

Telephone Numbers Are Portable; Is the NPAC?

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We've Got Your Number

Local number portability (LNP)—the ability to take your telephone number with you when changing service providers—is critical for competition in the U.S. telecommunications market. The overriding goal of the Telecommunications Act, signed into law on February 8, 1996, was to foster telecommunications competition. To accomplish this, it removed many government and regulatory roadblocks including permitting media cross-ownership and authorizing the Federal Communications Commission (FCC) to preempt state or local legal regulations that created barriers to entry into the telecommunications market. It also introduced new regulations to encourage competition, such as mandating unbundled access and requiring incumbent carriers and competitive operators to interconnect their networks. These measures gave competitive operators the network reach to access a potential subscriber. However, where was the incentive to change if switching carriers meant switching phone numbers, with all the aggravation and disruption that it brings to a consumer or enterprise? To remove this hurdle, the Telecommunications Act also mandated that the industry implement LNP and designate an administrator to ensure this barrier to competition was set aside.

The Number Portability Administration Center (NPAC) was established in 1997 under a five-year contract awarded to Neustar (then CIS, an operating division of Lockheed Martin) to support the implementation of LNP. Today, the U.S. NPAC is the largest number portability registry in the world. The NPAC:

- Manages more than 500 million telephone numbers
- Connects to over 4,700 individual customers, which represent approximately 2,500 network service providers
- Broadcasts over 1.2 million adds, changes and deletions in real time every day

Since the NPAC's establishment, its contract has been extended three times with Neustar—in 2000, 2003 and 2006. The current contract extension will not expire for another three years, in 2015. What happens then? The telecommunications industry is engaged in a procurement process, with oversight from the FCC, that will allow the NPAC service contract to either remain with Neustar or be awarded to another vendor—or perhaps multiple vendors, each of which would provide NPAC services to a portion of the U.S.

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In this whitepaper, Yankee Group lifts the manhole cover off this essential infrastructure element in today's network. We examine NPAC's role in the nation's infrastructure and take a look at the rigorous challenges facing any vendor offering NPAC services, including scalability, performance, neutrality and robustness. We discuss how LNP and NPAC are evolving in response to sweeping changes to the industry such as mobile communications and voice over Internet protocol (VoIP). We also examine the role that government, regulatory bodies and carriers play in administering the NPAC. Finally, we evaluate the risk of disruption as a result of moving NPAC services to a new provider or multiple providers.

This is the first in a series of whitepapers that examine the NPAC through a variety of industry lenses.

Putting the Act Into Action

The signing of the Telecommunications Act at the beginning of 1996 was the first step toward putting LNP into practice, but myriad questions remained regarding how it would be implemented and managed. Paragraph five of the FCC's "First Report and Order in the Matter of Telephone Number Portability," adopted on June 27, 1996, provided a guideline:

"We conclude that a system of regional databases that are managed by an independent administrator will serve the public interest."

The FCC concluded an independent administrator is key for LNP to be successful, on the grounds that porting services in a neutral manner is critical ("neutral" meaning that no favor is granted to any telecommunications provider over another, and with the introduction of wireless and VoIP, that no communications segment is favored over another). The rules strictly required that the LNP administrator be a neutral third party with no significant ties to any communications providers. As a result, Neustar is subject to restrictions regarding corporate ties to the communications industry including board and employee ownership of telecommunications service providers. In addition, Neustar is bound to a strict code of conduct that outlines the company's practices in working with carriers and their proprietary data.

LNP was a hot topic even before the FCC's mandate. Many carriers and equipment providers appeared to be working on solutions, including AT&T, MCI, DSC Communications, Nortel, Tandem Computers, Siemens Stromberg-Carlson, Stratus Computer, US Intelco, GTE and Pacific Bell. Plus, 22 states had already started their own task forces to develop LNP solutions and some states even began implementation timelines. Seven limited liability companies and regional NPAC registries were established, roughly corresponding to the seven former Regional Bell Operating Companies (RBOCs), to fulfill the FCC's order. The administration of the registries was put out for competitive bid and initially awarded to two vendors: Lockheed Martin was awarded the contract to develop and administer four of the seven U.S. regional NPACs, while Perot Systems was initially selected by the remaining three regions and Canada. However, Perot Systems failed to deliver a stable platform or meet the dates for the FCC-mandated national rollout scheduled to begin in October 1997. As a result, the contracts for the remaining three U.S. regional NPACs as well as the Canada NPAC were awarded to CIS Lockheed Martin, now Neustar, as well. Neustar has been operating the NPAC across the U.S. and Canada ever since.

