number Portability-based approach for Number Pooling."[5]

3.1.1.2 Individual Telephone Number (ITN) Pooling

Some members of the industry have indicated an interest in extending the Number Pooling concept to the Individual Telephone Number (ITN) level. In such a scheme, telephone numbers would be assigned to service providers one at a time, and the idea of "blocks" of telephone numbers being assigned to a service provider would no longer be relevant. Almost all service providers consider this approach as requiring a prohibitive investment in administration and operations support systems, because all telephone number administration would then need to occur on a ten-digit basis, increasing the necessary capacity of telephone number administration systems.

A limited form of ITN pooling exists in the context of toll-free portability. Today, toll-free numbers are assignable on a number-by-number basis to service providers from within the national toll-free database, and the NPA-NXX of a toll-free number

5. ATIS Technical Requirements No. 4, *Thousand Block Number Pooling Using Number Portability* (T1S1.6 Working Group, July 1999).

does not indicate the service provider that provides service for that number. ITN pooling would extend this concept to the entire NANP.

The FCC is requiring the NANC and INC to undertake additional study on ITN as an optimization measure. A report to the FCC is due by the end of 2000.

3.1.1.3 Unassigned Number Porting (UNP)

Unassigned Number Porting (UNP) is seen by some members of the industry as a variation on ITN pooling, in which numbers that have been allocated to a service provider, but not yet assigned to a customer, may be "ported" to another service provider, effectively creating another technique for sharing individual telephone numbers among service providers before customer assignment. The difference is that numbers do not remain in a "pool" while waiting to be assigned to customers, but belong to a particular service provider. This approach cannot truly be called "Number Pooling," but appears to have some number conservation advantages. The FCC discusses its reluctance to mandate UNP (and ITN pooling) in its Report and Order In the Matter of Telephone Number Conservation, concluding:

> "We reiterate our finding that UNP and ITN are not yet sufficiently developed for adoption as nationwide numbering resource optimization measures and conclude that ITN and UNP should not be mandated at this time."[6]

Some service providers claim that their systems are not capable of porting a number that is not already assigned to a customer.

As with ITN, the FCC is requiring the NANC and INC to undertake additional study on UNP as an optimization measure, with a report due by the end of 2000.

3.1.2 Establishment of Number Pooling Administration

Number Pooling Administration has not yet been established for the federal rollout of Thousands-Block Number Pooling. A competitive bid process is required based on the recent Report and Order.

The FCC states:

> "We conclude, therefore, that the thousands-block number Pooling Administrator should be a non-governmental entity that is not aligned with any particular telecommunications industry segment. The Pooling Administrator must be fair and impartial. The Pooling Administrator must also meet neutrality criteria similar to that articulated in the NANP Administration Third Report and

6. FCC 00-104, *Report and Order and Notice of Further Proposed Rule Making, In the Matter of Telephone Number Conservation* (CC Docket No. 99-200), March 2000.

> Order: 1) the Pooling Administrator may not be an affiliate of any telecommunications service provider as defined in the 1996 Act; 2) the Pooling Administrator and any affiliate may not issue a majority of its debt to, nor derive a majority of its revenues from any telecommunications service provider; and 3) notwithstanding the neutrality criteria set forth in 1) and 2) above, the Pooling Administrator may be determined to be or not to be subject to undue influence by parties with a vested interest in the outcome of numbering administration and activities."[7]

The NANC, in its role as advisor to the FCC on numbering, is currently developing technical guidelines for a Pooling Administrator. Several state public utility commissions have been granted the authority to implement interim Thousands-Block Number Pooling trials, and have selected an interim Pooling Administrator for the state pooling trials currently in place and some of those that are planned.

Once a Pooling Administrator has been designated, the timeline for establishment of national Thousands-Block Number Pooling will be established.

3.1.3 Establishment of Number Pooling Guidelines

In parallel with regulatory activities and technical requirements development, various industry committees have been working to establish technical and administrative guidelines to govern the implementation of pooling.

3.1.3.1 Role of the Industry Numbering Council (INC)

The Industry Numbering Council (INC) has published several iterations of the *Thousands-Block (NXX-X) Pooling Administration Guidelines*, generically defining the administrative functions of the Pooling Administrator. The most recent publication of this document is the April 2000 version. All INC guidelines are living documents and service providers should refer to the INC website **(www.atis.org/atis/clc/inc/inchom.htm)** for the latest version of any INC document.

The guidelines specify the process of administration and assignment of Thousands-Blocks (NXX-Xs) to Number Portability-capable service providers for use at a switching entity or Point Of Interconnection (POI) they own or control. In addition, these guidelines outline the processes used between the Pooling Administrator and:

- Code Holders
- *Local Exchange Routing Guide* (*LERG*) Assignees

7. FCC 00-104, *Report and Order and Notice of Further Proposed Rule Making, In the Matter of Telephone Number Conservation* (CC Docket No. 99-200), March 2000.

- Block Holders
- The CO Code Administrator
- The Number Portability Administration Center (NPAC)
- NANPA
- Regulatory Agencies.

3.1.3.2 Role of the Number Portability Administration Center (NANC)

The Pooling Administration Issues Management Group (IMG) of the NANC is performing the task of developing the technical requirements that will serve as the basis for the Pooling Administration System Request For Proposal (RFP) that the FCC is expected to issue later this year.

The LNPA Working Group, also within the NANC, has developed the functional requirements and interfaces specifications associated with the NPAC system itself. These include:

- **National Number Pooling Updates to Part 1 of the Interoperable Interface Specification**. The NPAC SMS Interoperable Interface Specification (IIS), originally developed in support of Number Portability, contains the information model for the Number Portability Administration Center and Service Management System (NPAC SMS) mechanized interfaces. Both Service Order Activation (SOA) and Local Service Management System (LSMS) interfaces to the NPAC SMS are described in the IIS. The updates provide additional detail to support pooled block administration across the NPAC SMS to LSMS interface.
- **National Number Pooling IIS Flows**. Contains message flow diagrams to illustrate the use of NPAC interfaces for Number Pooling. The version of the flows referenced in this document is based on NPAC Release 2.0; however, NPAC Release 3.0 is expected to be available later this year (presumably, the flows will be updated at some future date, as well).
- **National Number Pooling Functional Requirement Specification (FRS) - Delta Document.** Originally developed in support of Number Portability, the NPAC SMS Functional Requirement Specification (FRS) describes the technical requirements on the NPAC SMS itself. The delta document contains a list of required changes to the FRS to support Number Pooling.

3.1.4 Network Requirements Development

Network requirements for switching system support for Thousands-Block Number Pooling were developed during the latter half of 1998 by the T1S1.6 Working Group, following completion of its work on Service Provider Portability.

In 1999, the requirements were published in a single document (as opposed to the three that were produced by T1S1.6 for Number Portability). That document, *Thousand Block Number Pooling using Number Portability*, has received industry consensus and the approval of the FCC in FCC 00-104 as the basis for the upcoming national Number Pooling rollouts. In contrast to the various sources from which the T1S1.6 Number Portability requirements had to be constructed, the T1S1.6 created the Number Pooling requirements from no source material.

3.2 Number Pooling Order Processing - NANC Operations Flows

This section provides the operations flows for various Number Pooling provisioning tasks, as documented in the Number Pooling flows document that the LNPA Working Group of the NANC has published. The text associated with each figure gives further detail and explanation of the Number Pooling provisioning process; in some cases, additional text has been incorporated to provide an additional explanation of the INC Forms that are associated with certain steps in the process.

Associated with these operations flows are various forms that service providers need to complete as part of the overall order process. For detailed information on these forms, the reader should refer to the INC Thousands-Block Pooling Administration Guidelines (available on the INC website, **www.atis.org/atis/clc/inc/inchom.htm)**.

3.2.1 Pooling of Non-Contaminated Block

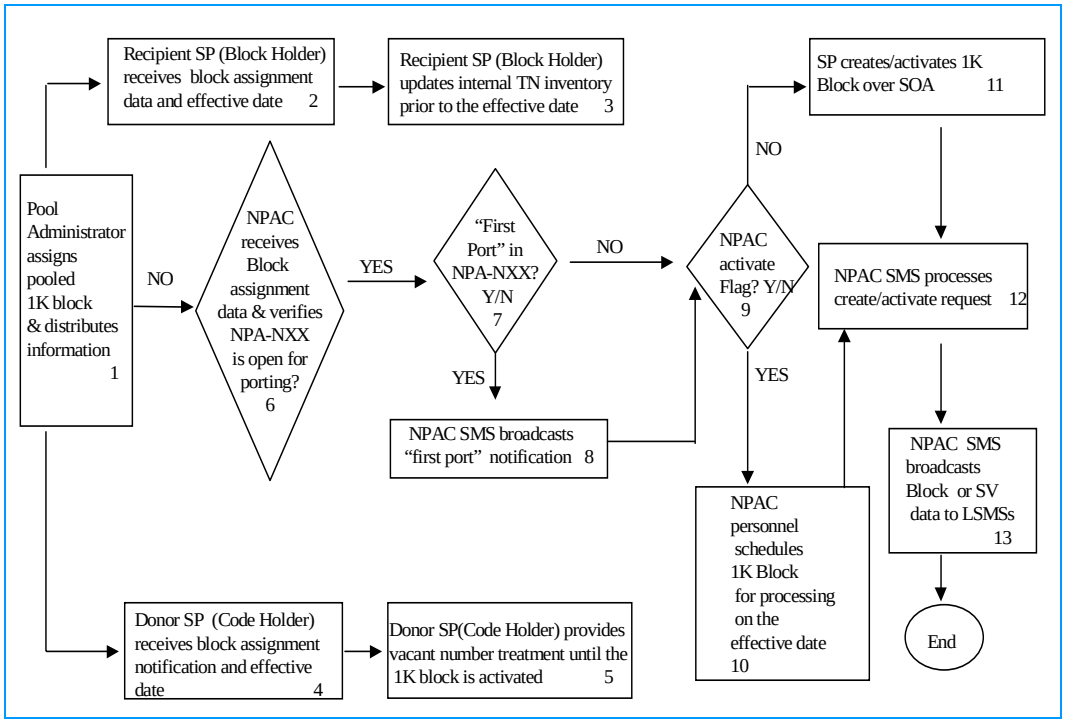

Figure 3-1. Pooling of Non-Contaminated Block

Block applicant applies for a Thousands-Block using the INC Part 1A Form.

1. Pool Administrator assigns pooled 1K Block and distributes information.
   - The process begins with the Pool Administrator assigning a block from the pool based on a request via a Part 1A Form from a Service Provider (SP), and updates the Routing Database System (RDBS).
   - It is assumed that before entering the pooling process the involved NPA-NXX of the block being assigned has been opened for porting in the LERG and NPAC.
2. Recipient SP (Block Holder) receives Block assignment data and the effective date.
   - The Pool Administrator advises the Recipient SP (Block Holder) of the TN range of the 1K Block being assigned and the effective date of the 1K Block via an INC Part 3 Form.

