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MAY 15 2019
Federal Communications Commission
Office of the Secretary

Kris Anne Monteith
Federal Communications Commission
Washington, D.C. 20554

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By electronic mail

Re: Additional Findings Report on Nationwide Number Portability

Ms. Monteith:

By this letter, I am transmitting the above-titled final report, which is responsive to your July 3, 2018 correspondence regarding the same.

As you know, the Nationwide Number Portability (NNP) Working Group has been evaluating issues concerning NNP since the Wireline Competition Bureau first referred to the NANC the topic in December 2017. Since that time, the NNP Working Group has reduced the choices essentially to two options: a National Local Routing Number (NLRN) or an Internet Protocol Local Routing Number (IPLRN).[1]

This choice depends on the trajectory of technological change in the industry. For example, an industry that comes to use IP to facilitate substantially all telephony could make IPLRN a relatively easy choice. The report does not reach a definitive conclusion of either of these options. However, the report identifies the commonalities in how calls are processed, and graphically represents these in an attachment to the report.

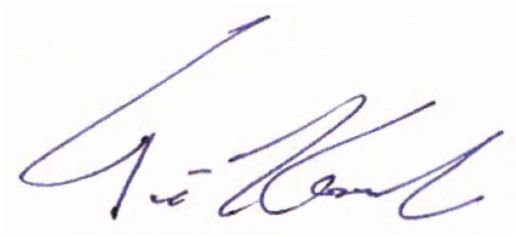
The report also does not conduct a comprehensive cost-benefit analysis. I regret to say that in this regard, despite the NNP WG's efforts, the NANC has still fallen short of the referral letter's mandate to the advisory committee. Part of the difficulty is that a net benefits analysis would have to make certain assumptions about the pace of various actors' technological change.

[1] The IPLRN is the renamed Non-Geographic Local Routing Number, as described in the previous NANC report on this subject.

Additionally, putting aside the totality of costs and benefits, individual systems' costs and benefits under NNP are dependent upon the technologies and protocols they presently use for call routing; they also depend upon the commercial and regulatory relationship of one system to another. There may be further NNP-related work that the NNP Working Group could undertake, as the report suggests. However, there are also policy considerations that the Commission might weigh about a uniform NNP policy versus systems that are not today technologically homogeneous before it considers its next step on this policy item.

I want to thank the NNP Working Group and especially its technical subcommittee, which through many hours met, deliberated, and drafted the enclosed report. The report was adopted at our May 8, 2019 NANC meeting on a majority vote; a minority report is attached at the end of the written report. Although it has not reached a consensus position, I believe the report is worthwhile and hope you find it informative as you continue your review of NNP and related issues.

Respectfully submitted,



Travis Kavulla

Chairman, North American Numbering Council

R Street Institute

North American Numbering Council

Nationwide Number Portability Issues Working Group

Additional Findings Report on Nationwide Number Portability

May 13, 2019

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Executive Summary

On October 26, 2017 the FCC released a Notice of Proposed Rulemaking and Notice of Inquiry. At the direction of the FCC (DA 18-995), the North American Numbering Council (NANC) established the Nationwide Number Portability Technical Sub-Committee to "help the NANC investigate the technical requirements necessary to support NNP and provide more detailed cost/benefit analyses of proposed solutions. The NNP Technical Subcommittee members will report their actions and recommendations to the NNP Issues Working Group, which, in turn, will report to the full NANC."[1]

This Sub-Committee has held numerous meetings. As a means to establish the basis of the deeper technical assessment, the 2 proposed models were reviewed. Detailed call flows were developed, presented, and discussed in detail.

Further discussions resulted in a determination of the commonalities of the two. Then the discussion progressed to the rating, routing, and billing aspects for originating, transit, and terminating switches, resulting in the documentation of those aspects for the 2 proposed models. For clarity, tables were developed to show the changes required, the party incurring the cost, and the level of magnitude of those costs, as well as who benefits. All of the items considered were discussed for the traditional wireline TDM, wireless, and VoIP networks.

[1] *Id.*¶ 3; With publication of the NNP Notice in the Federal Register, the FCC received initial comments in the matter on December 27, 2017 and reply comments on January 26, 2018.

This report brings to light how each of the 2 proposals stacks up for the operationalization each of the aspects above. The details are in the body of the report provided here.

While no consensus was reached in the timeframe allowed for the work, the team remains available and willing to continue to work through the issues.

At its May 8, 2019 meeting, the NANC voted to adopt this report. A minority report, authored by Richard Shockey, is appended following the report.