Moving a Number


Under the North American Numbering Plan (NANP), telephone numbers are allocated to carriers in blocks and linked with specific geographic regions (area codes) and specific switches (exchanges) within that region. On the public switched telephone network (PSTN), the dialed digits are translated to carrier-specific facilities that support a given subscriber. Put another way, a telephone number is a network address on the PSTN that the operator assigns to each of its subscribers. To quote the FCC: "[Telephone numbers] cannot be transferred outside the service area of a particular switch or between switches operated by different service providers without technical changes to the switch or network." Once a carrier is allocated a number, it belongs to that carrier, essentially forever. This means changing carriers without changing numbers requires a mechanism that can, every time the number is dialed, associate the old number with its new network switch or route.


The LNP method selected by the telecommunications industry and adopted by Neustar is based on AT&T's proposed Location Routing Number (LRN) technique, which assigns one or more unique, non-dialable telephone numbers known as LRNs to each switch in a carrier's network and then uses that number as a route address for ported numbers. After a number is ported to the subscriber's new service provider, the assigned LRN is used to route calls instead of the traditional dialed exchange digits. The technical challenge is ensuring that all carriers in the service area know which LRN to use and when they should use it so ported telephone numbers can successfully receive their phone calls.


This method is not as straightforward as it appears. For instance, Exhibit 1 illustrates what happens when a subscriber walks into a new service provider's storefront, decides to switch service and wants to keep his or her telephone number. In order to port the number to the new carrier, several steps are required.


Exhibit 1: The Number Portability Tango
 Source: Yankee Group and Neustar, 2012


Local Number Portability Process


The new service provider notifies the old service provider of the requested port and assigns an LRN for the switch. 


The old service provider validates the subscriber's information to help avoid fraud. 


The old service provider confirms the subscriber's information and notifies the new service provider. 


The new service provider registers the subscriber's intent to port with the NPAC and assigns a date and time for the port to occur. 

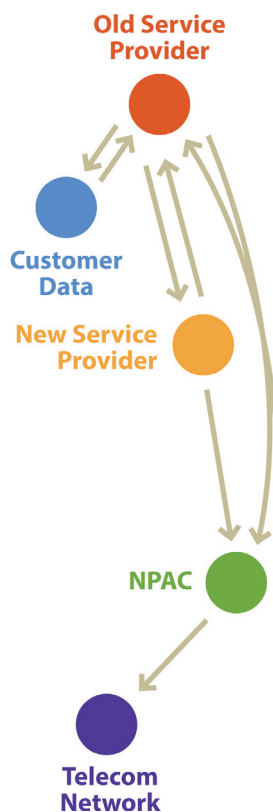
The NPAC creates a pending port and sends a notification to the old service provider. 

Optionally, the old service provider notifies the NPAC that it concurs with the port. 

The new service provider notifies the NPAC that the telephone number should be activated on its network. 

The pending port is set to "activate" in the NPAC. 

The NPAC broadcasts the port to all service providers in the regional telecommunications network within seconds to keep each provider's internal database synchronized with the NPAC registry. 



Note that all these steps must be completed before the new port goes live throughout the network. This is in keeping with the primary mandate of the NPAC: to foster competition in a neutral manner (hence the name *Neustar*) while placing the highest premium on the customer's privacy and delivering a friction-free experience.

Within the LRN portability system, complexities can occur at any step along the way, but they can be isolated and resolved with no disruption to the subscriber. For example:

- The port request may be incomplete, inconsistent or contain invalid information.
- Carriers may disagree about to which operator a subscriber belongs—most likely due to contractual obligations.
- The transaction may fail due to transmission or reception problems at either carrier involved in the port.
- The transaction may not flow through to all carriers in the NPAC system if one of them is having transmission or reception problems.