3. Recipient SP (Block Holder) updates internal TN inventory prior to the effective date.
   - The Block Holder updates its internal TN inventory.
   - The assignment of TNs in the 1K Block to customers may not be scheduled for activation prior to block activate date plus 1 day.
4. Donor SP (Code Holder) receives Block assignment notification & effective date.
   - The Pool Administrator advises the Donor SP (Code Holder/LERG Assignee) of the 1K Block being assigned and the effective date of the 1K Block.
5. Donor SP (Code Holder) provides vacant number treatment until the 1K Block is activated.
   - It is the responsibility of the Code Holder to provide vacant number treatment until the 1K Block is activated.
6. NPAC personnel receives Block assignment data via an INC Part 1B Form and verifies that the NPA-NXX is open for porting.
   - The NPAC personnel will verify that the NPA-NXX is open for porting in the NPAC.
   - If the NPA-NXX is not open for porting, the NPAC personnel will return the request to the Pool Administrator.
7. NPAC personnel builds the NPA/NXX-X Holder table no later than the effective date - 5 business days.
   - The NPAC requires specific data to build the NPA/NXX-X table. The NPA/NXX-X information consists of the TN range of the assigned 1K Block, the effective date (the date the 1K Block is transferred to the recipient SP), the Service Provider Identification (SPID) of the recipient SP, and the default routing for the block (LRN and DPC), NPAC Activate Flag. This information is transmitted via the INC Part 1B Form.
   - The NPAC Activate Flag indicates to the NPAC whether the recipient SP wants the NPAC to automatically download the block on the effective date. If set to N (No), the Recipient SP is required to use a SOA to initiate the download on the effective date. (see Block 10)
   - The NPAC will build this NPA/NXX-X table (TN range, SPID, effective date) after receipt of the data, but no later than the effective date to 5 business days to be compliant with the first port notification requirement. The default routing data is not included in the NPA/NXX-X table.

- The effective date is the date of transfer of service of the pooled Block to the Block Holder. The Block Holder has responsibility for ownership (TN inventory) of TNs which are processed in a disconnect/snapback after the effective date.
- NPAC personnel receive an alarm error message, if Pending Like, no Active TNs exist when creating the NPA/NXX-X table, they will send a report to the Pool Administrator and Code Holder for correction.

8. "First Port" in NPA-NXX.
   - Upon entry into the NPA/NXX-X Table, the NPAC SMS will determine if this is the first request for porting within the specified NPA-NXX of the 1K Block.
9. NPAC SMS broadcasts "first port" notifier.
   - NPAC SMS broadcasts first port notification to all SOAs and/or LSMSs no later than the effective date to 5 business days.
10. NPAC Activate Flag is checked.
    - If Yes, go to Step 9
    - If No, go to Step 10.
11. NPAC personnel schedules pooled port request for processing on the effective date.
    - On the effective date, the NPAC personnel will create the block in preparation for the broadcast.
    - The pooled port request includes the default routing data.
    - If block create goes into Fail or Partial Failure, an alarmable error message will be sent to the NPAC Personnel for them to resolve with the failed SPs.
12. SP creates pooled port request over SOA specifying TN range of 1K Block.
    - On the effective date, the SP creates a pooled port request over the SOA specifying the TN range of the 1K Block.
    - Pooled port request includes the default routing data.
13. NPAC SMS processes create/activate request.
    - NPAC SMS processes the create/activate request of the block.
14. NPAC SMS broadcasts Block or Subscription Version (SV) data to the LSMS
    - NPAC SMS broadcasts block or SV data to the LSMS in the appropriate format based on the NPAC SPID profile. If the receiving LSMSs supports Efficient Data Representation (EDR) [see Section 3.4.7], the block will be

broadcast to the NPAC SMS. If the receiving LSMSs do not support EDR, the NPAC will download individual SVs for each pooled number in the block.

3.2.2 Pooling of Contaminated Block

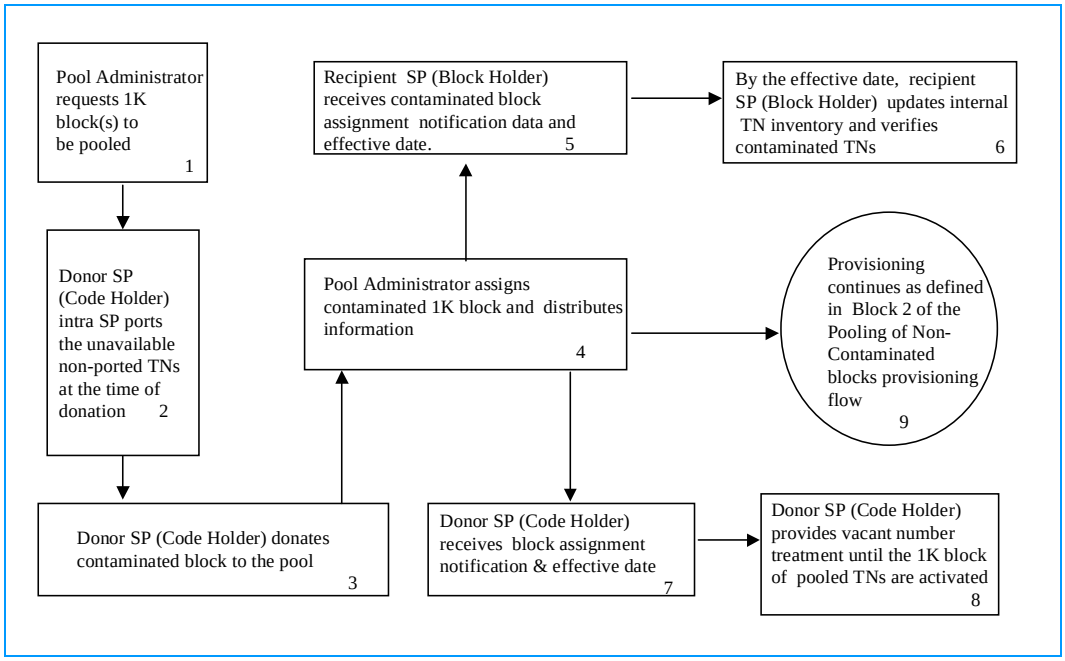

Figure 3-2. Pooling of Contaminated Block

1. Pool Administrator requests 1K Block(s) to be pooled.
   - The Pool Administrator can request that a contaminated block be donated to the pool.
2. Donor SP (Code Holder) intra SP ports the unavailable non-ported TNs at the time of donation.
   - The Donor SP (Code Holder) must intra-SP port all unavailable, non-ported numbers before donation to the pool. This results in each of these numbers having an individual TN in the NPAC and LSMSs.
3. Donor (Code Holder) donates contaminated Block to pool
   - Once the Donor SP (Code Holder) intra-SP ports the non-ported unavailable TNs, the Donor SP (Code Holder) can donate the contaminated block to the pool.
4. Pool Administrator assigns contaminated 1K Block, documents, and distributes information.
   - The Pool Administrator assigns the contaminated block from the pool based on a Part 1A request from a SP.
   - It is assumed that before entering the pooling process the involved NPA-NXX of the contaminated block being assigned was opened for porting in the LERG and NPAC.
5. Recipient SP (Block Holder) receives contaminated Block assignment notification data and effective date.
   - Recipient SP (Block Holder) receives block assignment notification from the Pool Administrator via a Part 3 Form.
6. By the effective date, recipient SP (Block Holder) updates internal TN inventory and verifies the contaminated TN(s).
   - Recipient SP (Block Holder) verifies the contaminated TNs of the 1K Block by checking the NPAC SMS or an LSMS database.
   - All unavailable TN(s) should have an SV in the NPAC database and all available TNs in the block should not have an SV of type “pool” in the NPAC database.
7. Donor SP (Code Holder) receives Block assignment notification & effective date.
   - The Pool Administrator will inform the Donor SP (Code Holder) of the effective date of the 1K Block being donated.
8. Donor SP (Code Holder) provides vacant number treatment until the 1K Block pooled TNs are activated.

- The Code Holder is responsible for vacant number treatment for blocks in the pool until the Block Holder activates them in the NPAC SMS.

9. Provisioning continues as defined in Block 2 of the "Number Pooling - Pooling of Non-Contaminated Block" flow.
   - From this point forward, provisioning resumes at Block 2 of the Number Pooling - Pooling of Non-Contaminated Block flow.

3.2.3 De-Pooling (Reclamation) of Block

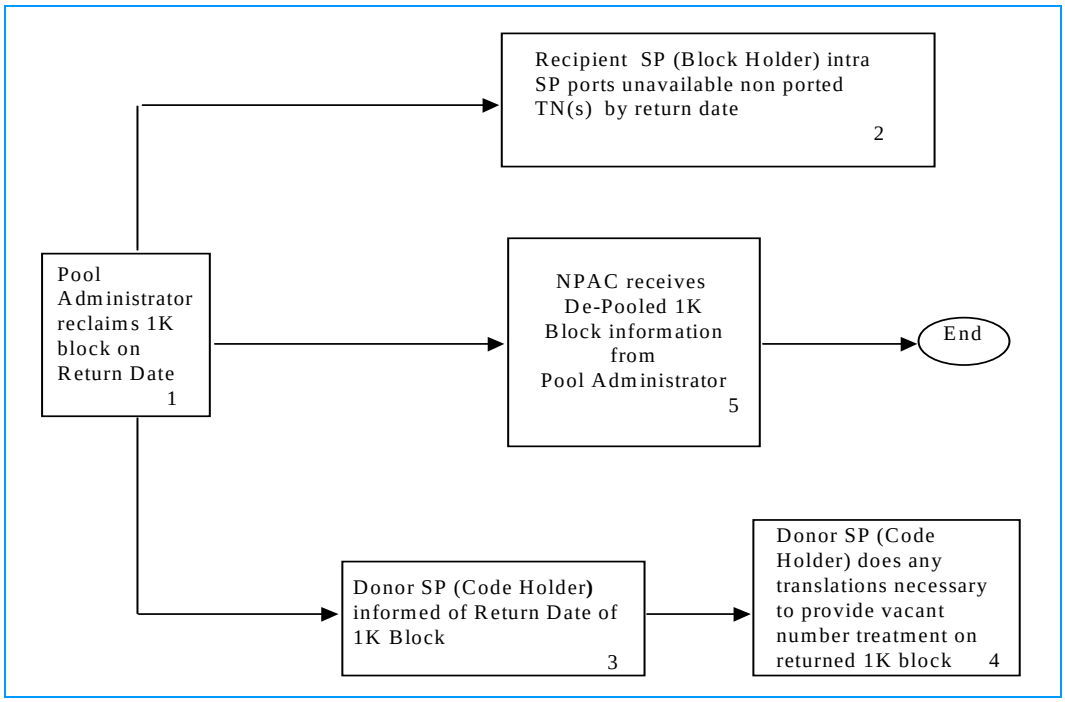

Figure 3-3. De-Pooling of Block

1. Pool Administrator requests/reclaims 1K Block on Return Date

   - The Pool Administrator can request/reclaim the return of a 1K Block via the Thousands-Block Reclamation Form if the SP has not activated the block with customers working on it within 60 days of the applicable activation deadline, or if the block is not being used for its intended purpose. The Block Holder can also return a 1K Block to the Pool Administrator. The return date is the date the block will be deleted from the NPAC and returned to the pool.

