



ATIS-1000083

Technical Report on Assessment of
Nationwide Number Portability

TECHNICAL REPORT



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ATIS-1000083, *Technical Report on Assessment of Nationwide Number Portability*

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ATIS Technical Report on

Technical Report on Assessment of Nationwide Number Portability

Alliance for Telecommunications Industry Solutions

Approved June 4, 2018

Abstract

This Technical Report provides further technical assessment of the potential approaches to Nationwide Number Portability (NRP) identified in ATIS-1000071, *Technical Report on a Nationwide Number Portability Study*.

Foreword

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between providers, customers, and manufacturers. The Packet Technologies and Systems Committee (PTSC) develops and recommends standards and technical reports related to services, architectures, and signaling, in addition to related subjects under consideration in other North American and international standards bodies. PTSC coordinates and develops standards and technical reports relevant to telecommunications networks in the U.S., reviews and prepares contributions on such matters for submission to U.S. ITU-T and U.S. ITU-R Study Groups or other standards organizations, and reviews for acceptability or per contra the positions of other countries in related standards development and takes or recommends appropriate actions.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes an optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, PTSC, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this document, PTSC, which was responsible for its development, had the following leadership:

- M. Dolly, PTSC Chair (AT&T)
- V. Shaikh, PTSC Vice-Chair (Vencore)
- G. Richenaker, Technical Editor (iconectiv)

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Assessment of Nationwide Number Portability

1 Scope & Background

1.1 Scope

This Technical Report provides further technical assessment of the potential approaches to Nationwide Number Portability (NNP) identified in ATIS-1000071, *Technical Report on a Nationwide Number Portability Study*. This Report includes an analysis of these potential NNP solutions with the goal of providing additional information on the technical and systems-related impacts needed to support NNP. This Report does not modify or amend any of the technical characteristics in any of the approaches that had been detailed in ATIS-1000071.

This Report also identifies any new standards or changes to existing standards/solutions that would be necessary to implement NNP, as well as implications for existing networks, in particular circuit-switched networks. This Report also considers whether criteria/metrics could be developed to assess the feasibility of deploying each of the identified NNP approaches within service provider networks.

1.2 Background

The Federal Communications Commission (FCC) asked the industry¹ and the North American Numbering Council (NANC)² to determine what changes to existing infrastructure and procedures would be required to permit users to port an E.164 geographic telephone number beyond current limits (essentially the rate center to which the NPA-NXX of the number is assigned) to any area of the nation. In July of 2016, PTSC issued ATIS-1000071.

In November 2017, the FCC released a Notice of Proposed Rulemaking (Notice) and Notice of Inquiry (NOI)³ to seek comment on how best to move toward complete NNP to promote competition between all service providers and to encourage efficient call routing. The Notice and NOI sought comments on:

- Removing the Commission's "N-1" requirement, which requires the second-to-last carrier to perform the number portability database query, to allow carriers flexibility in conducting number portability database queries to promote NNP and efficient network routing.
- Eliminating the Commission's dialing parity requirement, as it applies to interexchange service, to remove barriers to NNP and better reflect the competitive realities of today's marketplace.

In December 2017, the FCC Commissioner announced the re-chartered NANC, and in February of 2018, they issued the Working Groups Membership⁴, leading to the establishment of the Nationwide Number Portability Issues Working Group. The FCC seeks NANC recommendations on:

- Which of four (4) proposed models leads to timely and effective deployment of NNP.
- Costs, benefits, and barriers to implementation for each of the models.
- Consequences of the proposals for routing, interconnection, and public safety.
- Next steps to ensure NNP progresses.
- Any other recommendations deemed necessary to achieve the NNP goal.

¹ Letter from FCC Chair to President of CTIA, July 27, 2015.

² Letter from Chief of FCC Wireline Competition Bureau to NANC Chair, November 16, 2015.

³ In the Matter of National Number Portability, WC Docket No 17-244

⁴ FCC Public Notice – February 5, 2018 - FCC ANNOUNCES NORTH AMERICAN NUMBERING COUNCIL ISSUE-SPECIFIC WORKING GROUPS MEMBERSHIP. CC Docket No. 92-237

2 References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[Ref 1] ATIS-1000071, *Technical Report on a Nationwide Number Portability Study*.⁵

3 Definitions, Acronyms, & Abbreviations

For a list of common communications terms and definitions, please visit the *ATIS Telecom Glossary*, which is located at < <http://www.atis.org/glossary> >.

3.1 Definitions

GUBB (Geographic Unit Building Block): The smallest geographic unit *within an area of location portability* that is meaningful for rating purposes by any carrier.

Nationwide Number Portability (NNP): Allows portability outside the rate center and includes when a customer physically moves e.g., from one state to another, within a state, etc.

Intermodal Porting: Wireline to wireless and wireless to wireline porting.

3.2 Acronyms & Abbreviations

ALI	Automatic Location Identification
ANI	Automatic Number Identification
ATIS	Alliance for Telecommunications Industry Solutions
CAMA	Centralized Automatic Message Accounting
E9-1-1	Enhanced 9-1-1
ESCO	Emergency Service Central Office
EAS	Extended Area Service
FCC	Federal Communication Commission
GETS	Government Emergency Telecommunications Service
GUBB	Geographic Unit Building Block
ICA	Independent Computing Architecture
ILEC	Incumbent Local Exchange Carriers
IP	Internet Protocol
IP-NNI	Internet Protocol Network to Network Interface
IPX	Internetwork Packet Exchange
ISDN	Integrated Services Digital Network
ISUP	Integrated Services Digital Network User Part
IXC	Interexchange Carrier

⁵ This document is available from the Alliance for Telecommunications Industry Solutions (ATIS) at < <https://www.atis.org/docstore/product.aspx?id=28281> >.

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LD	Local Access and Transport Area
LD	Long Distance
LRN	Location Routing Number
LNP	Local Number Portability
LSMS	Local Service Management System
MF	Multi-Frequency
NANC	North American Numbering Council
NANP	North American Numbering Plan
NANPA	North American Numbering Plan Administrator
NG9-1-1	Next Generation 9-1-1
NG	Next Generation
NGGW	Non-Geographic Gateway
NGLRN	Non-Geographic Location Routing Number
NGN	Next Generation Network
NLRN	National Location Routing Number
NNP	National Number Portability
NP	Number Portability
NPA	Numbering Plan Area
NPAC	Number Portability Administration Center
NPD	Number Plan Digit
NPDB	Number Portability Database
NS/EP	National Security/ Emergency Preparedness
PA	Pooling Administrator
pANI	Pseudo Automatic Number Identification
POI	Point of Interconnection
PORC	Portability Outside the Rate Center
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
PTSC	Packet Technologies and Systems Committee
RBOC	Regional Bell Operating Company
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SMS	Service Management System
SP	Service Provider
SOA	Service Order Administration
SRDB	Selective Routing Database
SS7	Signaling System 7
TCAP	Transaction Capabilities Application Part
TDM	Time-Division Multiplexing
TN	Telephone Number
UE	User Equipment
URI	Uniform Resource Identifier
VoIP	Voice over Internet Protocol
WPS	Wireless Priority Service

4 Existing NNP Solution – Commercial Agreements

The following clause provides an assessment of a NNP solution that is currently available and in use today.