The NPAC registry must be able to execute all porting transactions accurately and quickly. Porting transactions are executed in a matter of seconds by the NPAC system and broadcast to all carriers in minutes—a necessary element of the FCC's mandate that subscribers be able to port their service in one day. The NPAC must also, however, include protocols and procedures for identifying, recovering from and reporting on any of these problems. It must record every completed transaction and also record and provide an audit trail for every failed transaction. To ensure that all carrier databases are synchronized, it also must identify any carrier that is experiencing problems receiving data and ensure that the problem carrier's database is synchronized when the problem is resolved. To ensure ongoing data integrity, Neustar must also maintain a fully redundant, real-time, synchronized backup system in the event that the primary system is down or cannot be reached.

Never Business as Usual

The NPAC is not a “set it and forget it” operation. The rate of change in telecommunications demands that the NPAC system scale to accommodate the rapid growth and at the same time be flexible enough to react to unforeseen or extraordinary demand, as we describe below.

Unbridled Growth

Think about the changes the U.S. telecommunications industry has experienced since 1997, just 15 years ago, when the NPAC was established: the emergence in force of mobile communications; the blistering growth rate of mobile and fixed traffic propelled by video; the advent of cloud computing, social networking and e-commerce; and the ascendance, overall, of the Internet for both personal and enterprise communications. The operators and devices subject to LNP are at the center of all these phenomena, and the rapid evolution of the NPAC has reflected these changes:

- Since 1997 the number of customers supported by the NPAC has grown substantially from the number of service providers that initially relied on it. Today, the NPAC handles the LNP requirements of more than 4,700 individual customers, ranging in size from Verizon and AT&T (with tens of millions of customers) to small rural carriers with fewer than 50,000 customers.
- The NPAC introduced wireless number porting in 2003, subsequent to another FCC order. At that time there were 159 million wireless subscriptions in the U.S. At the end of 2011, there were 327.8 million subscriptions (representing a penetration rate of 104 percent).
- When the Telecommunications Act was signed at the beginning of 1996, the U.S. had no reported VoIP fixed line connections. As of 2011, VoIP accounted for a third of all residential fixed line connections.
- In 1999 the NPAC executed 4.4 million LNP transactions. In 2011, that number was 469 million transactions (averaging 1.3 million transactions a day).

How has NPAC performance been affected by this breakneck pace of change? With by far the largest number of carriers under management and LNP transactions in the world, NPAC has:

- Processed 99 percent of all porting transactions in less than three seconds.
- Scored at least 3.5 out of 4.0 on customer feedback surveys since 2008. In 2011, Neustar scored its highest rating ever, 3.8 out of 4.0.
- Met 99.92 percent of over 11,000 contractual service measurements over the last five years, with 100 percent compliance in 2011.
- Implemented eight major software releases and three full platform upgrades since NPAC's inception.
- Been subject to several annual audits of security performance, neutrality and internal codes of conduct, as mandated by the telecommunications industry.

A Quick Comparison

Is the U.S. NPAC unique, or do all LNP designs provide a similar degree of robustness, scalability and performance?

Sweden is an enthusiastic and aggressive adopter of emerging technology. According to the Post and Telecom Authority (PTS), the Swedish regulator, Sweden has a fixed broadband penetration rate of 31.9 percent as of January 2011, the sixth highest in the EU, and a mobile penetration rate of 128 percent as of October 2010. Sweden registered 298,064 fixed number porting transactions and 310,142 mobile porting transactions in the first nine months of 2010—a fraction of the transactions handled by its U.S. counterpart. The PTS reports that the time taken to port fixed numbers was on average three days in 2010, a significant improvement over 2009 when it took a maximum of 15 days to port a fixed number. Likewise, the average porting time for a mobile number in Sweden in 2010 was three days. This is compared to a single day or less in the U.S., for both fixed and mobile ports. A U.S. subscriber can walk into a service provider's store and walk out with a new service plan and device, including having voice and messaging ported simultaneously, with no disruption to their service.