2. Recipient SP (Block Holder) intra-SP ports all unavailable non-ported pooled TNs by Return Date - 1 business day.

   - Upon receipt of return notification of the 1K Block, the Block Holder must intra-SP port all assigned pooled numbers before returning the 1K Block to the pool. This will result in each number having an individual SV (LISP) in the NPAC and LSMSs.

3. The Donor SP (Code Holder) is informed of the return of the Block to the pool and the return date.

   - The Donor SP (Code Holder) is the LERG Assignee Service Provider for the NPA-NXX.

4. The Donor SP (Code Holder) does any necessary translations to perform vacant number treatment on the returned Block.

   - The Code Holder/LERG Assignee is responsible for vacant number treatment for blocks in the pool until they are assigned to a Block Holder.

5. NPAC receives De-Pooled 1K Block information from the Pool Administrator.

   - NPAC receives confirmation of the 1K de-pooled Block from the Block Holder and the return date.

6. On Return Date, the NPAC SMS broadcasts to the LSMS to delete the Block Holder routing information for all pooled TNs in the Block, consistent with the EDR Flag in the SP profile.

   - For non-EDR LSMS, the NPAC will broadcast the delete of individual SVs with an LNP type of pool.

   - For EDR LSMS the NPAC will broadcast the block delete.

7. On Return Date, the NPAC SMS deletes the NPA/NXX-X and Block information.

   - Upon successful completion of the deletion of the SPs pooled TNs from all LSMSs the NPAC will delete the 1K Block tables, which contains the default routing information.

- NPAC returns the INC NPAC Reclamation Form to the PA and to the LERG Assignee.

3.2.4 Disconnect of Ported Pooled Number

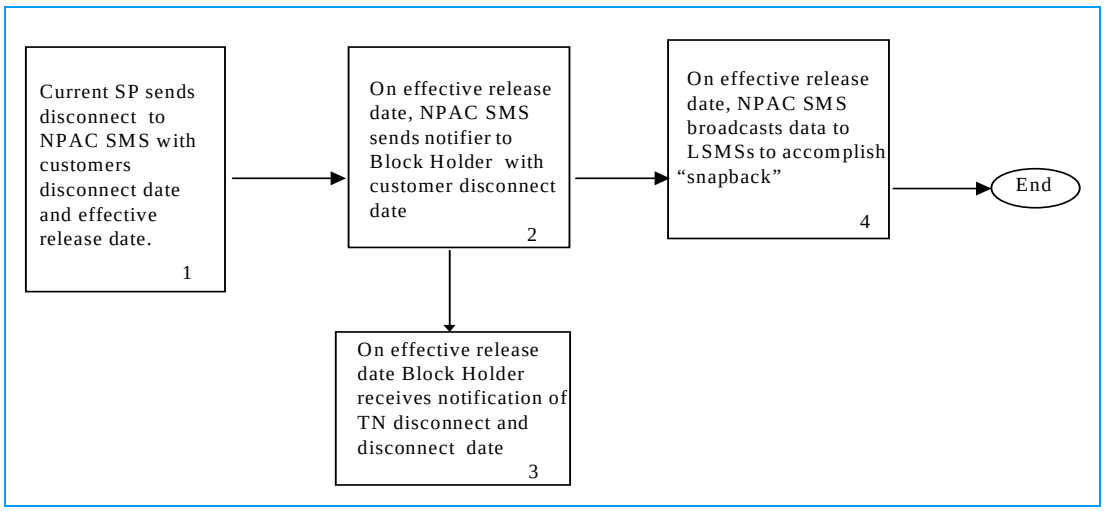

Figure 3-4. Disconnect of Ported Pooled Number

1. Current SP sends disconnect to NPAC SMS with customer disconnect date and effective release date.
   - The disconnect date is the date the customer's service is being disconnected.
   - The effective release date is the date the number is going to be released back to the Block Holder for default routing and TN administration.

     NOTE — The effective release date must be equal to or greater then the disconnect date.
2. On the effective release date, NPAC SMS sends notifier to Block Holder with the customer disconnect date.
   - On the effective release date, NPAC SMS sends a notifier to the Block Holder with the customer disconnect date
3. On effective release date, Block Holder receives notification of TN disconnect and disconnect date.
   - Any physical work or changes may be made by either the Old SP or Block Holder, as necessary.
4. On Effective Release date, NPAC SMS broadcasts data to LSMSs to restore default routing to Block Holders default switch.
   - The NPAC will broadcast appropriate data to the LSMSs based on the EDR flag in the SP profile.

3.3 Number Pooling Administration

3.3.1 Service Switching Point (SSP) Administration

Full support for Number Pooling at an SSP would require the SSP to categorize telephone numbers resident on the switch into the following classes of numbers: (1) assigned in an NXX for which the switch is the Code Holder, (2) assigned in an NXX for which the switch is the Block Holder, (3) not assigned, and (4) aging and waiting to “snap back” to the Block Holder.

Because a switch’s ability to provide Number Portability is a prerequisite for it to provide Number Pooling, the categories of telephone numbers can be further broken down into: (1) assigned (Code Holder), (2) assigned (Block Holder), (3) assigned (Ported-In), (4) not assigned (never used), (5) not assigned (Ported-Out), (6) not assigned (but in a pooled block belonging to the switch), and so forth. In practice, such number administration is left to operations support systems, and an

SSP typically does not have to worry about such details. The main reason for not burdening the SSP about the category a particular number is in is most calls do not require this level of detailed information to successfully complete.

However, a certain condition that occurs mainly as a result of interactions between Number Portability and Number Pooling (and is also sometimes related to the aging of numbers) caused concern among the developers of the Thousands-Block Number Pooling technical requirements. The “problem” scenarios involved the generation/suppression of a particular Release **Cause Code** (Cause Code 26), used in ISUP RELease messages, at potentially inappropriate times. In response, a set of procedures was developed that would allow the SSP to use knowledge of the status of a dialed number, embedded in the marking of the number as “NP-Reserved” and/or “Ported-Out,” to determine correct call processing for a particular class of calls (LRN-routed calls to unallocated numbers). This class of calls is described in more detail in Section 3.4.6.

The jury is still out on whether the requirements for NP-Reserved and Ported-Out markings will be widely deployed. Suppliers have simultaneously begun to support the feature, and offered their customers the ability to dispense with Cause Code 26 altogether. The rationale for the latter approach is that the difficulties are not as expensive to live with as the solution would be to implement.

The remainder of this section is devoted to a discussion of the significance of the NP-Reserved and Ported-Out markings in a Number Pooling environment. Readers who do not anticipate being directly involved in Number Pooling implementation may comfortably skip ahead to Section 3.4.

3.3.1.1 “NP-Reserved” Markings

The **NP-Reserved Marking** is used to identify the DNs on the switch that are allowed to be unallocated without generating Cause Code 26. The most typical use of this marking is to identify numbers for which a particular switch is the Block Holder.

Figure 3-5 illustrates the use of the NP-Reserved Marking in a pooling environment.

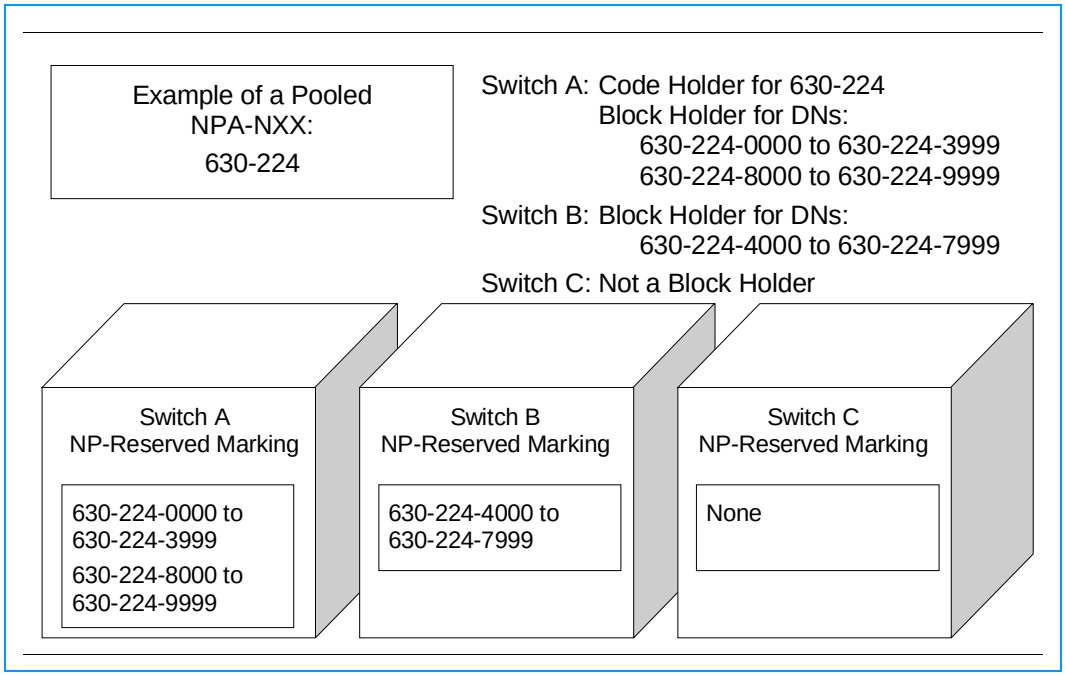

Figure 3-5. NP-Reserved Marking for Number Pooling

In this example, Switch A is the **Code Holder Switch** for the NPA-NXX 630-224. Thus, in the absence of a successful NP query (e.g., if the NPDB is unavailable), calls to telephone numbers in 630-224-XXXX would be routed to Switch A. (This concept is referred to as "default routing to the Code Holder" and is discussed in Section 3.4.4.) Switch A is also the **Block Holder Switch** for six of the Thousands-Blocks within the NPA-NXX. Switch B is the Block Holder switch for the four other Thousands-Blocks within 630-224.

The NP-Reserved marking is set on the numbers in the blocks assigned to each switch. This impacts the generation or suppression of Cause Code 26, as described in Section 3.4.6.

