North American Numbering Council

Nationwide Number Portability Issues Working Group

Additional Findings Report on Nationwide Number Portability

May 13, 2019

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;

[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.

- Should the code holder need to query the NPAC local DB and forward route the call, there would need to be CIC routing available to successfully route the call, as is done today.
- LSMS data for all NPAC regions will be required to support the NP query at the terminating switch.

Rating for terminating switches

- Unless under an alternate arrangement (e.g., commercial agreement), the terminating switch will determine the rating for the call regarding potential fees to the prior switch, which may be the originating switch or a transit switch. This requirement also applies to non-NNP calls and thus does not require operational changes.
- In the exception scenario where an originating and/or downstream transit switch exhausts all reasonable and expected effort to query the NP, and the call is routed via dialed digits to the code holder, the compensation between the carrier routing the call to the terminating carrier needs to be negotiated to determine the responsibility for compensation to the code holder that performs the queries and transport the NNP call to the terminating switch on its behalf.

Billing & Settlement for terminating switches

- If the terminating switch has to perform the LNP lookup and route NNP calls, then this query and the use of facilities to complete the call is potentially part of a commercial arrangement that would include an incremental fee billed to the upstream providers.

Discussion of NLRN

Technical Requirements Specific To NLRN

The premise for this NLRN assessment is the continued use of existing LRNs which would no longer be restricted to the same LATA as the NPA-NXX of the original serving operator. The implications as to what changes are required to support this, the order of magnitude of said cost, who incurs said cost and who benefits are covered in the assessment below. For completeness, the cost implications table identifies all perceived costs inclusive of those common to both NLRN and IPLRN. The following does not include those requirements that are common to both NLRN and IPLRN (see above for those).

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

Routing for originating switches using NLRN

- There are no special requirements for the originating switch routing function in the NLRN approach

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

[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

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Originating	Routing	Legacy Wireline (2-PIC)	ACQ[3] if feasible or downstream commercial arrangement; transport costs associated with reaching the IP network; adding IPLRN to all switch translations; CIC routing based on LRN;; ACQ requires LSMS data for all NPAC regions	All orig SPs who do not have ACQ already; all orig SPs; all orig SPs	L per switch; depending on IP capability and/or commercial agreements; S per switch	NNP SPs
Originating	Routing	VoIP	ACQ[3] if not already in use; Requires LSMS data for all NPAC regions	All orig SPs who do not have ACQ already	M per network	NNP SPs
Originating	Routing	Mobile	ACQ[3] if not already in use; Requires LSMS data	All orig SPs who do not have ACQ already	M per network segment	NNP SPs

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
			for all NPAC regions			
Originating	Routing	LNPA	Remove LATA edit prohibiting NNP	LNPA	N/A	NNP SPs
Originating	Rating	Legacy Wireline (LD Option)	LRN based rating[2];	Orig SPs with LD plans would enhance rating for NNP calls	L per network as calls that were previously rated as local now need to be rated as LD and Form 499[4] reporting	NNP SPs; Orig SPs might recover some costs for their NNP LD calls via the rate plan
Originating	Rating	Legacy Wireline (Local Option)	N/A	N/A	N/A	NNP SPs;
Originating	Rating	Legacy Wireline (2-PIC Option)	LRN based rating;	Orig SPs with LD plans would enhance rating for all calls	XL per network for rating and Form 499[4] reporting	NNP SPs; Orig SPs might recover some costs for their NNP LD calls via the rate plan

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
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	NNP SPs
Originating	Routing	VoIP	Potentially no change dependent on architecture or solution	N/A	S if applicable.	NNP SPs; Originating switch only on NNP LD calls
Originating	Routing	Mobile	Potentially no change dependent on architecture or solution	N/A	S if applicable.	NNP SPs; Originating switch only on NNP LD calls
Originating	Billing	All types	No Change	N/A	N/A	NNP SPs; Originating switch only on NNP LD calls
Transit	Routing	RBOC Tandem	Routing changes to egress the TDM Network via IP. If not supported, IP-	Transit Carriers	M per tandem switch if RBOC tandem is responsible for TDM to	NNP SPs; Originating switch only on NNP LD calls