Wireless carriers with a nationwide footprint may allow customers to move outside the Local Access and Transport Area (LATA) associated with their number by treating them as permanent roamers. Likewise, they can port in the numbers of customers that have moved outside their original LATA by porting the numbers to their Point of Interconnection (POI) in the original LATA. Since the POI in either case remains in the original LATA, end user billing, interconnection, and settlements are not changed.

In addition, subscribers who are already served by a wireless carrier that has a national footprint, can perform an intermodal port from their wireline to a wireless number. This allows those subscribers to move outside their LATA and also operate as a permanent roamer.

It is important to note that these capabilities are not available to all Service Providers (SPs) and subscribers. Service providers needing to obtain a commercial agreement with a third party will have additional costs that would not be incurred by national carriers.

The Commercial Agreement NNP solution provides a mechanism that allows the capabilities described above to be extended to wireless service providers that do not have a national footprint.

4.1 Commercial Agreements

4.1.1 Overview of Commercial Agreement Approach

An existing solution to nationwide portability for wireless service providers that do not have a national footprint is to use the facilities of third parties to provide a POI in the LATA of the donor provider and to deliver traffic from that POI to the network of the recipient provider in a distant LATA.

Service providers can port in a number that is located outside of a LATA when they have an interconnection point contract with another provider that has facilities in that donor LATA to provide a POI to which calls to the ported number can be routed. The party providing the POI arranges to route calls to ported numbers to the recipient network per terms of their commercial agreement or contract. In this way, the POI for a number that has effectively moved to a distant LATA can remain in the original LATA just as in the case of a provider with a national footprint treating customers who move as permanent roamers.

Some service providers currently use similar commercial agreements to exchange voice calls with other service providers, irrespective of NNP. These commercial agreements may be a viable short-term solution to NNP, but there may be issues faced by Voice over Internet Protocol (VoIP) providers that may not be faced by legacy service providers that do not predominantly rely upon VoIP. However, alternate solutions to commercial agreements may also have disproportionate impacts on those service providers that do not predominantly rely upon VoIP to provide service.

4.1.2 Impacts

4.1.2.1 SS7 Signaling

The commercial agreement approach requires no changes to the Signaling System 7 (SS7) signaling used to support Number Portability (NP) queries or call setup.

4.1.2.2 Call Processing & Network Routing

The commercial agreement approach requires no changes to call processing.

The party providing the donor LATA POI must arrange to route ported-out-of-LATA calls terminating to that POI to the recipient carrier. Further investigation is required to identify any impacts associated with intermodal porting scenarios where the POI provider is a wireline carrier and the recipient carrier is a wireless carrier. It is anticipated that routing from a wireline POI to a wireless network would be accomplished using existing routing capabilities.

4.1.2.3 Number Portability Administration Center (NPAC)

No known changes to the NPAC are required, as routing to the LATA of the donor remains unchanged.

4.1.2.4 Numbering Administration

There should be no impacts on number administration.

4.1.2.5 Accounting/Billing

The need for any accounting or billing changes would depend on the details of the commercial agreement between the out-of-LATA POI provider and the recipient carrier. Service providers entering into such commercial agreements may need to establish terms for inter-carrier settlements to address the billing of local and long-distance calls similar to what exists with wireless service providers. With terminating intercarrier compensation defaulting to Bill & Keep, impacts on terminating compensation should be minimized.

4.1.2.6 PSTN/IP Interworking

There should be no impacts on Public Switched Telephone Network (PSTN)/IP interworking.

4.1.2.7 Regulatory Related Services

4.1.2.7.1 Emergency Services

For ported wireless numbers, calls to 9-1-1 should be handled as they would be for roamers. Specifically, in the current Enhanced 9-1-1 (E9-1-1) environment, a pseudo Automatic Number Identification (pANI) associated with the cell site/sector from which the emergency call originated, is included in call setup signaling and is used to route the call to the appropriate Public Safety Answering Point (PSAP). The pANI is also used by the PSAP to retrieve location and callback information for the emergency call.

If a number is ported to wireline service, then the origination of a 9-1-1 call from that number will cause wireline emergency call handling procedures to be invoked. Emergency call setup signaling generated by the switch serving that ported number will include a calling number populated with the ported number rather than a pANI. Like other wireline originations to 9-1-1, the emergency call will be routed based on the calling number. [This assumes that the appropriate processes are in place to ensure that routing data associated with the ported number is correctly provisioned into the Selective Routing Database (SRDB)]. The ported number will be delivered to the PSAP in call setup signaling and will be used to retrieve location information associated with the emergency call, assuming that the call delivery interface to the PSAP supports it and that the appropriate data has been provisioned into the Automatic Location Identification (ALI) system. As described in ATIS-1000071, there is a potential issue with the delivery of calls originated by ported users to PSAPs that support traditional [i.e., Numbering Plan Digit (NPD) + 7-digit "CAMA-like"] Multi-Frequency (MF) interfaces from their serving Selective Routers due to the limitations in the number of Numbering Plan Areas (NPAs) that can be signaled using this interface. The NPD in the traditional MF signaling sequence is used in the context of E9-1-1 service to unambiguously identify to the PSAP which of up to four NPAs serves the originating station. If an NPD cannot be derived for an emergency call, a fictitious Automatic Number Identification (ANI) of the form 0-911-0TTT [where the TTT indicates the Emergency Service Central Office (ESCO) number associated with the originating office] will be signaled to the PSAP. With NNP, the number of NPAs that may potentially be associated with emergency callers that reside in a particular PSAP's serving area will be significantly larger than today. For PSAPs that support traditional MF interfaces, this will result in a larger number of emergency calls for which they will not be able to accurately identify the NPA associated with the callback number. This will negatively impact the ability of such PSAPs to call back emergency callers, should it become necessary to do so, and will also prevent the PSAP from being able to automatically obtain location information associated with the emergency call. It is important to note that the number of PSAPs that currently support traditional MF interfaces is relatively small, and that this limitation will not be an issue for legacy PSAPs that support Enhanced MF interfaces (which allow the delivery of a 10-digit ANI), or for Next Generation (NG) PSAPs that are interconnected to NG9-1-1 Emergency Services Networks via Internet Protocol (IP) interfaces.