3.3.1.2 "Ported-Out" Markings

The Ported-Out marking is used to identify the unallocated numbers on the switch that should generate Cause Code 26 (this is most important for DNs that also have NP-Reserved markings, because Cause Code 26 generation would occur for unmarked numbers anyway). The most typical use of this marking is to identify

numbers that have ported away from the Block Holder switch. See Section 3.4.6 for Cause Code 26 generation procedures associated with Ported-Out markings.

3.3.2 Administrative Responsibilities of Service Providers

According to the INC *Thousands-Block Pooling Administration Guidelines*, service providers have many responsibilities in a Thousand-Block Number Pooling environment. These responsibilities vary depending on whether the service provider is acting as a Code Holder, a LERG Assignee, a Block Applicant, or a Block Holder. This section outlines these responsibilities.

3.3.2.1 Code Holder Responsibilities

A Central Office (CO) Code Holder is an assignee of a full NXX code. CO Code Holders can either be Thousand-Block Number Pooling participants or not. CO Code Holders who are participants:

- Identify eligible thousand blocks for donation to the industry inventory pool upon initial establishment of the industry inventory pool;
- Update the LERG with the data on the thousand blocks within pooled NXX codes that are retained in its service provider inventory at the time of initial establishment of the industry inventory pool; and
- Become a LERG Assignee at the block donation date.

3.3.2.2 LERG Assignee Responsibilities

A LERG Assignee is the service provider listed as the entity associated at the NXX code level with a pooled NXX Code in the LERG, and is responsible for default routing functions associated with the pooled NXX Code. The LERG Assignee:

- Submits the appropriate CO Code request forms to the Pooling Administrator (PA) filled out as if the LERG assignee were requesting the CO code from the CO Code Administrator;
- Submits the Part 1B (NPAC Block Holder Data) form to the PA as appropriate;
- Verifies and tests that the NXX Code is open before the NXX Code Effective Date;
- Provides blank and vacant code announcements for unallocated thousand blocks;

- Maintains sufficient and auditable data to demonstrate compliance with the pooling guidelines;
- Notifies the PA if the LERG Assignee is no longer able to perform default LERG Assignee functions (e.g., the service provider is no longer providing service in the area that NXX Code serves).
- Confirms, before donating the thousand block to the industry inventory pool, that:
  - — All unavailable TNs within contaminated thousand blocks have been intra-service provider ported;
  - — The associated NPA/NXX is currently available for call routing, is opened for Number Portability in the LERG and the NPAC, and the NPA-NXX query triggers are applied in all switches and reflected in the appropriate network databases (e.g., STP routing tables);
  - — The NXX-assigned switch is currently Number Portability-capable and will process terminating traffic appropriately; and
  - — End Office Interconnection (EOI) trunking has been established between the NXX-assigned switch and other interconnecting networks.
- Relies on the PA to fill out and submit a Central Office Code (NXX) Assignment request and Confirmation Form (Part 4) in those circumstances in which the LERG Assignee is not the recipient of a full NXX code.
- Is responsible for providing the CO Code Part 4 (Assignment Request and Confirmation of Code In Service) to the PA to certify that the NXX obtained to meet a service provider's single customer request for a full NXX Code has been placed in service when the LERG Assignee is the recipient of a full NXX Code. (Note: in this instance, the PA will forward the CO Code Part 4 form to the CO Code Administrator).

3.3.2.3 Block Applicant Responsibilities

Block Applicants who request resources from the industry inventory pool:

- Must be licensed or certified to operate in the rate area, if required, and must demonstrate that all applicable regulatory approvals required to provide the service for which the thousand block is required have been obtained, and
- Complete the Thousand Block Application Forms per the pooling guidelines.

3.3.2.4 Block Holder Responsibilities

A Block Holder (or selected designee):

- Arranges for the entry of any information to the LIDB or other carrier-specific databases due to receipt of a new thousand block;
- Removes records from the LIDB, or other carrier-specific databases, for thousand blocks returned/donated to the industry inventory pool upon relinquishment of the thousand block (service providers that do not currently subscribe to LIDB need not add interfaces to or arrange for access to such databases);
- Abides by appropriate thousand block allocation and reclamation procedures;
- Provides forecasted thousand block requirements to the PA for projecting rate area exhaust and for input to the NPA code relief planning process;
- Maintains sufficient and auditable data to demonstrate compliance with the pooling guidelines;
- Verifies in the NPAC that TNs are assigned in any contaminated thousand block received from the PA to avoid duplicate TN assignments; and
- Completes and return the Part 4 (Confirmation of NXX-X Block In Service) form to the PA.

3.4 Thousands-Block Number Pooling Service Characteristics

This section describes some of the service characteristics associated with Thousands-Block Number Pooling.

3.4.1 Service Switching Point (SSP)

A Number Pooling-capable SSP can play the role of a Code Holder Switch, a Block Holder Switch, or both in a Number Pooling environment. The Code Holder is the SSP to which a full NXX code is allocated. The Block Holder is the SSP to which a thousands-block (NXX-X) has been assigned. When the Code Holder donates NXX-X codes to other Block Holders, then the Code Holder becomes responsible for default routing functions associated with the NXX code.

When an SSP receives a dialed DN from a line or a number in signaling from an incoming trunk, the SSP examines the number to determine whether it serves this number (i.e., does the number reside on the switch?). If the switch does not serve the number, and the switch determines that the NPA-NXX of the number is portable, then this would cause the NP trigger to be encountered on the SSP. This trigger is

in fact the Number *Portability* trigger and the processing that occurs as a result of encountering this trigger is identical to the processing that occurs in a Number Portability environment (see Section 2.1.5). Once the query is sent to the NPDB database and the LRN is received in the response, the call is then routed as it would in a Number Portability environment. The fact that the number is pooled or ported is transparent to the routing process. Moreover, there are cases that involve a pooled number that is also ported. This also is transparent to the SSP. The SSP will simply launch a query as a result of the NPA-NXX and when the response returns with the LRN the SSP will process and route the call based on the LRN, as Section 2.1.1.1 describes.

3.4.2 Common Channel Signaling (CCS) Network

The characteristics of the CCS network and the SS7 protocol for Number Pooling are identical for those of Number Portability. A pooled number is treated the same way in the network as a ported number (see Section 2.1.5.2).

3.4.3 Number Portability Database (NPDB)

For each number that is either a ported number, pooled number, or both, the NPDB will contain an entry for the LRN that corresponds to that number.

The NPDB receives an NP query (Info_Analyzed message) and responds with an Analyze_Route. If the number has been ported, pooled, or both, the Analyze_Route will contain the LRN of the switch that is actually serving that line. Depending on the implementation of the NPDB there will be an indication of whether the number is ported or pooled. (If a number is both ported and pooled, then ported may take precedence over the pooled.) Regardless of the implementation, however, the NPDB will return the corresponding LRN for each DN entry that it has. Queries for DNs that are neither ported nor pooled will cause the NPDB to return the actual DN that was dialed.

3.4.4 Default Routing to the Code Holder

In a Number Portability environment, when the Number Portability database is not accessible during the course of call processing (e.g., due to overload or other error conditions), default routing occurs. Calls to numbers in portable NPA-NXXs are directed toward the Donor network, based on the principle of maintaining standard six-digit routing.

When Number Pooling is also present, multiple switches are candidates to receive calls to a particular number based solely on six-digit routing, because an NPA-NXX

can be open on more than switch (i.e., some blocks are within that NPA-NXX belong to one switch, and some blocks belong to another). The standard solution is for calls to be default routed to the Code Holder Switch for the given NPA-NXX. This is analogous to the procedure of routing toward the Donor Switch, and so some measure of backward compatibility is maintained.

3.4.5 Snapback to the Block Holder

It is possible for a number assigned from a pooled block to subsequently be ported to another switch. The customer that ports his/her number may at some future point decide to discontinue service, and so the number will be disconnected.

Snapback is the term for the event whereby the responsibility for the ported DN is returned to the Block Holder after disconnect and aging. In particular, a conscious decision was made during the design of the administrative processes for Number Pooling that if a pooled number is ported away from the Block Holder and subsequently disconnects, it snaps back to the Block Holder *rather than the Code Holder*, after aging. The service provider serving the block is considered to be the assignee of the numbers in its blocks even when those numbers are not currently assigned to customers. The Block Holder is responsible, for example, to report utilization on the blocks in its inventory.

Once again, a parallel exists to procedures for Number Portability, in which the responsibility for a ported DN not in a pooled block is returned to the Code Holder (i.e., Donor Switch) after disconnect and aging.

3.4.6 Routing to Unallocated Numbers / Cause Code 26

Technical Requirements Number 3, *Number Portability Switching Systems*, provides requirements to address the scenario in which the NPDB view is not synchronized with the switch view of DNs resident on the switch, a scenario that may cause a call to be LRN-routed to a switch on which the called DN is unallocated. These requirements specify that such calls be released using a distinct release cause value, and that an appropriate notification be generated. Specifically, an ISDN User Part (ISUP) Release Message containing Cause Code 26, “misrouted call to a ported number,” is returned when an LRN-routed call attempts to terminate to an unallocated number. While this treatment was generally appropriate in a normal Number Portability environment, this treatment is inappropriate in a Number Pooling environment for calls that are LRN-routed to numbers in a pooled block that have not yet been assigned to a customer. Such calls are not misrouted; the NPDB correctly contains the LRN for the Block Holder Switch. Therefore, the requirements for sending Cause Code 26 in a Number Pooling environment must ensure that the cause value is sent only when the call is misrouted, and that another

type of treatment is provided for calls to unallocated numbers within a pooled block (i.e., numbers marked NP-Reserved).

The following scenario should help the reader to envision the sequence of markings that could be applied to a DN through various stages in its lifecycle.

1. A pooled block is assigned to a switch; each number in that block should be marked NP-Reserved. These numbers, if called, will generate unallocated number treatment.
2. A number from within this block is assigned. The NP-Reserved marking no longer governs the treatment of that number, because calls to that number will complete. The NP-Reserved marking can remain or be removed; which occurs most likely will depend on whether the original designation of the block as NP-Reserved was accomplished via a single range-level marking on the entire block, or accomplished via individual markings on a DN-by-DN basis.
3. The number ports away from the Block Holder Switch. At the Block Holder Switch, the Ported-Out marking should be placed on that number. Calls to that ported number should route to the Recipient Switch; however, if such a call is erroneously routed to the Block Holder Switch, the Block Holder Switch should provide Cause Code 26 treatment.
4. The number is disconnected and snaps back to the Block Holder Switch. The Ported-Out marking should be removed; the NP-Reserved marking should be reinstated (if it had been removed) until the number is again assigned to a customer.

To summarize, in a Number Pooling environment, ISUP RELease Cause Code 26 procedures are engaged when:

- The ISUP Forward Call Indicator (FCI) M-bit indicates that an NP query has been performed, and
- The terminating switch is identified by its Home LRN in the Called Party Number (CdPN) (the Initial Address Message [IAM] contains a Ported Number GAP), and
- The call cannot be completed by the terminating switch because the DN is not assigned on the switch, and
- Either:
  - — The DN is marked Ported-Out on that switch, or
  - — The DN is not marked Ported-Out and is not within an NP-Reserved range on that switch.