Introduction and Background

The NNP committee (in the June 2018 report), defined Nationwide Number Portability as:

"The ability of users of telecommunications services to retain existing telecommunications numbers without impairment of quality, reliability; or convenience when switching from one telecommunications carrier to another or when moving from one physical location to another."

The LNP architecture relies upon the use of location routing numbers ("LRNs") which identify the service provider's switch that serves the ported number. The Number Portability Administration Center (NPAC) supports queries of a database associated with the dialed numbers. The query returns the LRN for the dialed number. The FCC currently limits the geographic scope of an LRN to a Local Access and Transport Area ("LATA"), thereby restricting the ability of consumers to port a telephone number to a LATA other than its own. (The United States is covered by about 200 LATAs.)

This report investigates the technical requirements for the proposals for a National Local Routing Number (NLRN), and an Internet Protocol Local Routing Number (IPLRN). It discusses which entities need to make changes to the networks, which entities bear the costs for the changes, as well as which entities reap the benefits of each proposal. We thoroughly reviewed call flows for the two proposals, considered their impact on switching, transit and termination functions and reviewed call routing as well as rating.

We considered regulatory limitations to be beyond the scope of our work.

The working group recognized the difficulty of estimating cost across diverse operational and technical environments and offered order-of-magnitude estimates.

Description of NNP

The FCC released the NNP Notice of Proposed Rulemaking/Notice of Inquiry ("Notice"), on October 26, 2017, which also sought comment on "how best to move toward complete nationwide number portability to promote competition between all service providers, regardless

of size or type of service."[2] Specifically, the FCC requested input from industry stakeholders regarding prior work of the NANC, ATIS and other organizations.

In addition to issuing the NNP NPRM, the FCC's Wireline Competition Bureau ("Bureau") sent a letter to the Chairman of the NANC, dated December 7, 2017[3], directing its NNP WG to:

- Determine whether any of the four models discussed in the NNP Notice are preferable in terms of feasibility, cost, and adaptability to changing markets and technologies;
- Specify in detail the potential costs, benefits and barriers to implementing these proposals;
- Identify any likely consequences of these proposals for routing, interconnection, or public safety;
- Recommend next steps to advance full nationwide number portability; and Make any other recommendations deemed necessary to achieve this goal.

The Bureau further directed the NANC to approve a written report of its findings on those issues, and to transmit that report to the Bureau. The NANC approved this report at its May 29, 2018 meeting and is publicly available at http://www.nanc-chair.org.

On July 3, 2018, the Wireline Competition Bureau further directed[4] the NANC to investigate the technical requirements necessary to support NNP and provide more detailed cost/benefit analysis of proposed lasting solutions to:

1. Provide an analysis of the technical requirements for adopting an Internet Protocol Local Routing Number (IPLRN) solution (previously referred to as NGLRN – Non-Geographic LRN), including which entities will need to make changes if this solution is adopted.
2. Provide an analysis of the technical requirements for adopting a National Location Routing Number (NLRN) solution, including which entities will need to make changes if this solution is adopted.
3. Specify in detail the potential costs and benefits of the NLRN and IPLRN proposals, including which parties could bear which costs and reap which benefits; and
4. Recommend next steps the Commission and industry should take to achieve full nationwide number portability. The initial interim report was requested for the December NANC meeting 2018 The final report was requested for the first NANC meeting in 2019. An extension was given (due to the Government Shutdown) moving the final report's due date to Feb 29, 2019.

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[2] *Id.*¶ 2; With publication of the NNP Notice in the Federal Register, the FCC received initial comments in the matter on December 27, 2017 and reply comments on January 26, 2018.

[3] *See*, Letter from Kris Monteith, Chief, Wireline Competition Bureau, FCC, to North American Numbering Council Chair (Dec. 7, 2017), ("Wireline Bureau Letter"), http://www.nanc-chair.org/docs/mtg_docs/Dec17_NANC_Referral_NNP.pdf.

[4] See, http://nanc-chair.org/docs/mtg_docs/NNP-Ltr-frm-WCB-to-NANC-Chair-7-2018.pdf

A second interim report was done at the NANC's March 2019 meeting. This report includes the additional findings requested.

Description of National Location Routing Number (NLRN)

The National Location Routing Number ("National LRN") model supports national number portability using existing LRNs. The approach allows TNs to be ported beyond the current LATA boundaries, thereby allowing TNs to be made available to customers in any geographic location across the nation. This approach aims to minimize the changes required for routing calls to nationally ported TNs by expanding the use of the existing routing infrastructure.