4.1.2.7.2 National Security/Emergency Preparedness (NS/EP)

The commercial agreement between service providers for NNP will need to take into consideration providing priority treatment to calls identified as NS/EP including any associated number portability queries as discussed in clause 10.2.3.1 and 10.2.3.2 of ATIS-1000071. Also, as noted in clause 10.2.3.2 of ATIS-1000071, if mobile stations with Wireless Priority Service (WPS)/Next Generation Network (NGN) Government Emergency Telecommunications Service (GETS) subscriptions are allowed, nationwide porting may be subjected to NS/EP Service Level Agreement (SLA) rules, and if determined to be applicable, special arrangements would be needed. For example, if NNP of WPS-subscribed User Equipment (UE) is allowed, the recipient wireless provider must be WPS-capable if WPS is to be retained for the ported Telephone Number (TN)/UE. This would involve necessary arrangements associated with the WPS subscription (i.e., moving the WPS subscription to the ported WPS provider) and providing appropriate guidance to the WPS users.

4.1.2.8 Policy

No policy changes are required to implement commercial agreements.

4.1.2.9 Interconnection Agreements

Commercial agreements for NNP establish the agreed upon interconnection arrangement between the party providing the POI in the donor LATA and other providers delivering traffic to that LATA. Whether interconnection arrangements are between the parties delivering traffic to the donor LATA and the service provider providing the donor LATA POI, or between parties delivering traffic to the donor LATA and the distant recipient service provider, is to be determined. Interconnection arrangements must also exist between the service provider providing the donor LATA POI and the recipient service provider.

Regardless of the technical solution, full deployment of NNP will necessitate that the FCC first expand its number portability requirements beyond rate center boundaries and lift all restrictions that could prevent the porting of any telephone number to or from anywhere in the nation.

4.1.2.10 Summary

Generally, service providers that port numbers on a nationwide basis are limited to commercial agreements with carrier partners that provide IP connectivity to VoIP capable service providers that facilitate the exchange of voice traffic with Incumbent Local Exchange Carriers (ILECs). Given the limited number of nationwide carrier partners that offer the ability to exchange local traffic, there is little competitive pressure, resulting in fewer options in the terms and conditions of the agreements on the part of carrier partners.

Commercial agreements are a current method of facilitating NNP and have the elements necessary to be the interim solution that would have the least financial and operational impact to the industry’s service providers.

Table 4.1 – Summary of Commercial Agreement Impacts

Impact Analysis Summary	Commercial Agreements
SS7 Signaling	None.
Call Processing	None.
Network Routing	Further analysis is needed to identify impacts if the POI provider is a wireline carrier and the recipient carrier is wireless.
Number Administration	None.
NPAC	None.
Accounting/Billing	Varies.
PSTN/IP Interworking	None.

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Impact Analysis Summary	Commercial Agreements
Emergency Services	Potential impacts for numbers ported to wireline.
NS/EP	Commercial agreement between service providers will need to consider priority treatment of NS/EP identified calls. Special arrangement would be needed if NNP is deemed to be applicable to WPS/NGN GETS subscribed mobile handsets.
Policy	Expand portability requirements beyond rate center boundaries. Lift all restrictions that could prevent the porting of any telephone number to or from anywhere in the nation.

As reflected in Table 4.1, the use of this NNP option has little to no impact on the existing network or its systems. There are no changes to existing standards, nor any new standards required. The commercial agreement approach is the least impactful to the legacy Time-Division Multiplexing (TDM) networks that exist within the industry. By minimizing the impact to legacy networks (and associated costs of changes to these networks), the commercial agreements approach also would encourage service providers to continue to invest in the transition from TDM to IP.

Service providers are already voluntarily entering into these commercial agreements based on existing industry standards without any regulatory oversight. Such business arrangements are effective and no further regulatory mandates are necessary.

5 Near Term NNP Solutions; National LRN and Non-Geographic LRN

This clause provides the analysis of the near-term NNP solutions; National LRN and Non-Geographic LRN.

NNP breaks down the association between TNs and geography. In light of NNP, the FCC⁶ is considering changing policies regarding N-1 query processing and interLATA call processing for NNP TNs.

Regardless of the technical solution, full deployment of NNP will necessitate that the FCC first expand its number portability requirements beyond rate center and LATA boundaries and lift all restrictions that could prevent the porting of any telephone number to or from anywhere in the nation.

5.1 National LRN Solution

5.1.1 Overview

The National LRN NNP solution allows Location Routing Numbers (LRNs) to be used outside of the current LATA boundaries, thereby allowing TNs to be “ported” nationally. This NNP solution assumes that Service Providers will be permitted to have an LRN in multiple regional NPACs to identify the customer’s current location. However, this solution takes a straightforward approach, leveraging today’s infrastructure as it utilizes existing call routing functionality without the “costs” of additional administrative overhead.

⁶ In the Matter of National Number Portability, WC Docket No 17-244.

5.1.2 Impacts

5.1.2.1 SS7 Signaling

The National LRN NNP Solution requires no changes to the SS7 signaling used to support NP queries or call setup.

5.1.2.2 Call Processing & Network Routing

There is no requirement to change the call processing and network routing.

However, service providers would need to conduct an assessment to determine the network impacts of either performing all queries at the point of origination or maintaining the N-1 call completion scenario with the understanding that those TNs porting outside the LATA may require additional routing. In addition, some assessment of network equipment (e.g., switches) ability to handle substantially more NPAs (due to potential ported TNs from a much wider base of NPAs than the equipment may have the capability to handle today) needs to be performed.

Calls to ported numbers may appear to be local but querying the Local Number Portability (LNP) database will return an out-of-LATA LRN. Regional Bell Operating Company (RBOC) switch generics may be coded to block this type of call or to hand them off to an Interexchange carrier (IXC).

5.1.2.3 NPAC

Current NPAC system processes require the LRN and TN NPA-NXX components to be associated to the same LATA. Changes to support this proposal would require existing edits to be modified. Also, currently local systems connect to the regional NPAC Service Management System (SMS) database based on numbers being broadcast to the region where the NPA-NXX is allocated. Local systems would need to connect to all regions that numbers may port from and have the additional necessary capacity to receive the network routing information in support of the NPDB used for call routing.

The impacts to local systems, both Service Order Administration (SOA) and Local Service Management System (LSMS), would need to be assessed. Dependencies, assumptions, or design and implementation decisions likely exist regarding the relationships between NPA-NXXs, LRNs, and geographic areas of service and/or single NPAC regions. Present system implementations may be based on the current porting rules regarding porting only within a single LATA and/or NPAC region, and that association of an LRN with a single NPAC region, as well as rules that specify that a ported TN record can only exist in one NPAC region.