3.4.7 Efficient Data Representation (EDR)

Efficient Data Representation (EDR) refers to the ability of the NPAC SMS to communicate block information to service providers' local SMSs by transmitting single records for an entire thousands-block, rather than transmitting one thousand

individual records for each TN in the thousands-block. It also similarly refers to the ability of an NPDB to store a single LRN entry for an entire thousands-block.

The significance of support for EDR in a Number Pooling environment is recognized throughout the industry, because the transmission bandwidth and database capacity required to handle Number Pooling information on an individual TN basis is tremendous. Full support for EDR is expected with NPAC Release 3.0.

3.5 Number Pooling Call Processing - Call Flows

The following are various call flows that illustrate Number Pooling call processing.

3.5.1 Direct Call Completion - Originating Switch to Block Holder Switch

In Figure 3-6, Subscriber A 708-614-1111 dials Subscriber B 708-615-2222, whose number is within a pooled NPA NXX (i.e., 708-615 is pooled). The switch serving Subscriber B is the Block Holder for the thousands-block 708-615-2. The call flow is as follows:

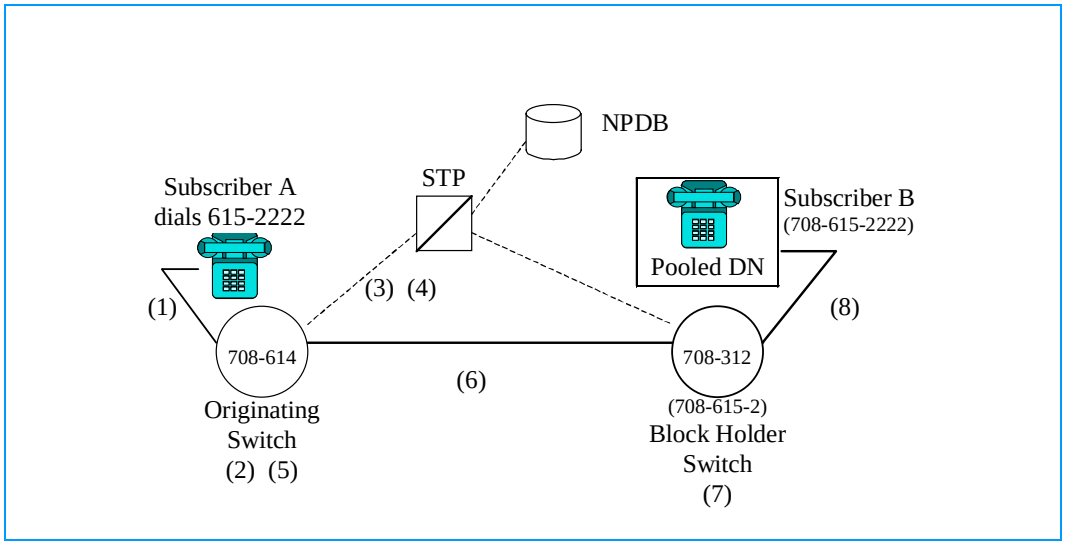

Figure 3-6. Direct Call Completion - Originating Switch to Block Holder Switch

1. Subscriber A dials Subscriber B (708-615-2222).
2. The originating switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that Subscriber B is in a portable NPA-NXX (708-615) and the DN does not reside on the switch.
3. The switch sends an Info_Analyzed query based on the dialed digits to the NPDB.
4. The NPDB sends an Analyze_Route response containing the LRN (708-312-xxxx) of the switch to which the call is to be routed.
5. The originating switch receives the NPDB response and selects a route out of the switch. The LRN is stored in the CdPN parameter and the dialed digits are stored in the GAP parameter of the ISUP IAM message. The FCI Ported Number Translation Indicator is set to indicate a query has been done (set to "translated number").
6. The call is routed to the switch associated with the LRN, which happens to be the Block Holder for 708-615-2.
7. The Recipient Switch receives and processes the contents of the IAM message. The switch determines that an LRN is received and that it is the switch's LRN. Since the LRN identifies this switch, the switch uses the contents of the GAP rather than the Called Party Number parameter to identify the subscriber.
8. The switch recognizes that it serves Subscriber B and completes the call.

3.5.2 Call Completion Via Code Holder Switch

In cases where the originating switch is not Number Portability capable and therefore does not recognize the dialed digits as a number in a pooled block, then the originating switch routes the call to the Code Holder based on the dialed digits. The Code Holder recognizes the number as being in a pooled block and performs the query. The call is then routed to the appropriate switch. Figure 3-7 shows this call flow:

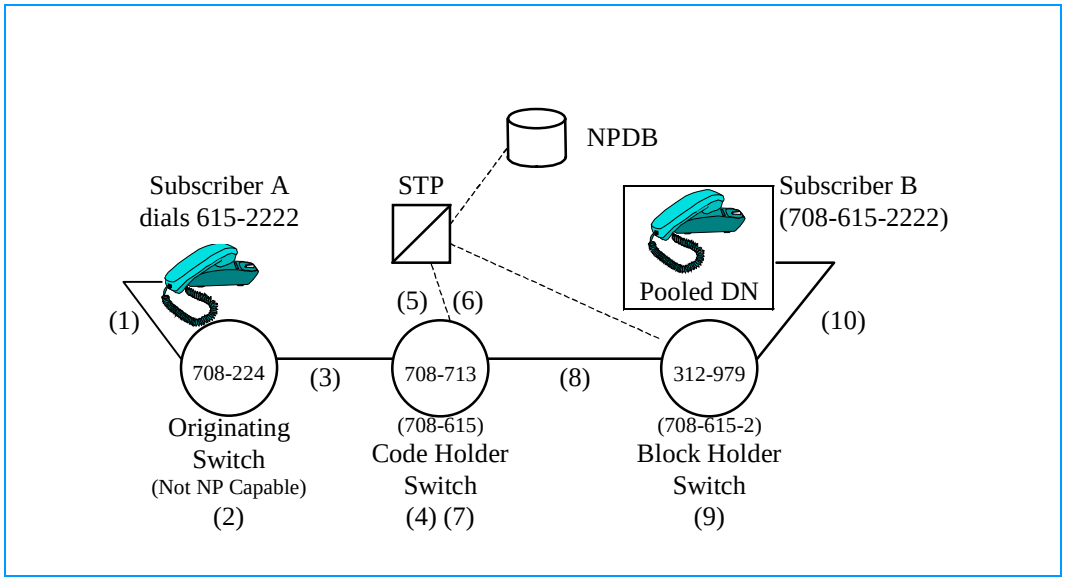

Figure 3-7. Call Completion Via Code Holder Switch

1. Subscriber A dials Subscriber B (708-615-2222).
2. The originating switch performs digit analysis on the dialed digits to determine how to route the call.
3. The call is routed to the Code Holder Switch based on the dialed number (originating switch is not involved in Number Portability).
4. The Code Holder Switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that Subscriber B is in a pooled NPA-NXX (708-615) and verifies that conditions have been met for a query to be sent.
5. The Code Holder Switch sends a query based on the dialed digits to the NPDB.
6. The NPDB sends a response back to the Donor Switch containing the LRN (312-979-xxxx) of the Recipient Switch.
7. The Code Holder Switch receives the NPDB response and selects a route out of the switch. The LRN is stored in the CdPN parameter and the dialed digits are stored in the GAP parameter of the ISUP IAM message. The FCI Ported Number Translation Indicator is set to indicate a query has been done (set to "translated number").
8. The call is routed to the switch associated with LRN 312 979-xxxx. This switch is also the Block Holder Switch for 708-615-2.
9. The switch receives and processes the contents of the IAM message. The switch determines that the LRN is its LRN. Since the LRN identifies this switch, the switch uses the contents of the GAP rather than the Called Party Number parameter to identify the subscriber.
10. The Block Holder Switch recognizes that it serves subscriber B and completes the call.

3.5.3 Calls Completed through an Interexchange Carrier (IXC)

The call flow for completing an interLATA call to a pooled number through an IXC is similar to the call flow for an interLATA call to a ported number through an IXC, as Figure 3-8 shows. The key difference is that in the ported case calls are completed to the Recipient Switch whereas in the Pooled case calls are completed to the Block Holder Switch.

1. Subscriber A (305-224-1111) dials Subscriber B (1-708-713-2222).

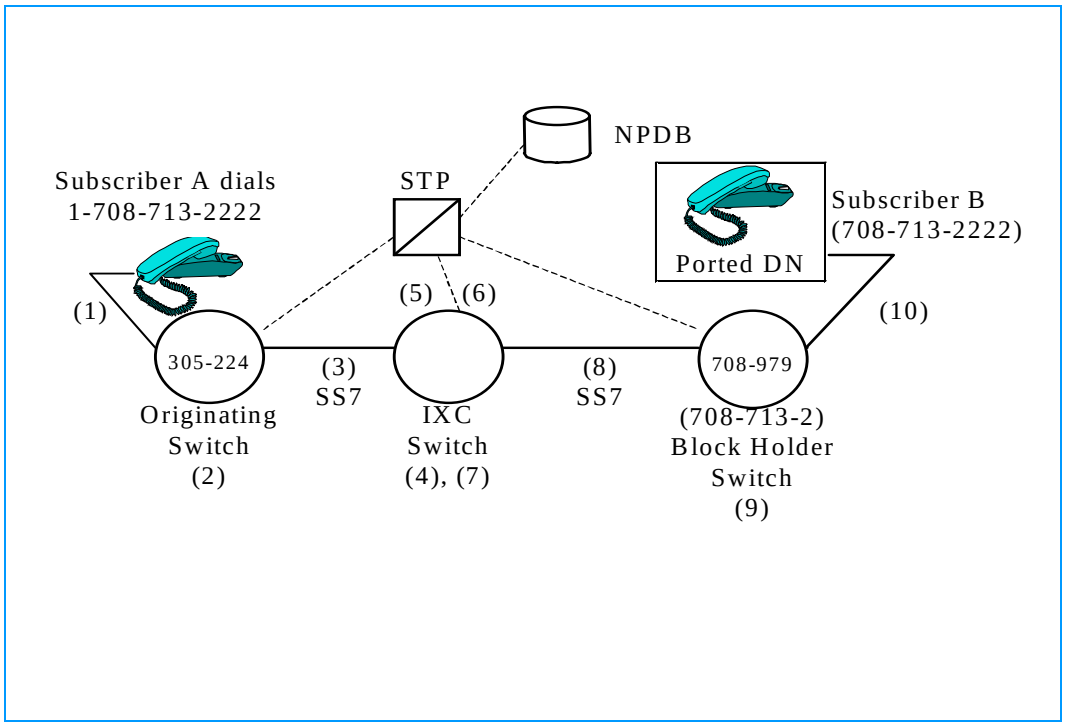

Figure 3-8. Call Completion Through an IXC

2. The originating switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that routing to the called DN (Subscriber B) requires routing to an IXC and does not perform the NP query.
3. The originating switch signals the dialed number to the IXC switch.
4. The IXC switch performs digit analysis on the incoming digits to determine how to route the call. The switch determines that the called DN (Subscriber B) is in a portable NPA-NXX (708-713) and verifies that conditions have been met for a query to be sent.
5. The switch sends a query based on the dialed digits to the NPDB.
6. The NPDB sends a response containing the LRN (708-979-xxxx) of the Recipient Switch.
7. The IXC switch receives the NPDB response and selects a route out of the switch.