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
			capable tandem service providers can be leveraged to translate TDM to IP. An additional query for NNP calls would be required to identify the destination SIP URI as well as LSMS access to all NPAC regions		IP translation. No change if IXC has the obligation to support IP calls.	
Transit	Routing	VoIP Transit	A query for NNP calls would be required to identify the destination SIP URI as well as LSMS access to all NPAC regions. Routing would need to be modified to support sending calls via this method including	N/A	M per network.	N/A

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
			codec negotiation or other SIP required attributes.			
Transit	Routing	IXC LD Tandem	A query for NNP calls would be required to identify the destination SIP URI as well as LSMS access to all NPAC regions.	N/A	M per network.	NNP SPs; Originating switch only on NNP LD calls
Transit	Routing	MSC Gateway	N/A	N/A	N/A	N/A
Transit	Rating	RBOC Tandem	The ability to rate calls routing on IPLRNs.	RBOC Tandem	L per network.	NNP service providers.
Transit	Rating	VoIP Transit	N/A	N/A	N/A	N/A
Transit	Rating	IXC LD Tandem	The ability to rate calls routing on IPLRNs.	IXC LD Tandem	L per network	NNP Service Providers.
Transit	Rating	MSC Gateway	N/A	N/A	N/A	N/A

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Transit	Billing	RBOC Tandem	N/A	N/A	N/A	N/A
Transit	Billing	VoIP Transit	N/A	N/A	N/A	N/A
Transit	Billing	IXC LD Tandem	N/A	N/A	N/A	N/A
Transit	Billing	MSC Gateway	N/A	N/A	N/A	N/A
Terminating	Provisioning	Legacy Wireline	Assumed not possible	N/A	N/A	N/A
Terminating	Provisioning	VoIP	SOA support for NPAC Voice URI and access to all NPAC regions	NNP SPs	S for SOA change; M for TN admin changes	NNP SPs
Terminating	Provisioning	Mobile	SOA support for NPAC Voice URI and access to all NPAC regions	NNP SPs	S for SOA change; M for TN admin changes	NNP SPs
Terminating	Provisioning	Mobile permanent roading	No Change	N/A	N/A	N/A
Terminating	Routing & Termination	Legacy Wireline	Assumed not possible	N/A	N/A	N/A

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Terminating	Routing & Termination	VoIP	N/A	N/A	N/A	N/A
Terminating	Routing & Termination	Mobile	N/A	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[1])	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[1])	M per network	NNP SP: Term SP if billing for onward routing
Terminating	Rating	Mobile	Support rating for onward routing to NNP provider	Term SP (Code Holder[1])	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[1])	M per network	NNP SP; Term SP if billing for onward routing

Switch	Telephony Function	Switch Type	NNP Changes Required	Who incurs Cost	Magnitude S/M/L/XL	Who Benefits
Terminating	Billing & Settlement	VoIP	Support billing upstream SP not using ACQ for NP query and NNP onward routing	Term SP (Code Holder[1])	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[1])	M per network	Term SP if billing for onward routing

Notes

1. 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.
2. Legacy wireline long distance charges may apply.
3. 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.
4. FCC Form 499 reporting requires additional NNP in order to continue providing separate statistics for intra and interstate calls.

Recommendation

The NNP Technical Sub-Committee has held numerous meetings to address the request from the FCC Wireline Competition Bureau to the NANC Chair, "… to investigate the technical requirements necessary to support NNP, and to provide more detailed cost/benefit analyses …" of the proposed solutions. The team performed deep technically-focused reviews on the NLRN and NGLRN proposed solutions from the initial NNP group's report, the PTSC report, the detailed call flows, and discussions investigating impacts to TDM, wireless and VoIP applications.