The NLRN approach also could allow service providers without a nationwide footprint to serve customers who have physically moved outside the rate center or LATA associated with their NPA NXX to an LRN in the rate center or LATA in which they now reside. Thus, "permanent roamer" calls can be routed appropriately based on the nationwide use of LRN while assisting the service providers in determining the correct interstate and jurisdictional nature of the call based on the location of the LRN assigned.

This approach has the disadvantage that it could lead to access stimulation or traffic pumping if service providers associate ported TNs with LRNs that are commercially advantageous but not geographically appropriate to the customer's new physical location or primary place of use.

Existing LRN routing principles can effectively support NNP, although there are some issues, described below, that need to be considered when taking LRNs outside the current construct of rate centers and LATAs.[5]

Description of Internet Protocol Location Routing Number (IPLRN)

The IPLRN solution will keep the current Local Number Portability architecture, including the role and responsibilities of the Number Portability Administration Center (NPAC). A new process would be implemented using IP-enabled switches or third-party IP networks that act as gateways. Service providers could use these gateways to assist in routing NNP calls. IPLRN would not discriminate between wireless and wireline TNs, and the solution may work for both. This is different from the prior approach described by NGLRN where a dedicated network of NGGWs could be created or designated specifically as the entry point to an IP network, from a TDM network, capable of routing IPLRN (NGLRN) NNP calls.

The IPLRN solution has two main elements:

- One or more new non-geographic area codes and administrative process to provide service providers with their own unique IPLRNs specifically and uniquely for NNP;

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[5] Refer to http://www.nanc-chair.org/docs/nowg/Jan06_Hurricane_Impact_Report.doc; and, North American Numbering Council, Local Number Portability Administration Working Group, *White Paper on Non-Geographic Number Portability* (Aug. 30, 2016)

- VoIP nodes, functioning as IP Network Entry Points, that host IPLRNs and provide connectivity to service providers that port in NNP TNs.

To enable NNP for a geographic telephone number ("TN"), the TN is associated with a service provider specific IPLRN within the TNs current NPAC region. This is contrary to currently how a traditional geographic service provider specific LRN is associated to a TN within the same LATA. When a service provider acquires an IPLRN from the new administration function, the service provider would associate a SIP URI to that IPLRN, identifying the specific IP Network to be used for call processing on the VoIP network. Each IP Network entry point delivers calls to one or more networks that terminate calls.

When an LNP query is performed on the dialed TN, the IPLRN is returned. Calls on the TDM network may query the local NPAC database and route based on the IPLRN's 3 digit area code to a VoIP network whether directly over a VoIP interconnect or over a TDM interconnect via a media gateway that would provide the TDM to IP protocol conversion that enables the call to continue in IP on a VoIP network. However, based on the routing of such 3 digit area code, each originating network would need to establish its own unique connection with a TDM interconnect via a media gateway that would provide the TDM to IP protocol conversion that enables the call to continue in IP on a VoIP network. The VoIP network would query the full 6/10 digit IPLRN to obtain the terminating IP Network address, i.e., a SIP URI. Once on the IP Network, the call would be routed to the terminating network. This functionality allows the TDM network to coexist and interoperate with the VoIP network. (*See*, Figure 2 – IPLRN TDM to IP call flow, below).

Calls that originate on a VoIP network may retrieve the 6/10 digit IPLRN from the local NPAC database and either receive the SIP URI in the same query or alternatively, may trigger on the IPLRN 3 digit area code to query a routing database with the full 6/10 digit IPLRN to obtain the IP Network's SIP URI. The call would be routed to the correct terminating IP Network using the SIP URI. (*See*, Figure 3 – IPLRN IP to IP call flow, below).

To summarize, the IPLRN solution uses a VoIP network consisting of VoIP nodes, which will terminate calls to NNP TNs. Service providers have multiple options as to how they update their routing (e.g., NPAC, commercial agreement, internal routing tables). However, there may be an option to update the SIP URI field via SOA and to retrieve IP routing information per number via LSMS. In addition to SOA, there may be an opportunity to include IP information via LERG. The IP Network may then route calls toward the terminating network based upon SIP URI and depending upon the terminating provider; the call may be terminated to a VoIP network or terminated to a media gateway that converts the protocol from IP to TDM. Thus, any time an NNP call is placed on the PSTN, it must route the call to an IP Network entry point so that the IP Network can route the call to the terminating network. For text messaging in an LNP environment, the NPAC records locally cached contain SPIDs that are used rather than LRNs to allow routing to the correct recipient service provider.