8. The IXC switch signals, using SS7 signaling, the LRN in the IAM CdPN to the Block Holder Switch. The IAM will include a “Ported Number” GAP containing the dialed digits and the FCI Ported Number Translation indicator will be set.
9. The Block Holder Switch performs digit analysis on the incoming digits to determine how to route the call and determines that the DN is on the switch.
10. The Block Holder Switch completes the call to the terminating subscriber.

3.5.4 Ported Number in a Pooled Block

There can be cases in which a thousands-block has been assigned to a switch (which then becomes a Block Holder) and a number from the assigned block is ported-out to another switch. The Block Holder Switch then also becomes a Donor Switch. Figure 3-9 illustrates a call flow for such situation. Note that the Block Holder/Donor Switch is not included in the call path, but has been included in the figure to help illustrate the way the NPDB is administered to route calls.

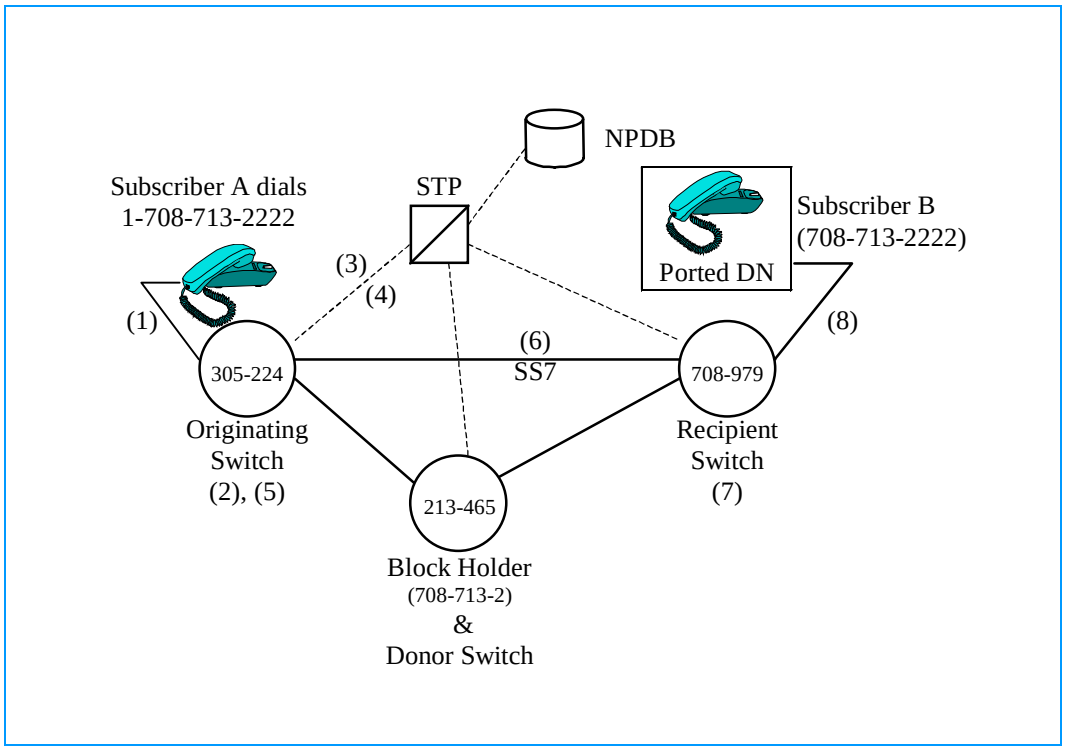

Figure 3-9. Ported Number in a Pooled Block

1. Subscriber A dials Subscriber B (708-713-2222).
2. The originating switch performs digit analysis on the dialed digits to determine how to route the call. The switch determines that Subscriber B is in a portable NPA-NXX (708-713) and the DN does not reside on the switch.
3. The switch sends an Info_Analyzed query based on the dialed digits to the NPDB.
4. The NPDB sends an Analyze_Route response containing the LRN (708-979-xxxx) of the switch to which the call is to be routed.

   (Although the switch whose LRN is 213-465-xxxx (the Block Holder) holds the 708-713-2 block, the NPDB has been correctly updated with the LRN for the 708-979 switch (the Recipient Switch for the ported number). In terms of providing routing information, the NPDB returns the LRN associated with porting the number to the Recipient Switch.)
5. These steps are similar to the call flow description for Section 3.5.1. The originating switch receives the response from the NPDB and routes the call to the Block Holder Switch, which completes the call to 708-713-2222.

3.6 Current Regulatory Environment and Trial Deployments

State and federal regulators now view Thousands-Block Number Pooling as an essential number conservation tool. This is mainly because local competition has been accelerating NPA-NXX exhaust, which results in NPA splits and the resultant consumer concern and confusion. When consumers are concerned and confused, regulators listen.

Why has competition accelerated NPA-NXX exhaust? The simple answer is that CLECs have needed to request separate Central Office codes (NPA-NXXs) per local service provider per incumbent rate center, regardless of actual customer demand. This is to ensure that all service providers (but especially incumbents) could continue to bill properly in the presence of local competition. As a result, new NPA-NXXs are frequently assigned to service providers while other NPA-NXXs already assigned to them contain many unused numbers.

Thousands-Block Number Pooling allows CLECs to request NPA-NXX-Xs, rather than NPA-NXXs, to acquire a service presence. This is a key difference because many fewer numbers must lie dormant in blocks of numbers distributed simply to allow competition. This is the single greatest factor that proponents of Number Pooling cite when arguing that Number Pooling will greatly slow number exhaust. The extent to which Number Pooling will actually slow the rate of NPA splits remains to be seen.

3.6.1 State Regulatory Activity

During 1999, the FCC gave some state regulators authority to mandate Thousands-Block Number Pooling. The following lists states for which at least one NPA is slated to begin participating in Number Pooling this year. (Illinois had previously been granted authority in NPA 847.)

- California First NPA: 310 Date: March 2000
- New York First NPA: 716 Date: April 2000
- New Hampshire First NPA: 603 Date: May 2000
- Maine First NPA: 207 Date: June 2000
- Texas First NPA: 512 Date: July 2000

Policies differ from state to state on whether participation is voluntary or mandatory; and whether only uncontaminated blocks must be donated to the pool, or all blocks that are less than 10% contaminated must be donated. A contaminated block has assigned telephone numbers, but has few enough assigned telephone numbers that it is still a pooling candidate. Importantly, the states usually follow state-specific variations of the Thousands-Block Pooling Administration Guidelines, but they are required to transition to the national guidelines by September 2000.

The following additional states have received authority to implement trials: Florida, Massachusetts, Connecticut, Wisconsin, and Ohio. All are still deciding on an appropriate timeframe in which to ask service providers to begin donating blocks. Additionally, the following states have all petitioned the FCC to implement trials: Nebraska, Indiana, Utah, Missouri, Iowa, Tennessee, Georgia, North Carolina, Virginia, Colorado, Pennsylvania, Washington, Arizona, Kentucky, and Oregon.

3.6.2 Federal Regulatory Activity

In March 2000, the FCC issued a Report and Order (and Notice of Further Proposed Rulemaking) on Numbering Resource Optimization.[8] In the FCC Order, Thousands-Block Number Pooling is mandated nationally, on a schedule to be determined. The salient points of the Order include the following:

8. FCC 00-104, *Report and Order and Notice of Further Proposed Rule Making, In the Matter of Telephone Number Conservation* (CC Docket No. 99-200), March 2000.

1. Mandatory nationwide Thousands-Block Number Pooling as a number resource optimization strategy (for wireless providers, not until they are required to provide Number Portability - the FCC has sought comment on the length of the interval that should be provided to a wireless service provider between the implementation of Number Portability and the implementation of Number Pooling)
2. Establishment of mandatory utilization data reporting the requirement to tie a carrier's ability to obtain numbering resources more closely to its actual need for numbers to serve its customers.
   - Year-by-year, 5-year forecast of expected numbering requirements, in terms of initial (footprint) and growth (demand) codes
   - Number utilization in terms of five defined categories of numbers
   - Basic frequency of reporting shall be semi-annually (previously had been done annually) on August 1 and February 1
3. Mandate that carriers fill their need for numbers out of open thousands blocks before beginning to use numbers from new blocks to facilitate reclamation, and sequential number assignment if states require it (on an interim basis).
4. Demonstration of need for numbers required to receive new allocations of numbers
   - Rate center-based utilization required to be reported because it more accurately reflects how numbering resources are assigned
   - Further comment sought on how utilization thresholds should be set for carriers not participating in Thousands-Block Number Pooling to determine that need has been demonstrated
5. Competitive bidding process to designate a Pooling Administrator.
6. Pooling schedule: Three NPAs per quarter-year from each of the seven NPAC regions. NPAs from within the largest 100 MSAs.
7. Timeframe: Nine months after the date on which the Pooling Administrator is selected. In the interim, states will continue to be granted authority to implement Thousands-Block Number Pooling on an individual basis.
8. T1S1.6 Technical Requirements adopted as the technical standard for a national Thousands-Block Number Pooling mechanism.
9. Efficient Data Representation (EDR) is "significant"; however, NPAC 3.0 is not endorsed as the standard Number Pooling software (other entities may develop software with EDR).

10. Block donation: All carriers are required to donate all thousands-blocks that have a less than 10-percent contamination level to the thousands-block number pool for the rate center from which the numbering resources are assigned.
11. Code reclamation within 60 days of expiration of the applicable activation deadline.[9]
12. Cost recovery policies designed to be competitively neutral and using same cost categories as Number Portability cost recovery.
13. Unassigned Number Portability (UNP) and Individual TN Pooling (ITN) are not yet sufficiently developed for adoption as nationwide numbering resource optimization measures and thus not mandated at this time. (As noted, the NANC and INC will report back to the FCC with a recommendation on these technologies by the end of 2000.)

9. INC has sought clarification on a definition for this date and its relation to the block/code effective date.

3.7 Number Exhaust in Other Countries

Number exhaust is not just a factor in the U.S. For the last several years, the ITU has been considering plans to combat the potential exhaust of country codes, and various recommendations have been produced discussing possible transition plans if the maximum length of country codes were to be increased.