Given the in-depth conversations focusing primarily on the technical feasibility of these two solutions, the team was unable to fully investigate the impacts of an NNP solution on interconnection, compensation, tariffs, and access charges. Because of this, many members were not in a position to select one proposal over the other. Readers are cautioned that due to time constraints this report does not address all aspects in the detail necessary for any conclusions to be made based on this report.

This sub-committee recommends that the impacts on interconnection, compensation, tariffs, and access charges be further investigated for the NLRN and IPLRN solutions.

Next Steps/Conclusion

An additional effort needs to be undertaken to study the impacts on interconnection, compensation, tariffs, and access charges.

APPENDIX A

Nationwide Number Portability Technical Subcommittee

Chair:

Somos

Mary Retka, Vice President for Industry Relations

Members:

AT&T Services, Inc.

Teresa Patton, Principal – Technology Solutions Manager

CenturyLink

Philip Linse, Director for Public Policy

Charter Communications, Inc.

Glenn Clepper, Director - Telephone Regulatory

Comcast Corporation

Beau Jordan, Director, Compliance Legal/Regulatory

Henning Schulzrinne, Professor

Telcordia Technologies, Inc. dba iconectiv

Chris Drake, Chief Technology Officer

T-Mobile USA, Inc.

Rosemary Leist, Sr. Numbering Policy Manager

Telnyx LLC

David Casem, CEO

APPENDIX B:

Nationwide Number Portability Technical Subcommittee

Co-Chair:
Courtney Neville, Associate General Counsel
Competitive Carriers Association
Co-Chair:
Richard Shockey, Chairman of the Board of Directors
SIP Forum
Voting Members:
Ben Aron, Director, State Regulatory and External Affairs
CTIA (Working Group Alternate)
Rebecca Beaton, Infrastructure Manager
Washington Utilities and Transportation Commission
Jerome Candelaria, Vice President and Counsel, Regulatory Affairs
California Cable & Telecommunications Association
NCTA – The Internet & Television Association
David Casem, CEO and Founder
Telnyx LLC
Glenn Clepper, Director, Regulatory
Charter Communications
Dana Crandall, Distinguished Engineer – Network Engineering & Operations
Verizon Communications
Mark Desterdick, Distinguished MTS, Network Infrastructure Planning
Verizon Communications (Working Group Alternate)
James C. Falvey, Member
Eckert Seamans Cherin & Mellott, LLC
LNP Alliance (Working Group Alternate)
Brian J. Ford, Senior Regulatory Counsel*
NTCA – The Rural Broadband Association

Matthew Gerst, Assistant Vice President, Regulatory
CTIA
Jay Gerstner, Senior Director Advanced Engineering
Charter Communications (Working Group Alternate)
Jennifer Hutton, Bill Application Process and Support Specialist
Cox Communications
Beau Jordan, Director, Compliance Legal/Regulatory
Comcast Corporation
Richard Kania, Senior Utility Analyst
Maine Public Utilities Commission
Philip Linse, Director for Public Policy
CenturyLink
David J. Malfara, Sr., President/CEO
ETC Group, LLC
LNP Alliance
James McEachern, Senior Technology Consultant
Alliance for Telecommunications Industry Solutions
Scott Mullen, Chief Technology Officer
Bandwidth.com, Inc. (Working Group Alternate)
Paul Nejedlo, Senior Administrator – Number Management
TDS Telecommunications Corporation
Cullen Robbins, IT/Telecom/Communications Analyst
Nebraska Public Service Commission
National Association of Regulatory Utility Commissioners
Greg Rogers, Deputy General Counsel*
Bandwidth.com, Inc.
Henning Schulzrinne, Professor, Columbia University
Michele Thomas, Senior National Director, Counsel
T-Mobile USA, Inc.
Susan Travis, Rate/Financial Analyst
Colorado Public Utilities Commission

Antonio Vickers, Manager, IT Operations and Billing

Cox Communications (Working Group Alternate)

Stephanie Wall, Regulatory Compliance Accountant

Smithville Communications

Bridget Alexander White, Manager – Business Development

John Staurulakis, Inc.