Assumptions

1. This report is informed by the Nationwide Number Portability Issues Working Group's initial June 7th report to the North American Numbering Council.
2. We assume central offices which do not currently support LNP will not support NNP either.
3. TDM end office switches are assumed not to be able to support serving customers with NNP numbers.
4. All switches that are currently LNP-capable would need to support the porting out of their customers. If the service provider is not able to provision an NNP subscriber, they would be not required to accept that customer's request.
5. All service providers must allow customers to port out their telephone number using NNP, except those exempted from porting out.
6. Service providers may bear the consequence for routing and transit to an NNP number.
7. For both NLRN and IPLRN, we conclude that All Call Query (ACQ) facilitates NNP and should be supported for all portable NPA-NNX. With ACQ, the originating service provider performs the number portability query on all originating calls. Where ACQ is not technically feasible in a service provider network, the service provider should route the NNP call on dialed digits to a downstream carrier that would perform the query.
8. ACQ, including the exceptions that may be performed downstream, would require the LSMS's access to all NPAC regions.
9. NNP ports will be processed in the code holder's NPAC region. Thus, the NNP recipient Service Provider would require SOA access to all NPAC regions.
10. For IPLRN, we assume all IXCs are IP-capable and can retrieve the URI for forward routing to the NNP subscriber.
11. For IPLRN, we assume all mobile networks use IMS cores and are capable of IP interconnection.
12. If calls traverse the TDM network in order to get to a NNP destination, we assume that the costs associated with doing so would be similar to what they are today, except for calls with the local routing option on IPLRN. For example, if a number was ported from New York to a Californian LRN, then the cost of that call from the original LATA would be equivalent to a long distance call from New York to California.

Cost/Benefit Analysis

The technical assessment for the NLRN and IPLRN approaches includes a cost analysis table which illustrates where Service Providers will likely need to make changes to support NNP based on different switch types. These entries further clarify the magnitude of the cost, who bears that cost vs. who gains the benefit.

Costs are stated as orders of magnitude using the following convention:

- Small (S) - $10K-$90K
- Medium (M) - $100-$999K
- Large (L) - $1M-$9.9M
- Extra-large (XL) - $10M+

Review of Requirements Common to Both Approaches

This section captures the technical requirements common to both the NLRN and IPLRN approach. The discussion is structured by functional switch types (i.e., originating, transit, and terminating switches) as well as their vintage (i.e., legacy TDM, IP) and type (i.e., wireline, VoIP, and mobile). We also apply the relevant telephony functions to each of those switches covering routing, rating, billing & settlement, provisioning, and termination as applicable.

Note that the subscriber billing issue is only relevant for originating SPs who have customers on an LD plan rather than a flat nationwide plan. The billing issue for transit carriers and terminating SPs relates to interconnection and related charges (e.g., transit fees) that may occur on a hop by hop basis, including supporting NNP functions.

For originating switches, both solution approaches have the following requirements:

Routing for originating switches

- All Call Query (ACQ) would be used - the originating switch would query the local NP database to retrieve the LRN for portable called numbers and set an indicator to inform downstream switches that the LRN has been retrieved. The LRN is used to translate digits to find routing instructions. If it does not exist, the dialed digits are used instead. LSMS data for all NPAC regions would be required.
- If the originating switch is not using ACQ, then it would route the call with dialed digits to egress to the next hop and should arrange for the NP query to be performed downstream. This should be the exception.
- The routing instructions will indicate the egress path to the next switch and may include primary and/or secondary routes. This is not a change from current switch behavior. The routing instructions may be to an IP or TDM network as appropriate for the originating carrier's business and technical practices.
- NP queries must be directed to local or hosted databases supporting all NPAC regions. There may be a cost implication for the local infrastructure or for third party hosting fees.
- LD CIC routing decision would need to be based upon the LRN returned by the NP query instead of the dialed digits. It is unknown if this capability exists in TDM networks.

Rating for originating switches

- For NNP calls under LD service plans, determine the rating for the call by using the calling TN, called TN and LRN if it exists. It is probable that the service provider will need to change its rating system to support NNP calls by comparing the dialed NPA-NXX(X) to the LRN in order to recognize the true "distance" of the called party.

- Independent of LD service plans, for NNP, Originating SPs must allocate the call jurisdiction based on the LRN not the called number. Refer to the NLRN and IPLRN sections below for specific points on this item.
- Outside of rating for subscriber billing, there may be a need to incorporate NNP knowledge into the settlement and reconciliation process with downstream partners.