Additionally, each country must make an individual assessment of the potential for number exhaust, and plan accordingly. For example, the U.K. has changed its national numbering plan twice in the last 5 years. Recently, the length of telephone numbers was increased from 9 to 10 digits to accommodate numbering capacity needs. This is a more radical change than the U.S. has yet proposed, because it involves a change to the numbering plan itself, rather than to number assignment procedures (as Number Pooling requires). However, INC is studying alternatives for NANP expansion in anticipation of eventual NANP exhaust.

The European Public Telecommunications Network Operators' Association (ETNO) made the following remarks regarding the applicability of Number Pooling outside the United States in a January 2000 analysis of recommendations favoring individual Number Pooling by the European Telecommunications Office (ETO):

> "On the matter of the experience in countries outside Europe, in particular Australia and the US., ETNO notes these with interest. However the drivers in these countries are different from those in European countries. In the US, the principle pre-occupation is the preservation of the existing North American Numbering Plan; hence the interest in Number Pooling. In Europe many countries have changed their numbering plans and Number Pooling is only of interest in exceptional circumstances."

These remarks underscore the decision made in the U.K. to go forward with a national numbering plan modification.

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All Telcordia documents are subject to change, and their citation in this document reflects the most current information available at the time of this printing. Readers are advised to check current status and availability of all documents.

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Glossary

This section contains a list of acronyms used in this document followed by detailed definitions for selected Number Portability and Number Pooling technical terminology.

Acronyms

ABS - Alternate Billing Services

ACG - Automatic Code Gapping

AIN - Advanced Intelligent Network

AMA - Automatic Message Accounting

ANI - Automatic Number Identification

ANSI - American National Standards Institute

ATIS - Alliance for Telecommunications Industry Solutions

BLV - Busy Line Verification

CCS - Common Channel Signaling

CdPN - Called Party Number

CgPN - Calling Party Number

CDMA - Code Division Multiple Access

CMRS - Commercial Mobile Radio Services

CNA - Connecting Network Access

CPC - Carrier Portability Code

CPE - Customer Premises Equipment

CTIA - Cellular Telecommunications Industry Association

DID - Direct Inward Dialing

DN - Directory Number

DPC - Destination Point Code

EDR - Efficient Data Representation

ESN - Electronic Serial Number

ETNO - European Public Telecommunications Network Operators' Association

ETO - European Telecommunications Office

FCI - Forward Call Indicator

FOC - Firm Order Confirmation

FRS - Functional Requirements Specification

GAP - Generic Address Parameter

GSM - Global System for Mobile Telecommunications

GTAI - Global Title Address Information

GTT - Global Title Translation

GUBB - Geographic Unit Building Block

HLR - Home Location Register

IAM - Initial Address Message

IIS - Interoperable Interface Specification

IMSI - International Mobile Station Identifier

INC - Industry Numbering Committee

ISDN - Integrated Services Digital Network

ISUP - ISDN User Part

ITN - Individual Telephone Number (Pooling)

IXC - Interexchange Carrier

JIP - Jurisdiction Information Parameter

LARG - LIDB Access Routing Guide

LATA - Local Access Transport Area

LEC - Local Exchange Carrier

LERG - Local Exchange Routing Guide

LIDB - Line Information Database

LNP - Local Number Portability

LOCREQ - LocationRequest INVOKE

***locreq* -** LocationRequest RETURN RESULT

LRN - Location Routing Number

LSMS - Local Service Management System

LSR - Local Service Request

MDN - Mobile Directory Number

MIN - Mobile Identification Number

MS - Mobile Station

MSID - Mobile Station Identifier

MTP - Message Transfer Part

NANC - North American Numbering Council

NANP - North American Numbering Plan

NCAS - Non-Call-Associated Signaling

NP - Number Portability

NPA - Numbering Plan Area

NPAC - Number Portability Administration Center

NPDB - Number Portability Database

NPREQ - NumberPortabilityRequest INVOKE

***npreq* -** NumberPortabilityRequest RETURN RESULT

NXX - Central Office Code

PIC - Presubscribed Information Carrier

POI - Point Of Interconnection

RCF - Remote Call Forwarding

RTP - Release To Pivot

SCCP - Services Connection Control Part

SCP - Service Control Part

SMS - Service Management System

SOA - Service Order Administration

SOE - Service Order Entry

SP - Service Provider

SPID - Service Provider Identification

SS7 - Signaling System Number 7

SSN - Subsystem Number

SSP - Service Switching Point

STP - Signal Transfer Point

SV - Subscription Version

TCAP - Transaction Capabilities Application Part

TCIF - Telecommunications Industry Forum

TCPN - Translation Called Party Number

TLDN - Temporary Local Directory Number

TN - Telephone Number

UNP - Unallocated Number Portability

VLR - Visitor Location Register

V&H - Vertical and Horizontal Coordinates

Definitions of Terms

Advanced Intelligent Network (AIN) A network in which: (1) service logic providing advanced services beyond traditional switch-based features is stored in Service Control Point (SCP) nodes; (2) Service Switching Points (SSPs) encounter triggers during call processing, which indicate that call processing should be suspended; and (3) SS7 TCAP queries are launched by SSPs (based on encountering triggers) to access this service logic.

Alternate Billing Services (ABS) Services offered using an intelligent network that allow subscribers to charge a call to a number or telephone other than the one they are using (e.g., calling card, bill-to-third-party).

Automatic Code Gapping Network management controls a Service Control Point (SCP0 or Number Portability Database (NPDB) application imposes on the switch to throttle query traffic on a three, six, or ten-digit basis.

Automatic Roaming Functions The functions that are performed within a wireless network that allow subscribers to roam or travel outside of their home service area and still receive wireless service.

Automatic Number Identification (ANI) Information available during call setup that identifies the caller. Depending on the method of call setup (e.g., Multifrequency [MF} versus Signaling System Number [SS7]), the information may be found in different forms. SS7 typically carries ANI information in the Charge Number parameter. ANI is sometimes, but not always, equivalent to the Calling Number. May be used as a source of Caller ID.

Block Holder Switch The switch the service provider designates to which a thousand block (NXX-X) has been assigned for use and allocation to end users.

Busy Line Verification (BLV) A service provided at an operator services switch, involving operator intervention to determine whether a line is busy. One application of this service would be to ascertain whether a line may be out of service.

Carrier Portability Code (CPC) Under CPC, each local service provider within a given area would be assigned a three-digit Carrier Portability Code (CPC). The database serving that area would contain all the telephone numbers that have been transferred from one carrier to another and their corresponding CPCs. A carrier querying the database for purposes of routing a call to a customer that has transferred his or her telephone number would know from the NXX code of the dialed number that the telephone number may have been transferred to another

local service provider. The carrier would query a database serving that area, which would return to the carrier a three-digit CPC corresponding to the service provider serving the dialed number. The carrier then would route the call according to the CPC and the dialed NXX code. The recipient service provider would then be responsible, upon receiving the call, to do a further translation to identify the switch serving the ported number.

Cause Code An SS7 parameter, typically found in a RELease message, that indicates the reason for the release of the call connection.

Code Holder Switch The switch the service provider designates to which the NXX is assigned in the Local Exchange Routing Guide (LERG).

Common Channel Signaling (CCS) The method for providing call setup information in out-of-band communication pathways, rather than using the voice channel itself to carry signaling information (compare with Multifrequency [MF] signaling). A "common channel" may carry call setup information for many calls simultaneously. Today's CCS system is Signaling System Number 7 (SS7).

Connecting Network Access (CNA) A trunk type defined for Number Portability (but also used for local interconnection) that provides AMA recordings for calls received from an interconnecting local network, for which no other AMA recording (e.g., Feature Group B, Feature Group D, Wireless Service Provider) would typically apply.

Connecting Network Access Record A new type of terminating access record to support recording of Number Portability information. This record may be generated for calls incoming to the intermediate (or Donor) switch when no other terminating access record is generated (e.g., for calls incoming over traditional, non-equal access inter-office trunks).

Contaminated Block of Numbers (Number Pooling) A thousands block in which at least one number is working before donation of that block to the pool.

Default Routing The ability of the switch to continue the call based on the dialed number when the NPDB application cannot be accessed because of abnormal circumstances or when the NPDB response contains a protocol error.

Direct Inward Dialing (DID) Direct Inward Dialing (DID) Service allows callers to reach individual stations without the call going through a Private Branch Exchange (PBX) attendant. The call is routed to trunks that will route the call directly to the station. DID customers usually buy DID lines in blocks of telephone numbers.

Directory Number (DN) A telephone number. In the U.S., a number that conforms to the North American Numbering Plan (i.e., a number that is of the form NPA-NXX-XXXX).

Donor Service Provider The service provider to which a Donor Switch belongs. Equivalently, the service provider from which a DN is ported.

Donor Switch The switch from which a DN was originally ported. More specifically, the switch that is considered the default destination for the NPA-NXX of the DN. In a Number Pooling environment, the Donor Switch is the Code Holder Switch.

Efficient Data Representation (EDR) The ability of a system or interface to represent a number block (typically a block of one thousand numbers) with a single record, entry, or transaction. A target capability for systems or interfaces involved in Number Pooling data processing.

End-User A user of telecommunication services. Examples are business, residential, coin, hotel/motel, etc.

Geographic Unit Building Block (GUBB) An element of a proposed technical solution for supporting Location Portability. Within the proposed solution, identification of the specific geographic location of an end user is accomplished by associating a GUBB with each DN.

Global TItle Translation (GTT) A method for routing SS7 messages to the proper destination system by deducing the correct Destination Point Code and Subsystem Number.

Individual Telephone Number Pooling (ITN) A type of number pooling in which the concept of a thousand block does not exist. Individual telephone numbers are distributed to service providers from the common number pool.

Initial Address Message (IAM) The first Integrated Services Digital Network User Part (ISUP) message an originating switch sends in the setup of a call involving another switch. It includes the Location Routing Number (LRN), Generic Address Parameter (GAP), and Forward Call Indicator (FCI) information for communication to downstream switches.

Integrated Services Digital Network (ISDN) A set of ITU-T standards for digital transmission over ordinary telephone copper wire as well as over other media.

Integrated Services Digital Network User Part (ISUP) The part of SS7 that encompasses the signaling functions required to provide voice and non-voice

services in ISDN and pre-ISDN architectures. The basic service the ISUP offers is the control of circuit-switched connections between subscriber line exchange terminations.

International Mobile Station Identifier (IMSI) A 15-digit, non-dialable identifier, specific to a service provider, and unique for each mobile station. Currently, the IMSI is used in GSM networks. It equates to the MIN in non-GSM networks.

Intermediate Switch A tandem switch.