5.1.2.4 Numbering Administration

There should be no impacts on national number administration.

However, numbering resources are state managed. Porting TNs out-of-state raises questions of regulatory and service provider responsibilities, liabilities, and numbering resource management.

State regulatory oversight aligns with NPA boundaries (all NPAs have geographical boundaries that lie within a given state) and all rate center boundaries lie within a given state. Rare isolated cases may exist between states having a common border to address various dialing and servicing issues for small areas.

5.1.2.5 Accounting/Billing

If call typing, e.g., local versus long distance (LD), is modified to be based on the LRN (for a TN ported out of its LATA) versus the dialed NPA-NXX, then from a consumer's point of view there could be some confusion if local/toll plans are involved, as there would be calls to the same NPA-NXX that are sometimes local and sometimes toll.

5.1.2.6 PSTN/IP Interworking

There should be no impacts on PSTN/IP interworking.

Although there is no industry consensus on how to route calls in an IP environment, many of the IP routing scenarios proposed do not change any of the existing industry regulations, processes, or assumptions. Therefore, there are many who hold the belief that the implementation of IP would not change the administration of how numbers are assigned from the NPA-NXX level downward, nor how routing data, NPAC, pooling, and block data are currently provisioned and distributed.

Consequently, this proposed national LRN solution would be pertinent in an all-IP environment unless, or until, the industry agrees that the provisioning and routing would be fundamentally different than how it occurs today and defines the requirements and specifications for its implementation.

5.1.2.7 Regulatory Related Services

5.1.2.7.1 Emergency Services

For ported wireless numbers, emergency calls should be handled as they would be for roamers. The impacts associated with emergency originations from numbers ported to wireline service are the same as described in clause 4.1.2.7.1 because the routing mechanisms used for calls to 9-1-1 are independent of the routing mechanisms used to route calls to ported numbers. The use of national LRNs will not create any additional impacts other than those identified in clause 4.1.2.7.1.

5.1.2.7.2 NS/EP

The general impacts identified in clause 4.1.2.7.2 are also applicable for the National LRN approach.

5.1.2.8 Policy

Dialing plan consistency (e.g., national 1+10-digit dialing) may be needed. For example, variations exist across the country with how calls can/should be dialed, i.e., 1+10 digits, 10-digits, and/or 7-digits. These are often related to logic associated with the dialed number relative to routing. For example, local calls originating and terminating within the same NPA, if only one NPA today serves the area, are usually dialed on a seven-digit basis. Areas where NPA overlays have occurred are dialed as 1+10-digits or 10-digits depending on the dial plan approved by the state. NNP impacts on the varying dialing plans and the associated impacts on consumers need to be assessed.

5.1.2.9 Summary

The national LRN approach allows a number to be ported to a foreign LRN – one with an NPA-NXX outside the LATA of the ported number. Conventionally, an originating carrier does not perform an LNP query on numbers outside of the LATA but routes the call instead to an IXC (the N-1 carrier) for query. In an NNP environment, this could cause a foreign number ported into a LATA to be sent unnecessarily to an IXC and might generate unnecessary toll charges. An originating service provider query would prevent this. On the other hand, if a local number is ported out of the LATA, an originating service provider query would allow proper routing, but the resulting toll charges might be unanticipated by the caller.

It is noted that the following challenges exist:

- The capability to query on calls to NPA-NXXs outside the LATA may not be uniformly supported.
- It is not clear how the existing six-digit query triggers can accommodate the number of foreign NPA-NXX ports. There may be too many potential NPA-NXXs for the normal six-digit (NPA-NXX) triggers to be employed for NNP, due to switch table limitations. However, a three-digit trigger may suffice.
- Even assuming a successful query, the switch must be able to override the normal requirement that the type of route (local or IXC) be selected based on analysis of the dialed number before the query rather than on the LRN.
- Carriers that want to avoid using LD routing for a call that has been ported into the local LATA must have access to all seven NPAC regions and the capacity to manage seven regions of porting data, either directly or through third-party commercial arrangements. It should be noted that the switches of many small and larger regional carriers do not have direct access to all seven NPAC regions.

The fact that LRNs are assigned on a per-switch, per-LATA basis also has important implications. When a foreign number ports into a LATA, neither the dialed number nor the LRN will allow determination of whether a call to the number from within the ported-to LATA is local, Extended Area Service (EAS), or IntraLATA toll. To the extent these distinctions remain important for routing, end user billing, or intercarrier settlements, implementation of NNP via a national LRN approach will require changes in policy.

Carriers also need to consider potential billing and settlement impacts of numbers ported outside the LATA, including what modifications might be required to ensure that jurisdiction-related factors (such as taxes) will be properly handled.

5.2 Non-Geographic Location Routing Number (NGLRN) Solution

5.2.1 NGLRN Solution Description

The NGLRN solution proposes a new numbering resource that includes a non-geographic area code to be used for routing numbers (NGLRNs) associated with NNP ported TNs. Calls to geographic TNs that have been ported would then be routed using an NGLRN. The area code of the NGLRN can be used as an indicator to networks that the call may be treated differently. For example, an NGLRN may indicate that the call can be billed or routed differently. NGLRNs would be hosted on a network of IP switches [Non-Geographic Gateways (NGGWs)] for call routing and termination. Connectivity to the NGGWs would only be offered using IP. NGGW providers would volunteer to offer this function and likely be vetted by an industry body.

The NGLRN solution requires that all carriers have the ability to route to NGLRNs. Carriers may choose to have agreements with transport providers who can route to NGLRNs rather than do it themselves. Otherwise, the solution does not require carriers to offer NNP service to their customers, connect directly to NGGWs, nor interface with administrative systems or processes required to enable the solution.

5.2.2 Impacts

5.2.2.1 TDM/SS7 Network

The NGLRN solution does not require any changes or modifications to TDM/SS7 infrastructure.

One of the key issues with regard to implementing any new industry-wide service or function is the impact it may have on TDM/SS7 networks. Given the migration to IP, TDM/SS7 infrastructure is becoming very difficult to maintain, i.e., there is very little expertise regarding the operation and maintenance of legacy systems, and manufacturers are no longer producing or updating these legacy systems and interfaces. Therefore, any solution proposed for NNP cannot require any changes to TDM/SS7 infrastructure.

The NGLRN solution does not require any changes to TDM/SS7 networks. The only requirement on TDM/SS7 networks is the ability to route calls based on an area code, which has always been a basic requirement of all telecommunications networks. This includes the ability to route calls based on non-geographic area codes (e.g., calls to toll-free numbers).