USConnect Holdings, Inc.

Special Members (Non-Voting):

Chris Drake, Chief Technology Officer

Telcordia Technologies, Inc. dba iconectiv

Tom McGarry, Neustar Fellow

Appendix C: Flows

Appendix D: Glossary

ACQ	All Call Query
ATIS	Alliance for Telecommunications Industry Solutions
CdPN	Called Party Number
C4	Class 4 Switch
C5	Class 5 Switch
CSCF	Call Session Controller Function
I-CSCF	Interrogating - Call Session Controller Function
P-CSCF	Proxy - Call Session Controller Function
S-CSCF	Serving - Call Session Controller Function
FCC	Federal Communication Commission
HSS	Home subscriber server
IP	Internet Protocol

IPLRN	Internet Protocol Location Routing Number
IP NNI	Internet Protocol Network to Network Interface
ISUP	Integrated Services Digital Network User Part
IXC	Inter Exchange Company
LATA	Local Access and Transport Area
LD	Long Distance
LRN	Location Routing Number
LNP	Local Number Portability
LSMS	Local Service Management System
MSC	Mobile Switching Center
NANC	North American Numbering Council
NGGW	Non-geographic Gateway
NGLRN	Non-geographic Location Routing Number
NLRN	National Location Routing Number
NNP	National Number Portability
NP	Number Portability
NPA	Numbering Plan Area
NPAC	Number Portability Administration Center
NXX	Exchange
RBOC	Regional Bell Operating Company
PSTN	Public Switched Telephone Network
RS	Route Server
SBC	Session Border Controller
SIP	Session Initiation Protocol

SP	Service Provider
SOA	Service Order Administration
SS7	Signaling System 7
TDM	Time-Division Multiplexing
TN	Telephone Number
UAC	User-Agent Client
UAS	User Agent Server
URI	Uniform Resource Identifier
URL	
VoIP	Voice over Internet Protocol

A

All Call Query (ACQ) is the requirement or function of originating service providers querying the called party telephone number in the routing database, on every call to determine LRN

Alliance for Telecommunications Industry Solutions (ATIS) is a standards body where companies in the information and communications technology (ICT) industry come together to address common, critical priorities. ATIS is accredited by the American National Standards Institute (ANSI)

C

Called Party Number (CPN) is a telephone number that has been dialed to reach a destination.

Call Session Controller Function (CSCF) represents a series of SIP servers or proxies, collectively called Call Session Control Function (CSCF), are used to process SIP signaling packets in IP call flows.

Interrogating - Call Session Controller Function (I-CSCF) is a proxies server retrieves information from IMS core elements for purposes of SIP registration and call set up.

Proxy - Call Session Controller Function (P-CSCF) is the first point of contact for the IMS core network. End-user devices connect to the proxy, and it forwards all messaging request to the applicable IMS Core elements registration, security, routing, etc.

Serving - Call Session Controller Function (S-CSCF) is the central node of the signaling plane. It is a SIP server but performs session control too. It is always located in the home network. It interfaces to the HSS to download user profiles and upload user to S-CSCF associations

Class 4 Switch or tandem, telephone switch is a U.S. telephone company central office telephone exchange used to interconnect local exchange carrier offices for long distance communications in the public switched telephone network. It doesn't connect directly to any telephones; instead, it connects to other class-4 switches and to class-5 telephone switches

Class 5 Switch is a telephone switch or telephone exchange in the public switched telephone network located at the local telephone company's central office, directly serving subscribers. Class-5 switch services include basic dial-tone, calling features, and additional digital and data services to subscribers.

F

Federal Communication Commission (FCC) The FCC regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia and U.S. territories. An independent U.S. government agency overseen by Congress, the commission is the United States' primary authority for communications law, regulation and technological innovation.