Billing and Settlement for originating switches

- For subscribers with LD service plans, a charge may have been applied that was unexpected by the consumer. In which case, the monthly bill will likely need to explain such charges and/or an education effort undertaken.
- As per the rating requirement, settlement and reconciliation with downstream network interconnection, usage and/or NP query charges will need enhancement unless otherwise agreed.

For transit switches, both solution approaches have the following requirements:

Routing for transit switches

- If ACQ was not used and the LRN needs to be retrieved, then the provider of the transit function should query the local NP database to retrieve the LRN and progress the call. LSMS data for all NPAC regions will be required.
- The provider of the transit function would then find the routing instructions using the LRN if it exists or the dialed digits if not.
- If ACQ was not used and the transit switch is not capable of performing the NP query, then the transit switch would use the dialed digits to egress to the next hop and expect the NP query to be performed downstream. This should be an exception scenario.
- The route list will indicate the egress path to the next switch and may include TDM and/or IP primary and/or secondary routes as well as selection factors beyond the TN or LRN such as intermediate provider routing, traffic balancing, quality or service, etc.
- This is not a change from current switch behavior except that RBOC Tandems currently do not support routing between LATAs. This applies to both NLRN and IPLRN when ACQ and CIC routing was not used by the originating switch. Whether this is hardcoded in the legacy switch software or configurable in routing tables is unknown and may vary by vendor.
- NP queries, if done in the transit switch, must be directed to local or hosted databases supporting all NPAC regions. There may be a cost implication for the local infrastructure or the result of third-party hosting fees.

Rating for transit switches

- The transit switch would determine the rating for the call in terms of transit charges to the upstream provider unless alternate arrangements (e.g., commercial agreement) have been made. This determines potential fees to the prior switch

(which may be the originating switch or another transit switch) as opposed to fees to the calling subscriber.

- Outside of rating for billing upstream, there may be a need to incorporate NNP knowledge into the settlement and reconciliation process with downstream partners unless that traffic is under an alternate arrangement (e.g., commercial agreement).

Billing & Settlement for transit switches

- New cost determinations on NNP calls will need to be incorporated into interconnection/transit fees for upstream billing unless that traffic is under an alternate arrangement (e.g., commercial agreement).
- If the transit provider is performing the LNP lookup on behalf of the originating switch, then this should be considered as potentially part of a commercial arrangement that would incur an incremental fee billed to the originating SP.

For terminating switches (i.e., the SP now serving the NNP subscriber), both solution approaches have the following requirements:

Provisioning for terminating switches

- The terminating SP must be able to provision an outside area end office code for the new NNP subscriber's TN onto their switch/network.
  - For VoIP, this should strictly be a configuration change that removes any previous restrictions for such TNs being provisioned and mapped to User Equipment (UE) within the terminating SP network. If such provisioning restrictions exist at all.
  - For mobile SPs, this should also strictly be a relaxation of provisioning rules in the Subscriber Data Management system (e.g., HLR/HSS), which maps a TN/MSISDN to a mobile station identifier (e.g., IMSI) within the mobile SP network. If such provisioning restrictions exist at all.
  - It is not expected that a legacy wireline switch could provision 200 or more outside area and office codes and thus is unlikely to provide service to NNP subscribers.

Routing and Termination for terminating switches

- The NP query should occur prior to arriving at the terminating switch. In an exception scenario where an originating and or transit switches exhaust all reasonable and expected efforts to query the NP, and the call is routed via dialed digits to the code holder, the code holder should attempt to complete the call to the termination where the ported-out NNP TN now resides. This involves the code holder performing the NP query and trunking the call to the end user for termination. As NNP TNs can be ported beyond the current LATA boundaries, allowing TNs to be made available to customers in any geographic location across the nation, e.g. IntraLATA, InterLATA, Interstate, or Intrastate trunking may be required by the code holder. The originating carrier is responsible for either querying the calls or entering into an arrangement with another entity to query the calls.

Rating for originating switches using NLRN

- Independent of LD service plans, for NNP, Originating SPs must allocate the call jurisdiction based on the NLRN and dialed digits.
- For 499 reporting, the originating SP must now look at both the called party LRN in order to determine intra vs. interstate statistics.

Billing & Settlement for originating switches using NLRN

- There are no special requirements for the originating switch billing and settlement functions in the NLRN approach.

