# Summary of Proposals & Impacts

## Commercial Agreements

### Overview of Commercial Agreement Approach

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

### Impact Analysis

#### SS7 Signaling

The commercial agreement approach in which a third party provides an interconnection point in the donor LATA and delivers calls to the recipient service provider that has ported a number into a foreign LATA requires no changes to existing SS7 signaling.

#### Call Processing

The commercial agreement approach requires no changes to call processing.

#### Network Routing

The party providing the donor LATA POI must arrange to route ported-out-of-LATA calls terminating to that POI to the recipient carrier. This can be accomplished with existing routing capabilities.

#### NPAC

No known changes to the NPAC are required. Investigation may be required to determine whether if the POI provider is a wireline carrier and the recipient carrier is wireless whether any negative impacts will result.

#### Numbering Administration

There should be no impacts on number administration unless it is determined that six-digit unique LRNs are required and these need to be assigned on a per-recipient service provider basis. If this were the case, then each recipient service provider would need an LRN (and thus a central office code) in each LATA from which it seeks to port numbers.

#### Accounting/Billing

The need for any accounting or billing changes would depend on the details of the commercial agreement between the out-of-LATA POI provider and the recipient carrier. With terminating intercarrier compensation defaulting to Bill & Keep, impacts on terminating compensation should be minimized.

#### PSTN/IP Interworking

There should be no impacts on PSTN/IP interworking.

#### Regulatory Related Services (Emergency and NS/EP)

For ported wireless numbers calls, emergency calls should be handled as they would be for roamers. Impacts on numbers ported to wireline service require further study.

Further analysis is needed to determine NS/EP impacts.

#### Policy

No particular policy impacts are expected for the commercial agreement approach.

#### Interconnection Agreements

Interconnection must be established between the part providing the POI in the donor LATA and other providers delivering traffic to that LATA. Whether actual interconnection agreements are between the distant recipient service provider or the service provider supplying the donor LATA POI is to be determined.

## National LRN

### Overview

This approach proposes a routing solution to enable NNP using Location Routing Numbers (LRNs).  This approach allows LRNs to be used outside of the current LATA boundaries thereby allowing TNs to be “ported” nationally.

###  Impacts

#### SS7 Signaling

There is no change required in SS7 signaling.

#### Call Processing & Network Routing

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

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

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

#### NPAC

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

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

#### Numbering Administration

There should be no impacts on national number administration.

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

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

#### Accounting/Billing

From a consumer point of view there could be some confusion if local/toll plans are involved, as there would be calls to the same NPA-NXX that are sometimes local and sometimes toll.

#### PSTN/IP Interworking

There should be no impacts on PSTN/IP interworking.

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

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

#### Regulatory Related Services (Emergency and NS/EP)

For ported wireless numbers calls, emergency calls should be handled as they would be for roamers. Impacts on numbers ported to wireline service require further study.

Further analysis is needed to determine NS/EP impacts.

#### Policy

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

## NNP Solution Based on GR-2982-CORE

### Overview of NNP Solution Based on GR-2982-CORE

GR-2982-CORE describes one solution for NNP that is based on the concept of a GUBB. A GUBB is an identifier that represents the geographic location of the end user in an area within which customers may port their TNs. Each GUBB is a separate, distinct area with specific non-overlapping borders. The territory covered by an area of location portability must be fully defined by one or more GUBBs. Every location within the area of portability corresponds to one and only one geographic block. Every TN in an area of location portability can be associated with one and only one GUBB, based on the TN’s geographic location in the area of location portability. GR-2982-CORE assumes that a GUBB is a six-digit number formatted as an NPA-NXX. The GR-2982-CORE solution assumes that at cutover, current rate centers will continue to exist, and a representative NPA-NXX will be assigned and working in each rate center.

The GR-2982-CORE-based NNP solution (referred to as PORC) assumes that routing continues to be done using existing LNP LRN-based mechanisms, but that the GUBB is used for carrier selection and rating purposes. GR-2982-CORE assumes a billing policy in which the end user calling a TN that has ported outside of the rate center will incur the transport charges for the call. Since charges based on GUBBs could be different from charges based on TNs, GR-2982-CORE suggests the use of a warning tone or announcement to alert the calling customer to this difference.

While the GR-2982-CORE-based solution strongly recommends that PORC routing queries be performed at the originating switch, it does not require that this be the case. In cases where no routing query is performed, the call will route “normally” to a donor switch based on the dialed NPA-NXX or the carrier access code. The donor switch will then be expected to perform the PORC routing query. Alternatively, a PORC routing query may be performed at a “surrogate” switch. In this scenario, the call is routed to the surrogate switch using an LRN provided by an LSPP/LNP query that took place at the originating switch, an intermediate switch, or the actual donor switch. A recipient switch is required to be capable of supporting a PORC routing query and processing the associated response.

GR-2982-CORE requires modifications to the TCAP signaling used to query the NNP routing database (referred to in GR-2892-CORE as the LNP SCP) consisting of a different Trigger Criteria Type value in the database query and, if the called number has undergone NNP, the inclusion of a terminating GUBB in the database response. Modifications to the SS7 ISUP signaling used between switches are also required to include the delivery of GUBB information and an indication that a PORC query has been performed. In addition to the call processing impacts at the switch that performs the PORC query (i.e., to generate and process the TCAP messages exchanged with the LNP SCP), call processing at subsequent switches will also be impacted by the presence of the additional information in incoming ISUP signaling.