The U.K. implemented LNP in its telecom network but used an architecture that differs from the U.S. NPAC. It is not alone. Other nations have tried to do the same and have suffered in terms of neutrality, performance or the subscriber's experience. The U.K. elected to use an LNP scheme called Onward Routing (OR), also known as "call forwarding" or "donor network." In this method, calls are forwarded from the old, or donor, network to the subscriber's new carrier, known as a recipient network. Neither the U.K. carriers nor regulator operate a central registry. Instead, the donor network is obliged to determine the recipient network and then switch the call. This is simpler and less expensive to implement than the U.S. system. However, there are tradeoffs in terms of neutrality, performance and flexibility. The donor network collects a fee for forwarded calls from the recipient network. If the subscriber changes service providers again, the number is returned to the donor network and then re-reported to the new recipient network. The trouble here is that if the donor network fails for some reason, so does the ported call. Worse, if a carrier goes out of business, all of its customers must give up their phone numbers because the OR system doesn't allow for actual phone numbers to be ported. This is what occurred in 2001, when 14,000 U.K. subscribers lost their telephone numbers during Atlantic Telecom's failure.

LNP designs vary across the world, but the U.S. NPAC is unique. In a future report, we will discuss how LNP is handled in other countries and evaluate the varying levels of performance.

Disaster Recovery

In their 2009 book "Disaster Recovery Planning for Communications and Critical Infrastructure," authors Leo Anthony Wrobel and Sharon M. Wrobel opined: "We are convinced that Neustar provides the North American communications industry with an in-place solution as well as the ability to not only manage virtually all the telephone area codes and numbers in real time but to also enable the dynamic routing of calls among thousands of competing communications service providers (CSPs) in the United States and Canada in times of disaster." They were referring specifically to an element rarely discussed when it comes to LNP—its ability to restore communications in the event of a natural disaster or national emergency.

It certainly makes sense to use LNP to restore residential or mobile phone service in the event of a switch failure or localized event. However, can LNP be used during a natural disaster when the damage is so severe that subscribers are evacuated across state lines?

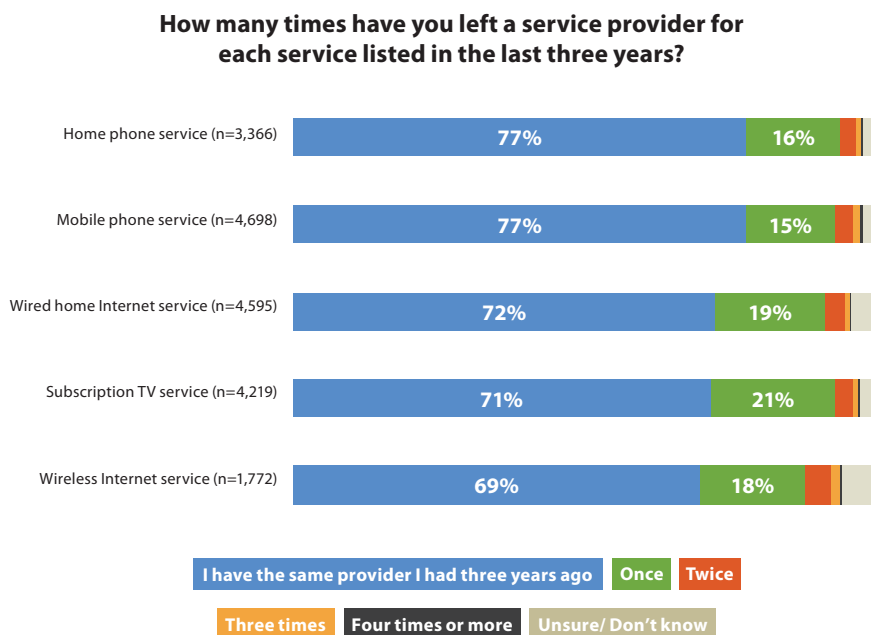
This is exactly what happened in August 2005 in the aftermath of Hurricane Katrina. Hundreds of thousands of subscribers lost service because operators' central switching facilities were flooded or experienced severe damage. Service providers used LNP to port numbers from non-operational switches to nearby functioning switches. In addition, the North American Portability Management (NAPM) LLC agreed to take an extra step and allow telephone numbers to move temporarily out of their service area for the purposes of call routing. Within minutes of NAPM's approval, Neustar and the carriers moved 300,000 numbers outside their service boundaries to receive calls and messages.