H

Home Subscriber Server (HSS) is a master user database that supports the IMS network entities that handle calls. It contains the subscription-related information, performs authentication and authorization of the user, and can provide information about the subscriber's location and IP information.

I

Internet Protocol (IP) is a packet-based protocol used to exchange data over computer networks. IP handles addressing, fragmentation, reassembly, and protocol demultiplexing. It is the foundation on which all other IP protocols (collectively referred to as the IP Protocol suite) are built.

Internet Protocol Location Routing Number (IPLRN) is a location routing number that is used to port numbers to and route non-geographically assigned telephone numbers to the IP enabled carriers.

IP Network to Network Interface (IP NNI) is an interface that specifies signaling and management functions between two networks. An NNI circuit can be used for interconnection of signaling (e.g., SS7), Internet Protocol (IP)

Inter Exchange Carrier (IXC) is a telephone company providing connections between local exchanges in different geographic areas. They also provide local access and transport area services as per the Telecommunication Act of 1996. They are commonly referred to as long-distance carriers

Integrated Services Digital Network User Part (ISUP) is part of Signaling System No. 7 (SS7), which is used to set up telephone calls in the public switched telephone network (PSTN). Link to additonal info

L

Local Access Transport Area (LATA) is a geographical area designated as a LATA in the National Exchange Carrier Association. It often defines an area where a Regional Bell Operating Company is permitted to offer exchange telecommunications and exchange access services. Currently, the geographic scope of a local routing number is limited to a LATA, meaning numbers can only be ported within a LATA assignment.

Long Distance (LD) is a telephone call made to a location outside a defined local calling area or those calls that cross LATA boundaries.

Local Routing Number (LRN) is a ten-digit number in a database called a Service Control Point (SCP) that identifies a switch for a local telephone exchange. The assignment of a location routing number to telephone numbers allows for local number portability.

Local Number Portability (LNP) refers to the ability of a "customer of record" of an existing fixed-line, VoIP or mobile telephone number assigned by a carrier to reassign the telephone number to another carrier

Local Service Management System (LSMS) is a system used by a Service Provider which receives data broadcast from the Number Portability Admiration Center (NPAC). The LSMS provisions the service provider's downstream systems, such as its call routing database.

Legacy Wireline Switch (LWS) is a telephone switch or telephone exchange in the public switched telephone network, directly serving subscribers. Also called a Class 5 Switch or TDM switch, an LWS is a computer specialized for TDM-based, circuit-switched telephone calls.

Services include basic dial-tone, calling features, and additional digital and data services to subscribers connected to a local loop.

M

Mobile Switching Center (MSC) is the primary service delivery node for Global System for Mobile Communications (GSM), responsible for routing voice calls and SMS as well as other services. It also enables mobile devices to communicate with other mobile devices and telephones in the Public Switched Telephone Network (PSTN).

N

North American Numbering Council (NANC) is a Federal Advisory Committee that was created to advise the Commission on numbering issues and to make recommendations that foster efficient and impartial number administration.

Non-geographic Gateway (NGGW) are VoIP nodes, that host NGLRNs and provide connectivity to service providers that port in NNP TNs

Non-geographic Location Routing Number (NGLRN) is a model supporting national number portability by establishing a new numbering admiration network gateway function for the assignment and porting of telephone numbers to NGLRN vs. a traditional local routing number.

National Location Routing Number (NLRN) is model supporting 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.

National Number Portability (NNP) is 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.

Number Portability (NP) allows the customer of record to reassign the number to another carrier ("service provider portability"), move it to another location ("geographic portability"), or change the type of service ("service portability").

Numbering Plan Area (NPA) divides territories into Numbering Plan Areas (NPAs), each identified by a three-digit code commonly called area code. The NPA is the first three digits of a ten-digit telephone number (**NPA**)-NXX-XXXX or **303**-372-1000.