For transit switches, the specific requirements for NLRN are as follows:

Routing for transit switches using NLRN

- NLRN calls, whether via ACQ or query in the transit switch, that are determined to be intra-LATA must be successfully routed by the RBOC tandems with no change due to NNP.
- Non-ACQ calls which require the RBOC tandem to perform the NP query may encounter routing limitations for those NLRN calls determined to be inter-LATA. Again, the extent of this limitation is likely vendor specific.
- Any inter-LATA calls would not encounter an RBOC tandem if the NPAC query was performed upstream such as with ACQ.

Rating for transit switches using NLRN

- For FCC reporting (e.g., Form 499 intrastate vs. interstate info), it is probable that the transit carrier will need to change its rating system to analyze calls by comparing the calling party LRN or TN if not ported/pooled with the called party LRN and TN in case either party is an NNP subscriber.

Billing & Settlement for transit switches using NLRN

- There are no special requirements for the transit switch billing and settlement functions in the NLRN approach

For terminating switches (i.e., the SP now serving the NNP subscriber), the specific requirements for NLRN are as follows:

Provisioning for terminating switches using NLRN

- There are no special requirements for the terminating switch provisioning function in the NLRN approach.

Routing and Termination for terminating switches using NLRN

- There are no special requirements for the terminating switch routing and termination function in the NLRN approach.

Rating for terminating switches using NLRN

- There are no special requirements for the terminating switch rating function in the NLRN approach.

Billing & Settlement for terminating switches using NLRN

- There are no special requirements for the terminating switch billing and settlement function in the NLRN approach.

The following chart reflects NLRN network changes required for NNP implementation, who benefits, and who incurs the associated costs, and the order of magnitude of those costs. This includes changes and costs common to the IPLRN approach.

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Originating	Routing	Legacy Wireline	ACQ if feasible or downstream commercial arrangement[1] ; CIC routing based on LRN; LSMS access to all NPAC regions	All orig SPs who do not have ACQ already	L per switch; TBD CIC based on LRN per switch; S per network to access all regions	NNP SPs
Originating	Routing	VoIP	ACQ[1] ; LSMS access to all NPAC regions	All orig SPs who do not have ACQ or all NPAC regions already	M per network; S per network to access all regions	NNP SPs
Originating	Routing	Mobile	ACQ[1] ; LSMS access to all NPAC regions	All orig SPs who do not have ACQ already	M per network segment; S per network to access all regions	NNP SPs

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Originating	Routing	LNPA	Remove LATA edit prohibiting NNP	LNPA	N/A	NNP SPs
Originating	Rating	Legacy Wireline	LRN based rating	Orig SPs with LD plans must enhance rating for all calls	XL per network for rating and Form 499 reporting[2];	NNP SPs; Orig SPs might recover some costs for their NNP LD calls via the rate plan
Originating	Rating	VoIP	LRN based rating if LD rate plan	All Orig SPs who do not currently do this	L per network for rating changes and 499 reporting[2]	NNP SPs
Originating	Rating	Mobile	LRN based rating;	All Orig SPs	L per network for rating changes	NNP SPs
Originating	Billing & Settlement	Legacy Wireline	Subscriber itemized bills and/or Education program[3]	Orig SPs with LD plans must enhance billing for all calls	XL per network	NNP SPs; Orig SPs might recover some costs for their NNP LD calls via the rate plan
Originating	Billing & Settlement	VoIP	No changes if no LD plans	N/A	N/A	N/A

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Originating	Billing & Settlement	Mobile	No changes if no LD plans	N/A	N/A	N/A
Transit	Routing	RBOC Tandem	Routing table changes to egress the LATA	RBOC tandems	S per switch if supported[4]	NNP SPs; Transit Carrier if chargeable
Transit	Routing	VoIP Transit	Infrastructure, capacity and configuration changes Routing table changes if required; Provide NP query for Orig SPs lacking ACQ; Will require LSMS access to all NPAC regions	VoIP transit carriers; Orig SPs for NP queries	Routing update is S per network; L/XL; S per network for all NPAC regions	NNP SPs; Transit may charge Orig SP for the NP query
Transit	Routing	IXC LD Tandem	Provide NP query for Orig SPs lacking ACQ; Will require LSMS access to all NPAC regions	IXC LD carriers; Orig SPs for NP queries	M per network if need to add IN SCP NP query; S per network for all NPAC regions	NNP SPs; IXC may charge Orig SP for the NP query
Transit	Routing	MSC Gateway	N/A	N/A	N/A	NNP SPs
Transit	Rating	RBOC Tandem	LRN based rating may be needed for proper upstream	RBOC Tandem	L per network	NNP SPs; Tandem may