After reviewing the results of the Katrina NPAC action, the North American Numbering Council (NANC) Local Number Portability Administration Working Group (LNPA WG) concluded: "Moving numbers, even across LATA boundaries, is a viable method, especially for wireless carriers, to restore service." As a result, FCC has incorporated LNP into its emergency response protocols.

Customer Churn

LNP was implemented to promote competition by enabling subscribers to change carriers without changing telephone numbers. Consumers have certainly taken advantage of this. As shown in Exhibit 2, almost a quarter of Yankee Group's survey respondents have changed residential and/or mobile service providers over the past three years. However, recent trends in consumer buying have given the NPAC a workout that was not anticipated 15 years ago when it was founded.

Exhibit 2: Voting With Their Feet: US Customer Churn
Source: Yankee Group, 2012



Shiny New Objects

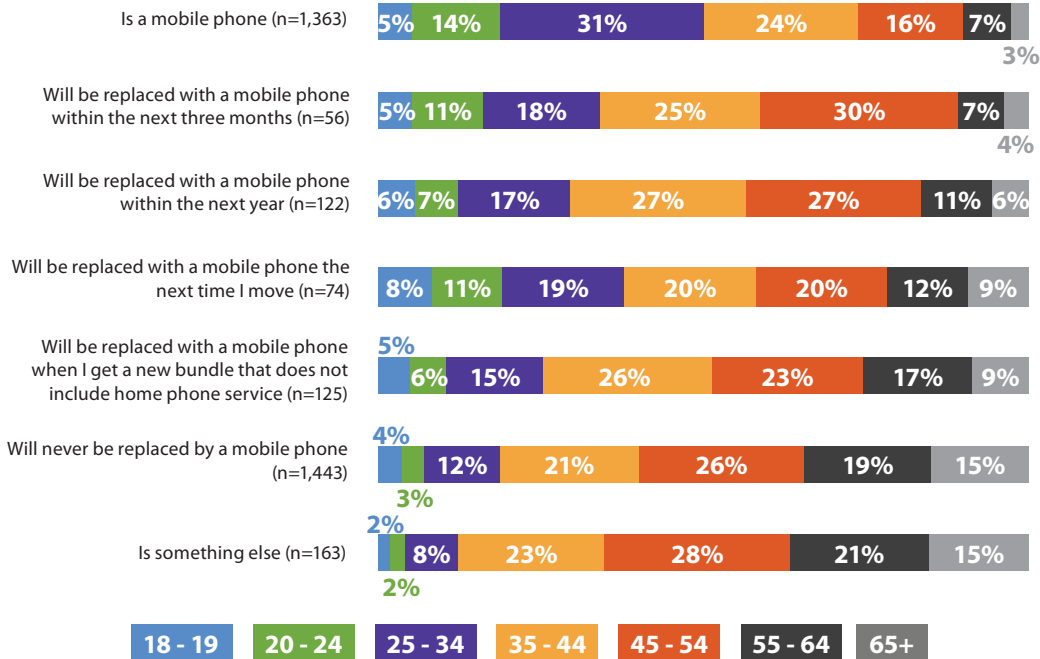
In Q4 2011, Sprint became the last of the three major U.S. carriers to make Apple’s iPhone available to its mobile subscribers. The carrier reported it sold 1.8 million iPhones during the quarter, and 40 percent of the buyers—i.e., 720,000 subscribers—were new to Sprint. The original iPhone went on sale at the end of June 2007. In the first five quarters, AT&T sold 6.1 million iPhones. AT&T reported similar new customer percentages of about 40 percent for these early quarters. As new coveted technology is introduced into the consumer telecommunications market we see sharp upticks in large-scale customer migrations (as opposed to normal churn). The NPAC system has handled these large-scale number migrations with equanimity and without incident. The fact that the NPAC supports fixed-to-mobile number portability differentiates it from LNP in most other countries, as we discuss in the following section.

The Changing Number Mix: Mobile and VoIP

In 1996, when the Telecommunications Act was signed, there were 44 million registered mobile lines in the U.S. according to Yankee Group research. As of 2011, that number was 321.6 million. At the same time, the number of fixed residential lines was eroding as consumers chose to “cut the cord” (and their monthly bills), eliminating their land line and relying exclusively on their mobile connection. Yankee Group surveys show that this trend will continue. Over a third of our U.S. consumer survey respondents have cut the cord, and it is clear from the generational bias our survey points out that more will do so in the future (see Exhibit 3).