Carriers have a choice of either implementing connectivity to the IP network that supports NGLRNs or contracting with a transport provider that interfaces to that network. Carriers with TDM/SS7 networks may choose to contract with a transport provider to handle calls to NGLRNs. This would be a simple matter of routing to the transport provider based on the area code of the NGLRN.

5.2.2.2 Call Processing/Network Routing

The NGLRN solution does not require originating queries on all calls nor changes to interLATA call processing, however, the same considerations regarding the efficient routing of calls to ported numbers apply as for the National LRN solution.

Some carriers have a requirement to offer their customers a choice of IXC, e.g., due to equal access requirements. These carriers also have a requirement to suppress the LNP query at the originating switch for calls that appear to be inter-LATA and pass those calls off to the IXC so that the IXC may perform the query. This process is performed to accommodate the N-1 query requirement. Some carriers offer their customers both local and long-distance

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service. For calls to numbers within a portable NPA-NXX, the carrier could choose to query the call in the originating network because they are both the originating carrier and the N-1 carrier.

The one main requirement for all carriers is that they have the ability to route calls to NGLRNs. To do this, carriers will route calls to NGGWs. The latter means that carriers may need to enter into an agreement with an IP transport provider to complete calls to NGLRNs. Policies must be established to ensure this requirement

With the NGLRN solution, carriers can handle calls the way they do today. That is, if they follow the N-1 routing they can hand calls off to the IXC, if they perform originating queries on all calls they can continue to do that, and if they contract with a transport provider to perform LNP queries they can continue to do that. The only requirement is that a carrier supports a mechanism that will allow them to route calls to NGLRNs.

To implement NGLRNs, it may be more efficient, but not necessary, for the FCC to rescind the N-1 query requirement as well as the interLATA call processing requirement for calls to NNP TNs.

5.2.2.3 NPAC

There are no software modifications required to the NPAC for the NGLRN solution.

NGLRNs will have to be added to the NPAC as valid LRNs, as is done today for geographic LRNs. The main difference is that the same NGLRN will be able to be duplicated across multiple NPAC regions. Operationally this is not done today.

5.2.2.4 Number Administration

The NGLRNs will need to be administered by some entity. This could be done by either of the existing administrators [i.e., the North American Numbering Plan Administration (NANPA) or the Pooling Administrator (PA)], or the industry could choose to select a new administrator.

NGLRNs will have to be allocated to the terminating carrier. Service provider and routing information (e.g., the NGGW address) must be associated with the NGLRN. This data needs to be available to carriers.

NGLRNs are only 10-digits; there are no block assignments. The area code (3-digits) is an indication to PSTN networks to route to an IP network. Once on the IP network, the full 10-digits will be used to determine an Internet address, such as a Uniform Resource Identifier (URI). The NGLRN administration system will provide the 10-digit NGLRN-to-URI mapping.

5.2.2.5 Accounting/Billing

Accounting/billing changes to the end user are up to each carrier. This applies to all proposed NNP solutions.

Carriers that bill on a minute basis will not need to change billing.

The NGLRN solution does not propose a method of providing the customer's geographic location to originating networks. This means that this solution does not support distance-based billing, nor does it consider the questions surrounding intercarrier compensation.

5.2.2.6 PSTN/IP Interworking

There is no industry consensus on where the PSTN/IP interworking is required to take place between TDM networks and IP networks. This must be addressed through the terms of an interconnection or traffic exchange agreement.

The NGLRN solution provides the ability to interwork the TDM/SS7-based PSTN with a post-transition IP-based PSTN and the ability to transition customers and the network from TDM/SS7 to IP.

The NGLRN solution assumes the availability of an all-IP network of switches (i.e., the NGGWs) that interconnect with the TDM/SS7 PSTN as a result of routing calls based on an NGLRN. TDM/SS7 switches would route calls based on the NGLRN area code to a transport network (the carrier's own or a third party's) that can route calls to the terminating network via the NGLRN.

5.2.2.7 Regulatory Related Services

There is no new functionality required for the NGLRN solution to enable regulatory related services. However, this option poses no requisite for interconnection otherwise provided by existing Tariff or Interconnection Agreements applicable to the PSTN.

5.2.2.7.1 Emergency Services

Calls to 9-1-1 initiated by wireless and VoIP customers that have ported their TNs using an NNP solution would use the pANI-based solutions that are currently deployed. Calls to 9-1-1 initiated by wireline customers that have ported their TNs under NNP will be subject to the same considerations as described in clause 4.1.2.7.1. The impacts identified in clause 4.1.2.7.1 are independent of the use of NGLRNs to support NNP.

5.2.2.7.2 NS/EP

The general impacts identified in clause 4.1.2.7.2 are also applicable for the NGLRN approach. In addition, there will be a need to ensure that the network of NGGWs (IP network) is capable of recognizing and providing priority to NS/EP calls/sessions including any query/response to NPDBs. Also, there will be a need to make sure that any third-party arrangement as described for the NGLRN option has the necessary capabilities to provide priority treatment and handling of NS/EP calls/sessions (i.e., if the third party is not a GETS Service Provider).

5.2.2.8 Policy

The only policy change specific to the NGLRN solution is requiring carriers to have the ability to route to NGLRNs. Carriers may choose to have agreements with transport providers who can route to NGLRNs rather than do it themselves. As described in clause 5.2.1, this solution does not require carriers to offer NNP service to their customers, connect directly to NGGWs, nor interface with administrative systems or processes necessary to enable the solution.

Regardless of the technical solution, full deployment of NNP will necessitate that the FCC first expand its number portability requirements beyond rate center and LATA boundaries and lift all restrictions that could prevent the porting of any telephone number to or from anywhere in the nation.

NNP further breaks down the association between TNs and geography. In light of NNP, the FCC⁷ is considering changing policies regarding N-1 query processing and interLATA call processing for NNP TNs.

5.2.2.9 Summary

The NGLRN approach handles porting numbers outside of the LATA by associating them to non-geographic LRNs formed from a special non-geographic NPA. Calls to NNP-ported numbers would be routed based on NGLRNs to special gateways so that the calls can be completed over an IP network where transport would be provided from the originating LATA to the terminating carrier. The jurisdictional issues identified above for the national LRN approach would also need to be addressed for the NGLRN approach.

An originating LNP query for all calls would be helpful, but not required, in the context of the NGLRN solution (as it would be for the national LRN solution) to avoid routing what might turn out to be a local call to an IXC. The implementation of an NGLRN approach also requires carriers to consider potential billing and settlement impacts of numbers ported outside the LATA, including what modifications might be required to ensure that jurisdiction-related factors (such as taxes) will be properly handled.