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
			billing and downstream settlement and reconciliation Downstream query and transport			recover some costs from upstream SP
Transit	Rating	VoIP Transit	LRN based rating may be needed for proper upstream billing and downstream settlement and reconciliation	All VoIP transit carriers who do not currently do this	M per network	NNP SPs; VoIP transit may recover some costs from upstream SP
Transit	Rating	IXC LD Tandem	LRN based rating may be needed for proper upstream billing and downstream settlement and reconciliation	All IXCs	M per network	NNP SPs; IXCs may recover some costs from upstream SP
Transit	Rating	MSC Gateway	LRN based rating may be needed for downstream settlement and reconciliation	All mobile carriers using MSC Gateways	M per network	NNP SPs
Transit	Billing & Settlement	RBOC Tandem	Support billing upstream if NP query must be done in terminating switch;	RBOC Tandem	M per network	NNP SPs; RBOC tandem may recover some costs from

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
						upstream SP
Transit	Billing & Settlement	VoIP Transit	Support billing upstream if NP query must be done in terminating switch;	VoIP transit carriers	M per network	NNP SPs; VoIP transit may recover some costs from upstream SP
Transit	Billing & Settlement	IXC LD Tandem	Support billing upstream Orig SP not using ACQ for NP query and NNP routing	IXC carriers	M per network	NNP SPs; IXC transit may recover some costs from upstream SP
Transit	Billing & Settlement	MSC Gateway	N/A	N/A	N/A	N/A
Terminating	Provisioning	Legacy Wireline	Likely impossible to support all 200+ NPAs as served TNs	NNP SPs	XXL if at all feasible	NNP SPs
Terminating	Provisioning	VoIP	Will require SOA access to all NPAC regions; May need to relax any restrictions for served area codes and any other TN admin dependencies that	NNP SPs	S for SOA change; M for TN admin changes	NNP SPs

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
			ported customers are in same LATA;			
Terminating	Provisioning	Mobile	Will require SOA access to all NPAC regions; May need to relax any restrictions for served area codes and any other TN admin dependencies that ported customers are in same LATA;	NNP SPs	S for SOA change; M for TN admin changes	NNP SPs
Terminating	Provisioning	Mobile permanent roaming[5]	No change	N/A	N/A	N/A
Terminating	Routing & Termination	Legacy Wireline	Assumed not possible if NNP TN not provisionable	N/A	N/A	N/A
Terminating	Routing & Termination	VoIP	No change	N/A	N/A	N/A
Terminating	Routing & Termination	Mobile	No change	N/A	N/A	N/A
Terminating	Rating	Legacy Wireline	Assumed not possible if NNP TN not provisionable; Support rating for onward routing to NNP provider	Term SP (Code Holder[6])	M per network	NNP SP; Term SP if billing for onward routing
Terminating	Rating	VoIP	Support rating for onward routing to NNP provider	Term SP (Code Holder[6])	M per network	NNP SP: Term SP if billing for onward routing

Functional Switch Type	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Terminating	Rating	Mobile	Support rating for onward routing to NNP provider	Term SP (Code Holder[6])	M per network	NNP SP; Term SP if billing for onward routing
Terminating	Billing & Settlement	Legacy Wireline	Support billing upstream SP not using ACQ for NP query and NNP onward routing	Term SP (Code Holder[6])	M per network	NNP SP; Term SP if billing for onward routing
Terminating	Billing & Settlement	VoIP	Support billing upstream SP not using ACQ for NP query and NNP onward routing	Term SP (Code Holder[6])	M per network	Term SP if billing for onward routing
Terminating	Billing & Settlement	Mobile	Support billing upstream SP not using ACQ for NP query and NNP onward routing	Term SP (Code Holder[6])	M per network	Term SP if billing for onward routing

Notes

1. Originating switches lacking the capability for ACQ need to make arrangements for downstream NP queries in order to avoid call completion failures. It has not been determined that all TDM switches in use today are ACQ capable.
2. FCC Form 499 reporting requires additional NNP insight in order to continue providing separate statistics for intra and interstate calls
3. We do not propose an audible alert.
4. Some tandems may not be configurable to support inter-LATA calls.
5. Some mobile Service Providers may elect to continue using permanent roaming rather than adopt the NLRN approach in which case these transit and provisioning costs would not be applicable for such calls.
6. The use of a code holder for query and routing in exceptions where the query does not take place by the originating or transit switch would not be successful in conditions where the ported out number no longer resides in the original rate center, i.e., where the code holder

likely does not have information necessary to route via originating subscriber's PIC. Thus, the appropriate CIC would be unavailable for the routing needed to transport the originating carriers call. This type of default routing should be avoided. Rather ACQ or query prior to the terminating network should be used.