Number Portability Administration Center (NPAC) is a database and registry to enable number portability for the United States and Canada. The database contains the data used to

route, rate, and bill telephone calls for telephone numbers that are no longer assigned to the original carrier.3

Exchange (NXX) is the three-digit code that forms the second part of a 10-digit telephone number. The NXX is also known as the "central office code" or "exchange".

P

Public Switch Telephone Network (PSTN) is the aggregate of the world's circuit-switched telephone networks that are operated by national, regional, or local telephony operators, providing infrastructure and services for public telecommunication. The PSTN consists of telephone lines, fiber optic cables, microwave transmission links, cellular networks, communications satellites, and undersea telephone cables, all interconnected by switching centers, thus allowing most telephones to communicate with each other. Originally a network of fixed-line analog telephone systems, the PSTN is now almost entirely digital in its core network and includes mobile and other networks, as well as fixed telephones.

R

Route Server (RS) is an routing server for a SIP network. Route Server can be deployed as a routing server for Local Number Portability dips.

S

Session Border Controller (SBC) is a network element deployed to protect SIP based Voice over Internet Protocol (VoIP) networks. The functions include security, connectivity between networks, quality of services policy, and media (voice, video, and other) services.

Session Initiation Protocol (SIP) is a signaling protocol used for initiating, maintaining, modifying and terminating real-time sessions that involve video, voice, messaging and other communications applications and services between two or more endpoints on IP networks.

Service Provider (SP) is a company that has traditionally provided telephone and similar services allowing users to send and receive telephone calls and faxes

Service Order Administration (SOA) is a hosted or managed service that automates the process of updating the Number Portability Administration Center (NPAC) during the number porting process.

Signaling System 7 (SS7) is an architecture for performing out-of-band signaling in support of the call-establishment, billing, routing, and information exchange functions of the public switched telephone network (PSTN). Link to Wikipedia

T

Time-Division Multiplexing (TDM) is a method of putting multiple data streams in a single signal by separating the signal into many segments, each having a very short duration. Each individual data stream is reassembled at the receiving end based on the timing.

Telephone Number (TN) is a sequence of digits assigned to a fixed-line telephone subscriber station connected to a telephone line or to a wireless electronic telephony device, such as a radio telephone or a mobile telephone, or to other devices for data transmission via the public switched telephone network (PSTN) or other public and private networks.

U

User Agent (UA) collectively the **User Agent Client** (UAC) and **User Agent Server** (UAS) is used to establish connections and enable sessions between users and the IMS network.

Uniform Resource Identifier (URI) is a string of characters that unambiguously identifies a logical or physical resource on a network, of which the best-known type is the web address or URL.

V

Voice over Internet Protocol (VoIP), also called IP telephony, is a methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks

North American Numbering Council

Nationwide Number Portability Issues Working Group

Minority Report[8]

I wish to congratulate the members of the technical sub-working group for their efforts under extremely difficult circumstances. The challenges they face were not of their own making but reflected difficult time lines and challenging policy and economic choices that were beyond the scope of the referral made to the NANC by the Wireline Competition Bureau.

Regretfully I cannot support the report for the principal reason that includes references to IP-LRN (formally NG-LRN) which, in my opinion, should not have been included for consideration as a possible technical solution to the National Number Portability issue.

In my judgment the working group should have focused its limited resources on the N-LRN solution as the only viable option.

In the previous report to the NANC we rejected out of hand the GR-2982 Core (GUBB) solution as in appropriate since it relied on modification to SS7 to implement. It has been apparent for years that SS7 or the entire TDM network architecture cannot and should not be modified as we continue down the road of the all IP Transition of the Voice Communications network of the United States.

The principal issue in IP-LRN's is to facilitate interconnected SIP/IMS networks and tangentially proports to solve the problem of National Number Portability. IP-LRN's are attempting to solve a business model problem for IP centric service providers that should properly be addressed in the Technology Transitions proceeding which has been ongoing for many years now.

The issue of how to facilitate all IP Interconnection for Real Time Voice Communications using NANP numbering has been understood for nearly 20 years and has been well documented. I have been directly involved in many of those efforts.