Jurisdiction Information Parameter (JIP) A Integrated Services Digital Network User Part (ISUP) parameter containing an NPA-NXX representative of the switch from which a call (or call leg) has originated. Wireline service providers populate the JIP with a value taken from a Location Routing Number (LRN) (i.e., its first six digits) associated with that switch. Some service providers use a single value of the JIP for calls originating at a particular switch; other service providers use a JIP corresponding to an LRN used in the LATA of origination; still others use multiple JIP values to provide additional information about the rate area from which the call has originated. Usage is not consistent among wireline service providers. Wireless service providers also use JIP in identifying the mobile switch of origination for a call, but this is independent of any Number Portability considerations.

Local Access Transport Area (LATA) A defined geographic area where equal access switches or access tandem switches can provide carrier access to the local switch.

Line Information Database (LIDB) A database of information about individual DNs, used to provide services such as calling card authorization and originating line number screening, as well as determination of an end user's local service provider for routing to proper service agents.

Location Portability Allows the end-user to retain the same DN when changing physical locations.

Location Routing Number (LRN) A 10-digit number, in the format NPA-NXX-XXXX. The first 6 digits of the LRN identify the switch.

Local Exchange Carrier (LEC) Routing for a call that does not involve an Interexchange Carrier (IXC). For this case, an IXC is neither dialed nor presubscribed.

Message Transfer Part (MTP) The lowest level in the SS7 protocol hierarchy that serves as a reliable transport system between two signaling points. The MTP

includes functions equivalent to the physical, link, and network layers of the OSI Reference Model.

Mobile Directory Number (MDN) The 10-digit North American Numbering Plan (NANP) number that is dialed to reach a specific mobile handset.

Mobile Identification Number (MIN) The 10-digit number the cellular network uses for the purpose of communication between the cellular switch and the cellular phone. This is the number that, along with the Electronic Serial Number (ESN), is programmed into the cellular phone. In the pre-LNP environment, the MIN and MDN are the same number. In the post-LNP environment, the MIN and MDN will be different for ported MDNs. The MIN and IMSI are referred to collectively as MSID (Mobile Subscriber Identity).

Mobile Station Identifier (MSID) Either a MIN or IMSI will be used. This could be a 10-digit MIN in the NPA-NXX-XXXX format or an E.212 IMSI.

N-1 network The network responsible for performing the Number Portability query for a given call. “N-1” indicates a network that would typically be the next-to-last network to touch a given call (e.g., the Interexchange Carrier [IXC} in a long-distance call scenario, or the originating network in a two-network call scenario). Designation of a network as “N-1” for a given call is not affected by the number of networks that actually are involved in the call (e.g., if a call must be re-routed from the donor network to the recipient network, one extra network is added to the call path, yet the network prior to the donor network is still considered to be the “N-1” network).

NP query A request for call routing information sent from the switch to the NPDB when a call encounters an NP trigger.

NP-capable SSP An SSP that has the requisite software to perform Number Portability functions.

NP-Reserved Marking A switch marking on a DN or range of DNs indicating that the DN or DNs belong within a pooled block.

NP trigger The Number Portability trigger. The NP trigger is an event that occurs in an NP-capable switch allowing the switch to query the Number Portability Database for further call processing instructions.

Non-Call-Associated Signaling (NCAS) Signaling messages associated with network functions other than call setup (e.g., CLASS messages).

Non-Ported Number A DN that may or may not be in a portable NPA-NXX, but resides on the switch to which it is assigned in the Local Exchange Routing Guide (LERG).

North American Numbering Council (NANC) Committee operating under the auspices of the FCC, to provide advice to the FCC on numbering policy. Author of the process flows that govern intercarrier communications for Number Portability order processing. Also responsible for selecting administrators for Number Portability and Number Pooling.

North American Numbering Plan (NANP) Method for describing valid Directory Numbers (DNs) in the U.S. and Canada. Numbers in the North American Numbering Plan are of the form "NPA-NXX-XXXX", where N is a digit from 2 through 9, and other digits range from 0 through 9.

Number Portability Administration Center (NPAC) Regional centers that coordinate the porting process by synchronizing Number Portability databases, managing intercarrier communications during Number Portability order processing, and interfacing with service providers' Service Order Administration systems and Local Service Management Systems.

Number Portability Databases (NPDBs) An application that is usually housed at the Service Control Point (SCP) that responds to NP queries with data about the customers ported service.

Number Portability Information Information associated with a ported DN that Automatic Message Accounting (AMA) recording uses to identify the Recipient Switch (e.g., the switch's LRN) of the ported DN to assist in billing.

Numbering Plan Area (NPA) The first three digits of a telephone number. Also known as an "area code."

Originating Party LNP Module An LNP module that contains Number Portability information for an originating party.

Originating Switch The switch serving the calling party.

Parameters Specific units of information contained within a message. For example the CalledPartyID is a parameter in the Analyze_Route message that carries the identity of the called party, or in the case of a ported number call it carries the LRN.

Point Of Interconnection (POI) The point within a Local Access Transport Area (LATA) at which a Local Exchange Carrier's (LECs) responsibility for access service ends and an Interexchange Carrier's (IXCs) responsibility begins.

Pooled Number A number within a pooled and allocated block of DNs that is working, assignable, or aging in the Block Holder Switch.

Pooling Administrator Entity responsible for the administration of the NXX-X blocks within an NPA.

Portable NPA-NXX An NPA-NXX designated as "open" for portability. No numbers may have actually ported.

Ported Number (1) In the absence of Number Pooling: a DN is considered to be ported if it resides on a switch other than the switch to which it is assigned in the LERG. (2) In the presence of number pooling: (a) Outside of a pooled block, a DN is ported if it is working, assignable, or aging in a switch other than the Code Holder Switch; (b) Within a pooled block, a DN is ported if it is working, assignable, or aging in a switch other than the Bock Holder Switch.

Ported-Out Marking A switch marking on a DN or range of DNs that indicates that the DN or DNs have been ported out from the switch to which they were previously assigned.

Presubscribed Interexchange Carrier (PIC) A carrier that a network user subscribes to, to provide interconnection between local exchanges on an Intra and/or InterLATA basis.

Rate Center A rate center denotes a geographic area used to distinguish rate boundaries. {Note: In this document "rate center" denotes the smallest geographic area used to distinguish rate boundaries. In other contexts, rate centers may contain even smaller geographic areas used for rating (e.g., rate districts, wire centers, rate areas).}

Recipient Service Provider The service provider to which a Recipient Switch belongs. Equivalently, the service provider to which a DN is ported.

Recipient Switch The switch to which the DN is ported.

Release to Pivot (RTP) A technical approach to Number Portability in which a call may be released back to a previous switch (the "pivot" switch) in the call path along with Rerouting Information (RI) obtained from a database query.

Remote Call Forwarding (RCF) The is an interim solution for Number Portability that redirects all incoming calls to the customer from the switch that previously served him/her (Donor Switch) to the new switch now serving this ported customer (Recipient Switch).

Service Control Points (SCPs) Remote databases within the SS7 network that store service logic capable of providing translation and routing data needed to support Advanced Intelligent Network services.

Service Order Administration (SOA) The software that sits between a Billing/ Customer Care Service Order Entry (SOE) system and the NPAC that facilitates communication with the NPAC. Among other functions, it is the vehicle used to establish a ported number entry in the NPAC.

Service Order Entry (SOE) A focal point where requests from multiple users are funneled to pass to the Service Order Administration (SOA). This may be the billing/ customer care system or another delivery point that would provide the funnel from multiple system(s) locations. This architecture needs to be designed.

Service Management Systems (SMSs) An operations support system used to facilitate the provisioning and administration of service data required by the SCP. Use of this term does not imply any specific technology platform.

Service Portability Allows an end-user to retain the same DN when changing services.

Service Provider Portability Allows an end-user to retain the same DN when changing service providers.

Service Switching Points (SSPs) Switching systems capable of temporarily suspending call processing to launch queries to remote databases (Service Control Points [SCPs]) that provide additional service logic. In the case of Number Portability, an SSP will launch the Number Portability query to determine whether the called number is (or is not) ported.

Service Transfer Points (STPs) Elements of the packet-switched network that transport SS7 messages between Service Switching Points (SSPs), and between SSPs and Service Control Points (SCPs). Repositories for Global Title Translation information.

Signaling Connection Control Part (SCCP) Part of the SS7 protocol residing between the Message Transfer Part (MTP) and Transaction Capabilities Application Part (TCAP) that provides communication between signaling nodes by adding circuit and routing information to the signaling message.

Signaling System Number 7 (SS7) An ANSI standard protocol service provider networks and other interconnecting networks deploy to support out-of-band CCS architectures. The protocol divides signaling specifications into the Message Transfer Part (MTP), the Signaling Connection Control Part (SCCP), the ISDN User

Part (ISUP), the Operations and Maintenance Application Part, the Application Service Part, and Transaction Capabilities Application Part (TCAP).

Snapback The event whereby the responsibility for a ported DN is returned to the block hold (if the DN is in a pooled block) or the code holder (if the DN is not in a pooled block) after disconnect and aging.

Specific_Digit_String (SDS) trigger An Advanced Intelligent Network (AIN) trigger. A mechanism for deciding whether to launch a query to an AIN Service Control Part (SCP) based on comparing some or all of the digits of the called number with a predefined digit string. A query is launched when the first N (N may range from three through ten) digits of the called number match the trigger's target digit string.

Telecommunications Act of 1996 (TA96) Legislation the U.S. government created intended to provide increased competition in the telecommunications industry. It stipulated that Regional Bell Operating Companies (RBOCs) were required to meet a "competitive checklist" before being allowed to offer in-region long-distance service. One of the elements of the checklist was a requirement to offer Number Portability (interpreted by the FCC to mean Service Provider Portability).

Terminating Party LNP Module An LNP module that contains Number Portability information for a terminating party.

Thousands-Block A set of one-thousand telephone numbers sharing the same first seven digits (NPA-NXX-X).

Transaction Capabilities Application Part (TCAP) The highest layer in the SS7 protocol suite. Transaction Capabilities in the SS7 protocol are functions that control non-circuit related information transferred between two or more signaling nodes.

Transition Mechanism Mechanism for forcing a Number Portability query on a specific telephone number during the period when that number is being ported from the Donor Switch to the Recipient Switch. Also known as the *unconditional trigger* or the *10-digit trigger*.

Unallocated Number A DN is unallocated on a switch if it is not assigned to a customer on the switch.

Unallocated Number Portability (UNP) A type of Number Pooling in which numbers are assigned to thousand blocks, and then ported to other switches before initial assignment.

Vertical and Horizontal Coordinates (V&H) A numerical method of determining airline mileage between locations. Geographic locations of rate centers are expressed in V&H coordinates; this mapping forms the basis of typical residential customer billing tariffs. Geographic locations of wire centers are also expressed in V&H coordinates; this mapping forms the basis of typical access billing tariffs.

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