Discussion of IPLRN

Technical Requirements Specific to IPLRN

IPLRN uses a newly established non-geographic NPA (area code) to move calls terminating to NNP enabled numbers to the IP network for proper termination. The implications of establishing IPLRN as the preferred NNP method including needed changes, costs, and benefits are discussed below. While the previous design, NGLRN, included the need for a separate element called the NGGW, we seek to clarify that its function can be performed by any IP-enabled switch. The following does not include those requirements that are common to both NLRN and IPLRN (see above for those).

For IPLRN, originating switches have to meet the following specific requirements:

Routing for originating switches using IPLRN

- If the LRN is an IPLRN, the routing instructions will indicate the egress path to the next switch, which would need to be an IP-enabled switch on the provider's network or a route to a TDM tandem service provider who can provide routing to an IP network. The IPLRN's sole purpose on a legacy switch is to identify that a number is NNP and that therefore the call must egress the TDM network at the earliest opportunity.
- CIC routing may be used as an egress method to route IPLRN calls to the originating subscriber's PIC
- Local routing may be used as an egress option to route IPLRN calls to newly established infrastructure trunking that would enable the egress of NNP calls to an IPLRN network
- Upon reaching an IP network, an NPAC dip will be completed to retrieve the SIP VOICE URI from the subscription version record. In the absence of a SIP VOICE URI record, it is possible to use the LERG to identify the default route based on data in the LERG.[6]

Rating for originating switches using IPLRN

- Determine the rating for the call by using the calling TN, called TN and LRN if it exists. If an IPLRN is detected for the terminating number, then a transit rates may apply to this call.
- Some rating systems may require a change specific to the implementation of IPLRN.

[6] CIGRR Issue 256

Billing & Settlement for originating switches using IPLRN

- There are no special requirements for the originating switch billing and settlement functions in the IPLRN approach.

For transit switches, the requirements for IPLRN are as follows:

Routing for transit switches using IPLRN

- If the LRN is an IPLRN, the routing instructions will indicate the egress path to the next switch, which would need to be an IP-enabled switch on the provider's network or a route to a TDM tandem services provider who could act as an entry point to a common IP network. The IPLRN's sole purpose on a legacy switch is to identify that a number is NNP and therefore must egress the TDM network at its earliest opportunity.
- Upon reaching an IP network, if required, an NPAC dip will be completed to retrieve the SIP VOICE URI from the subscription version record. In the absence of a SIP VOICE URI record, it may be possible to use the LERG to identify the default route based on data in the LERG.[7]

Rating for Transit for transit switches using IPLRN

- For FCC reporting (e.g., Form 499 intrastate vs. interstate information), there may be no need to change rating systems, as the jurisdiction would be determined by the detection of an IPLRN and no determination of called and calling party.

Billing & Settlement for transit switches using IPLRN

- There are no special requirements for the transit switch billing and settlement functions in the IPLRN approach

For terminating switches, the specific requirements for IPLRN are as follows:

Routing and Termination for terminating switches using IPLRN

- In order to terminate NNP calls through an IPLRN, the terminating switch must be IP or have the capability to receive calls via an IP-transit or IP-originating network.

Rating for terminating switches using IPLRN
commercial agreement

- There are no special requirements for the terminating switch rating function in the IPLRN approach

Billing& Settlement for terminating switches using IPLRN

- There are no special requirements for the terminating switch billing and settlement functions in the IPLRN approach

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[7] CIGRR Issue 256

The following chart reflects IPLRN network changes required for NNP implementation, who benefits, and who incurs the associated costs, and the order of magnitude of those costs. This includes changes and costs common to the NLRN approach.

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Originating	Routing	Legacy Wireline (LD)	ACQ[3] if feasible or downstream commercial arrangement; transport costs associated with reaching the IP network; adding IPLRN to all switch translations	All orig SPs who do not have ACQ already; all orig SPs; all orig SPs	M-L per switch; depending on IP capability and/or commercial agreements; S per switch	NNP SPs
Originating	Routing	Legacy Wireline (Local)	ACQ[3] if feasible or downstream commercial arrangement; adding IPLRN to all switch translations; ACQ requires LSMS data for all NPAC regions; trunking between TDM and IP switches	All orig SPs who do not have ACQ already; all orig SPs; all orig SPs	L per switch; S per switch; M per switch depending upon IP capability or commercial agreement; M per switch	NNP SPs