It should be noted that the following challenges exist:

- A new non-geographic area code to be used for LRNs (NGLRNs) for call routing to NNP TNs.
 - Administrative processes for managing the new numbering space.

⁷ In the Matter of National Number Portability, WC Docket No 17-244.

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- Association between NGLRN and routing and service provider information.
- A network of IP switches (non-geographic gateways, or NGGWs) to host the NGLRNs.
 - Similar to today's LATA tandems.
- Service providers must route calls to NGGWs on an IP network to complete to NGGWs/NGLRNs for delivery to the terminating network based on the NGLRN.
 - Service providers can route to the IP network either using their own network or a partner network.

Service providers have built their operational support systems and network processes around the existing number allocation and porting systems and processes. Implementing the NGLRN approach likely require network related changes. These may include reconfiguration of the legacy TDM network to facilitate routing, a change that would require further investment in the legacy networks

5.3 Summary and Comparison of National LRN & Non-Geographic LRN Solutions

Table 5.1 - Summary of National & Non-Geographic LRN Impacts

Impact Analysis Summary	National LRN	Non-Geographic LRN
SS7 Signaling	None.	None.
Call Processing	May appear to be Out of LATA but now local. Suppression of LNP query by some carriers.	May appear to be Out of LATA but now local. Suppression of LNP query by some carriers. Restrict NNP port-ins to wireless and VoIP carriers.
Network Routing	Query at point of origination vs N-1.	Query at point of origination vs N-1. Process to provision and distribute new NGLRNs, Arrangement with a carrier for calls to NNP TNs, new network element.
Number Administration	Porting TNs out-of-state raises regulatory questions.	New NPA, select Adm., allocate to NGGW providers. Porting TNs out-of-state raises regulatory questions.
NPAC	Connect to multiple regional DBs.	New NGLRN added to all seven regional databases. Needs new data element so not to conflict with existing LRNs.
Accounting/Billing	Yes- Ported out of LATA calls – could be local or toll.	Yes - Ported out of LATA calls – could be local or toll. Does not support distance-based billing – does not convey geographic location to originating network.
PSTN/IP Interworking	None.	Impact is dependent upon Interconnection options and obligations of providing interworking function.
Emergency Services	No solution-specific impact.	No solution-specific impact.
NS/EP	No solution-specific impact identified.	No solution-specific impact identified.

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Impact Analysis Summary	National LRN	Non-Geographic LRN
Policy	Dialing Plan consistency, N-1 requirement, changes to intercarrier compensation.	Dialing Plan consistency, N-1 requirement, changes to intercarrier compensation.

Facilitating a national LRN, or NGLRN approach would require that carriers examine changes that may be necessary to their systems, processes, and equipment. Implementation of the National LRN or NGLRN approach may necessitate updates to the existing Industry Numbering Guidelines and/or the development of new guidelines and would require a more detailed analysis and possibly testing.

These options have common set of impacts

- Service providers would need to conduct an assessment to determine the network impacts of either performing all queries at the point of origination or maintaining the N-1 call completion scenario with the understanding that those TNs porting outside the LATA require additional routing in the case of National LRN or further specification of how the call is routed to the Non-Geographic LRN.
 - The capability to query on calls to NPA-NXXs outside the LATA may not be uniformly supported.
 - It is not clear how the existing six-digit query triggers can accommodate the number of foreign NPA-NXX ports. There may be too many potential NPA-NXXs for the normal six-digit (NPA-NXX) triggers to be employed for NNP, due to switch table limitations. However, a three-digit trigger may suffice.
 - Even assuming a successful query, the switch must be able to override the normal requirement that the type of route (local or IXC) be selected based on analysis of dialed number before query rather than on the LRN.
 - The fact that LRNs are assigned on a per-switch, per-LATA basis also has important implications. When a foreign number ports into a LATA, neither the dialed number nor the LRN will allow determination of whether a call to the number from within the ported-to LATA is local, EAS, or IntraLATA toll. To the extent these distinctions remain important for routing, end user billing, or intercarrier settlements, implementation of NNP via a national LRN or NGLRN approach will require changes in policy
- Numbering resources are state managed. Porting TNs out-of-state raises questions of regulatory and service provider responsibilities, liabilities, and numbering resource management.
- From a consumer point of view there could be some confusion if local/toll plans are involved, as there would be calls to the same NPA-NXX that are sometimes local and sometimes toll. The NGLRN approach does not support distance-based billing.
- From an NPAC perspective:
 - NGLRNs will have to be added to the NPAC as valid LRNs, as is done today for geographic LRNs. The main difference is that the same NGLRN will be able to be duplicated across multiple NPAC regions. Operationally, this is not done today.
 - From a National LRN perspective current NPAC system processes require the LRN and TN NPA-NXX components to be associated to the same LATA. Changes to support this proposal would require existing edits to be modified. Also, currently local systems connect to the regional NPAC SMS database based on numbers being broadcasted to the region where the NPA-NXX is allocated. Local systems would need to connect to all regions that numbers may port from to receive the network routing information in support of the NPDB used for call routing
- Dialing plan consistency (e.g., national 1+10-digit dialing) may be needed. For example, variations exist across the country with how calls can/should be dialed, i.e., 1+10-digits, 10-digits, and/or 7-digits. These are often related to intelligence in the dialed number relative to routing. For example, local calls originating and terminating within the same NPA, if only one NPA today serves the area, are usually dialed on a seven-digit basis. Areas where NPA overlays have occurred are dialed as 1+10-digits or only 10-digits depending on the dial plan approved by the state. NNP impacts on the varying dialing plans need to be assessed

This NGLRN option has not only administrative impacts associated with identifying and administering a new, as yet undefined non-geographic numbering resource, but also network impacts including the development and deployment of yet undeveloped network elements, e.g., NGGW, and changes in how routing is currently performed, e.g., may require a dip outside of the current ecosystem and requires TDM carriers to partner with an IP carrier, if the carrier participates, for query and routing.

Implementing either of these options would require Service Providers to make changes to their networks and systems. In addition, to support any of these options, Regulators would need to ensure that the regulatory environment complements the technical approach.

6 Long Term NNP Solution – Internet Interconnection

This clause describes a long-term solution for providing NNP.

6.1 Internet Interconnection

6.1.1 Overview

The US is moving towards IP interconnection on a nationwide basis. Unlike the legacy PSTN where the originating network determines the route, IP interconnection may have different characteristics compared to TDM. For example, service providers will be responsible for getting traffic to and from aggregation points where it will be exchanged with other carriers.