Exhibit 3: Consumers Are Shifting to Mobile
Source: Yankee Group, 2012

My primary home telephone...



In 2003, the U.S. NPAC expanded to include not only mobile-to-mobile number portability, but also fixed line to mobile, making it the first LNP system worldwide to do so. Cord-cutting users can retain the convenience of their numbers even as they move away from fixed lines.

VoIP has also contributed to the precipitous decline of plain old telephone service (POTS) lines from 110 million in 1996 to just over 52 million today. There are dozens of small VoIP service providers in the U.S., primarily targeting residential and small enterprise customers. The FCC started requiring number portability for VoIP providers in 2007 and the NPAC registry evolved to meet this new demand. Beginning in December 2008, the FCC, as part of Form 477, required operators to report interconnected VoIP service (i.e., VoIP services that were not limited to dialing other subscribers with the same VoIP service and enabled the subscriber to dial any POTS or mobile number). Prior to that, individual incumbent and competitive Local Exchange Carriers (LECs)—to a varying and largely unknown degree—included or excluded VoIP. Yankee Group data shows that VoIP now accounts for a third of consumer fixed access lines (see Exhibit 4).

Exhibit 4: There's More VoIP Than You Think

Source: Yankee Group, 2012

	2008	2011
Consumer Switched Access Lines	72,432	52,641
Consumer Cable Switched	1,514	673
Consumer Cable VoIP	12,881	24,685
Consumer BYO VoIP	2,820	1,879
Consumer FTTH VoIP	205	5,042
Enterprise	72,774	95,501
Total Fixed Lines	162,626	180,421

(numbers are in millions of connections)

Subscribers today have the choice to switch between numerous communications technologies and keep their telephone numbers. It is clear from these trends that for any LNP solution to remain relevant in 2012 it must take into account both mobile and VoIP connections. The NPAC enabled mobile number portability in 2003 and VoIP portability was added in 2008. Adding the myriad VoIP and mobile service providers has swelled the NPAC to approximately 4,700 customers, with thousands of entities relying on NPAC data to deliver content and messaging. The NPAC database and operational software also had to be changed in order to fold VoIP and mobile into the mix and incorporate fields specific to these technologies. Most importantly, support for these types of connections included full number portability transfers between fixed, mobile and VoIP. This capability made the U.S. and Canada the first countries in the world to enable full portability between fixed, mobile and VoIP lines. The NPAC's ability to absorb rapid growth isn't coincidence; the original system was built with flexibility and scalability in mind.

Porting the NPAC

In this whitepaper, we are looking at how the NPAC has performed since its inception. Has it scaled, incorporated new technologies, lowered pricing, lowered response time, maintained reliability and satisfied its carrier customers? By any measure of these criteria, the answer has to be yes. For example:

- **The NPAC has scaled to become the largest LNP administration in the world**, supporting over 500 million numbers and approximately 4,700 customers, and processing over 1.2 million transactions a day.
- **The NPAC has had eight major software releases and three platform upgrades.** It supports both mobile and VoIP communications within the same LNP database and was the first LNP administrator to do so.
- **The NPAC has lowered per-transaction pricing by 60 percent since 2002** while continuously increasing functionality and performance.

- **FCC requirements, industry support and Neustar’s performance allows U.S. subscribers to change operators and keep their phone number without service disruption, often in under a single business day.** This is not the case worldwide.
- **Per industry requirements, Neustar is heavily audited to ensure continued compliance with the NPAC’s regulatory requirements.** These audits ensure strict compliance with neutrality, performance and several other contractual requirements, all evaluated by independent third parties.
- **The NPAC operates with five nines (99.999 percent) of reliability** (against a service level requirement mandate of 99.9), maintaining 7/24/365 operations and a fully redundant back-up system.
- **The NPAC has maintained a “Superior” NPAC Customer Survey rating.** In 2011 the rating was 3.8 out of 4.0.

It is clear the NPAC is not broken, so awarding it to multiple providers would not “fix” any aspects of the process. From our current perspective, no advantage to changing providers emerges. We will revisit these issues and more as we examine LNP from a variety of industry perspectives in future whitepapers.

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