I would point out several relevant items.

First. For nearly 9 years I was the co-chair of the IETF ENUM working group that produced RFC 6116. ENUM relies on the use of Domain Name System (DNS) technology to perform a number to URI translations. This technology is in use today and is the basis of the ITRS database maintained by the FCC to facilitate the Telephone Relay Service and may be used to help

[8] Richard Shockey, SIP Forum

facilitate Video Relay services in the future. ENUM works, it's fast, highly saleable though it does have some shortcomings that I will not elaborate on here.

Second. The NANC many years approved a variety of URI fields in the NPAC that could be used for phone number to URI translations at a service layer granularity. Voice Video Text etc. These are collectively the NANC 400 fields. I was directly involved in the design of those fields. Since the introduction of those fields. Not one service provider in the United States has ever provisioned a single NANC 400 NPAC field.

Third. ATIS and the SIP Forum Network to Network TF tried to deliver to the industry a consensus report on IP interconnection and we concluded there was NO CONSENSUS. ENUM was studied as an option. For now, the elements of the industry are satisfied with negotiated bi-lateral agreements. This may have to change in the future but IP-LRN's are not the optimal technical solution.[9]

Fourth. It should be pointed out that the Commission has steadfastly refused to classify Interconnected VoIP as a Title II service. The Commission has used its plenary numbering authority under Section 252(e) 1 of the Act to impose mandatory 911 and LNP obligations on VoIP service providers. In my judgement the Commission would have to revisit that decision if it choose to take the IP-LRN solution seriously.

Fifth. The IP-LRN proposal has been significantly modified from its original NG-LRN form that would have potentially mandated IP Gateways in every rate center and LATA's. The Commission has been trying to nudge the industry away from rate centers and LATA's but as the Intercarrier Compensation reform effort proved there is still significant resistance to that effort.

Other Consideration

The Technical subcommittee correctly concluded that there are several issues beyond the scope of the technical working group that will have to be considered if there is to be progress on implementing National Number Portability.

First. It is not clear to me Commission is prepared to address the forest of issues surrounding ratings and tariffs especially on the problem of Originating Access charges. I have serious doubts NNP can proceed without forcefully addressing this challenge.

Second. It is not clear whether IP-NNP or a national system of IP Interconnection will require service providers, especially smaller rural carriers would be forced into accepting the burden of Bi-Directional transport costs to new all IP points of interconnection.

Third. It is not entirely clear whether NNP requires the imposition of National 10 Digit Dialing which would have not just economic impacts but political impacts on states that still permit 7-

[9] https://www.sipforum.org/download/joint-atissip-forum-technical-report-ip-interconnection-routing-atis-1000062-sipforum_twg-6/?wpdmdl=2780

digit local dialing such as Montana, North Dakota South Dakota, Maine, Vermont, Delaware, Alaska etc.

Fourth. The economic impact of All Call Query on smaller service providers is not well understood. Especially the significant costs of equipment upgrade to enable a localized full cache of the NPAC which NNP would probably require. This is an industry with very, very thin margins and some networks are more advanced than others.

This begs the question raised in the NNP WG of whether it is technically feasible to permit some elements of the industry to enable NNP and establish a timeline for others to follow.

Some observers have noted that the impending STIR/SHAKEN Call Authentication Mandate outlined by Chairman Pai and now pending before Congress may result in a mandate to all IP interconnection since the Call Authentication data can only survive carrier to carrier if the call signaling remains SIP/IMS in the call path. There is merit to this argument. Only time will tell if this is the case. It should be noted that STIR/SHAKEN imposes real and significant costs to the industry. In any event the combination of STIR/SHAKEN and NNP and all IP Interconnection may be a "Bridge to Far" for the industry.

Conclusion

It is my personal recommendation that the Wireline Competition Bureau reject any further consideration of IP or NG LRN's and concentrate on the NLRN option taking into consideration that there are significant economic impacts that are still not well understood.