Where service providers cannot agree on the terms of interconnection, the default is for each to provide a POI on the Internet, essentially a set of Session Border Controller addresses where traffic can be delivered. Under Internet interconnection all service providers must be able to resolve telephone numbers to IP addresses for interconnection. This may be accomplished in a number of ways, whether directly by a secure query infrastructure that replaces the functions of the NPAC and LERG or indirectly via existing numbering aggregation constructions such as central office codes and LRNs.

Originating service providers will resolve the dialed North American Numbering Plan (NANP) number for all calls to an internet address whether based on bilateral agreements for interconnection (which may still predominate) or the default Internet POI and route the call to its destination regardless of the location of the called number.

Unlike the legacy PSTN where the originating network determines the route, IP interconnection may have different characteristics compared to TDM. As Service Providers introduce and expand IP-based service offerings, there is increasing interest in identifying the opportunities for the industry to facilitate IP routing of VoIP traffic using E.164 addresses. In 2015 the ATIS/ Session Initiation Protocol (SIP) Forum Internet Protocol Network to Network Interface (IP-NNI) Task Force had taken on the initiative to develop a Technical Report to describe the candidate proposals recognizing that IP traffic exchange is developing as an overlay to existing TDM interconnection and will be implemented by different service providers with varying timelines.

The Report presented multiple views of current IP interconnection and routing mechanisms. Although the Report did not identify a specific recommendation, it did highlight the complexities of various alternatives. One of the assumptions is that the traditional legacy TDM routing paradigm based on block, NPA-NXX, and LRN routing will no longer be the basis for routing. Instead, IP routing may be based on the entire TN, which would eliminate the need for LRNs. This change would have cascading impacts on systems and operations, number administration, etc. At the same time, due to this paradigm shift it would enable new network functionality and regulatory requirements such as enabling National Number Portability.

6.1.2 Summary of Impacts

6.1.2.1 SS7 Signaling

No new SS7 capabilities are required. Existing interworking between SS7 Integrated Services Digital Network User Part (ISUP) and SIP will suffice.

6.1.2.2 Call Processing

All service providers must be able to resolve telephone numbers to IP addresses for interconnection. This may be accomplished in a number of ways, whether directly by a secure query infrastructure that replaces the functions of the NPAC and LERG or indirectly via existing numbering aggregation constructions such as central office codes and LRNs.

6.1.2.3 Network Routing

Whether the recipient SP should be required to effectively establish a POI in the originating service area by obtaining numbering resources (even a 10-digit LRN) so the issue of how an interconnection agreement will work requires further study. Alternatively, SPs could connect through intermediaries where an Independent Computing Architecture (ICA) did not previously exist. How this intermediary role may be kept minimal, e.g., signaling broker as opposed to full Internetwork Packet Exchange (IPX) transport provider, requires further study. The answer may lie in arrangements to certify SPs and allow them to access any Internet POI on that basis through some security infrastructure.

6.1.2.4 NPAC

The NPAC can be used for TN to IP resolution as considered in the ATIS/SIP Forum IP-NNI Task Force routing Report, ATIS-1000063. Alternatively, it can be replaced by a secure, possibly distributed, registry infrastructure that directly resolves dialed numbers to interconnection addresses on a portability corrected basis.

6.1.2.5 Numbering Administration

Number administration need not change but could evolve to more easily support non-geographic assignment, if that were judged desirable, since in-LATA POI establishment would not be required.

6.1.2.6 Accounting/Billing

With terminating compensation defaulting to bill & keep and end user billing moving to all distance or unlimited offers, there will be no unexpected toll charge issues and no jurisdictional routing problems. Transport arrangements and cost recovery follow the Internet model providing competitive market discipline and eliminating opportunities for arbitrage.

6.1.2.7 PSTN/IP Interworking

The Internet Interconnection model assumes the PSTN has become all-IP, at least with respect to interconnection.

6.1.2.8 Regulatory Related Services

6.1.2.8.1 Emergency

The mechanisms used to route 9-1-1 calls in an all-IP environment have been specified in applicable standards and are independent of the routing mechanisms used to route calls to ported numbers.

6.1.2.8.2 NS/EP

The general impacts identified in clause 4.1.2.7.2 are also applicable for the Internet approach. In addition, as discussed in clause 10.2.3.6 of [ATIS-1000071], given that "The Internet Interconnection considers the implementation of NNP in an environment in which this requirement for interconnection is replaced with a default requirement to provide a POI on the Internet," NS/EP implications need further study. Specifically, given that NGN-GETS is based on the assumption that NS/EP communications will be supported over carrier managed IP-based NGNs, it means that the concept of replacing the requirement for interconnection with a default requirement to

provide a POI on the Internet will need specific arrangements to address priority treatment, QoS, and security of NS/EP calls/sessions.

6.1.2.9 Policy

Internet Interconnection requires a redefinition of interconnection obligations.

6.1.2.10 Summary

Table 6.1 - Summary of Internet Connection Impacts

Impact Analysis Summary	Internet Interconnection
SS7 Signaling	None.
Call Processing	Must be able to resolve telephone numbers to IP addresses for interconnection.
Network Routing	Network interconnection and routing alternatives exist and further analysis is needed.
Number Administration	Need not change.
NPAC	TBD – Depending on industry approach.
Accounting/Billing	With terminating compensation defaulting to bill & keep and end user billing moving to all distance or unlimited offers, there will be no unexpected toll charge issues and no jurisdictional routing problems.
PSTN Interworking	Assumes All IP Interconnection.
Emergency Services	No solution specific impact.
NS/EP	Further analysis needed. Will need specific arrangements to address priority treatment, QoS, and security of NS/EP calls/sessions on Internet POI.
Policy	Requires a redefinition of interconnection obligations.

As shown in Table 6.1, there are impacts related to the implementation of all IP infrastructure. As was mentioned, Service Providers are transitioning their networks to IP, and the industry needs to determine an acceptable path forward for interconnection and routing in an all-IP environment. However, it is noted that the implementation of an all IP-environment enables the introduction of NNP without modifications or changes to the existing TDM infrastructure.

7 NNP Option GR-2982-CORE – No Longer Being Considered

This clause provides information as to why the NNP solution based on GR-2982-CORE⁸ is no longer being considered as an NNP option.

The GR-2982-CORE-based Portability Outside the Rate Center (PORC) solution requires changes to the SS7 Transaction Capabilities Application Part (TCAP) signaling used in querying an NP database. Specifically, it requires the use of a new value in the Trigger Criteria Type parameter of the NP query, and the inclusion of Terminating GUBB information in the NP response. The PORC solution also has SS7 ISUP signaling impacts in that it requires the assignment of a new value to the O bit in the in Forward Call Indicators (FCI) parameter, as well as new values in the Type of Digits field within the SS7 Generic Digits Parameter associated with GUBB information.

Interconnection agreements associated with a GR-2982-CORE-based NNP solution would have needed to address support for NNP between networks, and specifically support for the transport of additional signaling elements (e.g., Terminating GUBB, Redirecting GUBB, and FCI O Bit information) between networks. Interconnection Agreements would also have to address policies related to billing/settlements between interconnected carriers, and the use of GUBBs to drive call rating and carrier selection.

This NNP option cannot be implemented given its impact on legacy, manufacturer-discontinued network elements and the significant changes required to SS7 and therefore should be removed from consideration as an NNP option.

8 Recommendations & Path Forward

The existing LNP system was designed in many ways to minimize the impact upon then-existing regulatory and billing schemes, which distinguished between local and toll calls. This was at a time when Bell Operating Companies were not yet allowed to carry interLATA traffic. While there are technical challenges to National Number Portability, it cannot be implemented without changing the complex system of compensation from a consumer and intercarrier perspective that drives the industry.

It is apparent that the Commercial Agreement approach provides the most cost efficient NNP approach to the industry because it is currently in use and available now. However, it is not without issues, as described in clause 4. If these challenges are appropriately addressed, commercial agreements are the current method of facilitating NNP and have the elements necessary to be the recommended interim solution that would have the least financial and operational impact to the industry's service providers.

The near-term NNP approaches detailed in clause 5, National LRN and Non-Geographic LRN, have technical and regulatory implications. Implementing any of these approaches comes with significant cost to the industry with changes to routing, charging, modifications to the NPAC, etc., as well as regulatory considerations including dialing plan consistency, number administration issues, and changes to inter-carrier compensation. The issue to address in the near-term approaches is not only the cost in network modifications but the required regulatory changes to implement NNP. Impacts associated with the near-term NNP approaches must be weighed against the number of subscribers who would utilize the capability.

The NNP option, GR-2982-CORE, cannot be implemented given its impact on legacy, manufacturer-discontinued network elements, and the significant changes required to SS7, and is therefore removed from consideration as an NNP option.

The long-term approach, Internet Interconnection, which is preferred, provides a path forward for enabling NNP, but it comes without a definite timeframe or the specification of a default interconnection paradigm. It should be noted that regulatory changes would still need to be made prior to NNP implementation.

NNP is available now via Commercial Agreements, but if one of the near-term approaches is being contemplated, it would be advisable to get a cost assessment from the FCC. The cost assessment could be supported using information provided by industry stakeholders and would be a valuable tool in evaluating each of the options.

This assessment could then be used to evaluate the implications remaining with commercial agreements until the preferred long-term approach is viable or by implementing one of the near-term approaches.

⁸ GR-2982-CORE, *Local Number Portability (LNP) Capability Specification: Location Portability, Issue 1*, December 1997

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Regardless of the technical solution, full deployment of NNP will necessitate that the FCC first expand its number portability requirements beyond rate center and LATA boundaries and lift restrictions that could prevent the porting of telephone numbers to or from anywhere in the nation.

9 Impact Analysis Matrix

The following table provides a comparison of the proposals and impacts.

	Commercial Agreements	National LRN	Non-Geographic LRN	Internet Interconnection	GR-2982-CORE
SS7 Signaling	None	None	None	None	Requires changes to the SS7 TCAP signaling used in querying an NP database.
Call Processing	None	May appear to be Out of LATA but now local. Suppression of LNP query by some carriers.	May appear to be Out of LATA but now local. Suppression of LNP query by some carriers. Restrict NNP port-ins to wireless and VoIP carriers.	Must be able to resolve telephone numbers to IP addresses for interconnection.	Requires the use of a new value in the Trigger Criteria Type parameter of the NP query, and the inclusion of Terminating GUBB information in the NP response. Also requires the use of GUBBs to drive call rating and carrier selection.
Network Routing	Further analysis if POI provider is a wireline carrier and the recipient carrier is wireless.	Query at point of origination vs N-1.	Query at point of origination vs N-1. Process to provision and distribute new NGLRNs, Arrangement with a carrier for calls to NNP TNs, new network element.	Network interconnection and routing alternatives exist and further analysis is needed.	A PORC-capable switch must be able to distinguish NPA-NXXs that have been designated as portable, launch a PORC query to the LNP database requesting information necessary to rate and route a call.
Number Administration	None	Porting TNs out-of-state raises regulatory questions	New NPA, select Adm., allocate to NGGW providers Porting TNs out-of-state raises regulatory questions.	Need not change.	Porting TNs out-of-state raises regulatory questions.
NPAC	None	Connect to multiple regional DBs	New NGLRN added to all seven regional databases. Needs new data element so not to conflict with existing LRNs.	TBD – Depending on industry approach.	Will require that GUBBs, like LRNs, be administered over a wide geographic area. The NPAC could expand its role to include administration of GUBBs. This would require new functionality at the NPAC.

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	Commercial Agreements	National LRN	Non-Geographic LRN	Internet Interconnection	GR-2982-CORE
Accounting/Billing	Varies	Yes- Ported out of LATA calls – could be local or toll.	Yes - Ported out of LATA calls – could be local or toll. Requires minute based billing – does not convey geographic location to originating network.	With terminating compensation defaulting to bill & keep and end user billing moving to all distance or unlimited offers, there will be no unexpected toll charge issues and no jurisdictional routing problems.	GUBBs provide the basis for real-time rating. Assumes a billing policy in which the end user calling a PORC TN would incur the transport charges for the call.
PSTN/IP Interworking	None	Impact is dependent upon Interconnection options and obligations of providing interworking function.	Impact is dependent upon Interconnection options and obligations of providing interworking function	Assumes All IP Interconnection.	Extensions to SIP would be needed. New SS7-SIP interworking would need to be defined.
Emergency Services	Further analysis for ported to wireline.	No solution-specific impact.	No solution-specific impact.	No solution-specific impact.	No solution-specific impact.
NS/EP	No solution-specific impact identified.	No solution-specific impact identified	No solution-specific impact identified	Further analysis needed. Will need specific arrangements to address priority treatment, QoS, and security of NS/EP calls/sessions on Internet POI.	No solution-specific impact identified.
Policy	Expand portability requirements beyond rate center boundaries. Lift all restrictions that could prevent the porting of any telephone number to or from anywhere in the nation.	Dialing Plan consistency, N-1 requirement, changes to intercarrier compensation.	Dialing Plan consistency, N-1 requirement, changes to intercarrier compensation.	Requires a redefinition of interconnection obligations.	Conforms to existing LNP policy.