The mechanisms described in GR-2982-CORE were defined in a timeframe that pre-dated considerations related to the IP transition. While extensions to SIP have been defined to support LNP, support for a GR-2982-CORE-based PORC solution in an IP environment would require additional extensions to SIP to allow information such as the Terminating GUBB, Redirecting GUBB, and an indication that a PORC query has been performed to be signaled between IP network elements in support of call setup involving PORC customers. If it is assumed that existing TCAP-based mechanisms will continue to be used to support NP queries/responses in an IP environment, then the impacts of supporting a GR-2982-CORE-based PORC solution will be the same as in a circuit-switched environment. However, if it is assumed that evolution to an IP environment will require a new NP query/response architecture and/or protocol, then further study will be required to examine viable alternatives for supporting this functionality.

### Impact Analysis

The following text provides an analysis of impacts of the GR-2982-CORE solution with respect to the following attributes.

#### SS7 Signaling

The GR-2982-CORE-based PORC solution requires changes to the SS7 TCAP signaling used in querying an NP database. Specifically, it requires the use of a new value in the Trigger Criteria Type parameter of the NP query, and the inclusion of Terminating GUBB information in the NP response. The PORC solution also has SS7 ISUP signaling impacts in that it requires the assignment of a new value to the O Bit in the in FCI parameter, as well as new values in the Type of Digits field within the SS7 Generic Digits Parameter associated with GUBB information.

#### Call Processing

At the switch that performs the PORC query, the escape criteria that might inhibit an LNP trigger from being detected (e.g., criteria like 0+ dialed calls or calls destined for a toll carrier other than the carrier of the originating switch) may be different than for an LSPP query. If a number has been ported outside the rate center, the appropriate carrier or the operator services system cannot be determined prior to a query being sent to the NP database. A switch that performs a PORC query must also populate the correct Trigger Criteria Type in the NP query and use the GUBB information (if present) in the response to support the carrier selection and rating applied to the call. The switch that performs the PORC query must also populate the outgoing SS7 ISUP signaling correctly, with the appropriate setting of the O Bit in the FCI and GUBB information populated in the Generic Digits Parameter (if received in the response from the NP database).

Switches that are subsequent to the one that performs the PORC query in the call path must be capable of processing the information in the FCI O Bit and Generic Digits parameter (if present) to determine whether a PORC query should be performed and to determine the rating for the call. Routing at subsequent switches will be based on the LRN, as is the case for LNP today.

#### Network Routing

As with LSPP/LNP today, network routing in a PORC environment will be based either on the dialed digits/Called Party Number (if the dialed number is not ported) or on the LRN (if one is provided by the NP database because the dialed number is ported).

In the context of the GR-2982-CORE-based NNP solution, carrier selection will be based on the GUBB. The GUBB will be used by the switch to determine the type of call (i.e., intra-network/intra-rate center, inter-network/intra-rate center, inter-rate center/intra-LATA, inter-rate center/inter-LATA). If the type of call is inter-rate center/inter-LATA, or inter-rate center/intra-LATA with the calling party’s designated carrier an entity other than the Local Service Provider, determination of the transport carrier will be based on switch-based routing tables that reflect the geographic relationship of the calling and called party’s serving switches, the geographic relationship of the calling and called party stations, and the Class of Service of the calling party.

#### NPAC

Support of the GR-2982-CORE-based solution for NNP will require that GUBBs, like LRNs, be administered over a wide geographic area, since all carriers will need to be able to locate their customers geographically for all other carriers. Like LRNs, it is expected that the administration of GUBBs would be performed by a neutral third party. As such, the NPAC could expand its role in NP-related data administration to include administration of GUBBs. This would require new functionality at the NPAC.

#### Numbering Administration

The six-digit GUBB approach utilized by the GR-2982-CORE-based NNP solution does not require changes to existing rate centers or number administration principles. Existing rate centers provide the geographic basis for the GUBBs that are fundamental to the PORC solution. Every DN in an area of location portability will be associated with one and only one GUBB, based on the DN’s geographic location in the GUBB “template” or “map” associated with the area of location portability.

#### Accounting/Billing

In a GR-2982-CORE-based NNP implementation, real-time rating (i.e., the switch call processing used to perform charge determination resulting in an AMA record that reflects a correct Structure Code, Call Code, etc.) will be based on the GUBB. Using the established rate centers as the basis for GUBB definition permits established billing and rating systems to continue to use the existing vertical and horizontal coordinates to define the common point from which to calculate mileage for toll distance rating. The use of GUBBs as the basis for real-time rating will require modifications to switch processing.

#### PSTN/IP Interworking

Due to the timeframe in which GR-2982-CORE was written, the GR assumes a circuit-switched environment and does not address IP-based networks or interworking between TDM and IP-based networks in support of NNP. IETF RFC 4694 and ATIS-1000679.2015 describe mechanisms for supporting LNP by signaling LSPP-related information, such as the dialed number, LRN, JIP, and the FCI M Bit, forward by including parameters associated with tel URIs passed in the SIP P-Asserted-Identity and Request-URI headers. Extensions to SIP would be needed to support the transport of the additional information (i.e., Terminating GUBB, Redirecting GUBB, and FCI O Bit information) used by the GR-2982-CORE-based NNP solution. New SS7-SIP interworking would also need to be defined to support transitional architectures consisting of a mix of TDM and IP-based network elements. The use of a protocol other than TCAP to support NP queries in an IP environment requires further study.

#### Regulatory Related Services (Emergency and NS/EP)

Because 9-1-1 calls do not utilize NP-based routing mechanisms, potential issues related to the delivery of emergency calls originated by location-ported users and routed via legacy Selective Routers to legacy PSAPs that support Traditional MF interfaces are independent of any NNP solution. As described in Clause 10.1.2, transitional and long-term architectures that utilize a Next Generation Emergency Services Network already provide mechanisms that could be used to support the delivery of emergency calls to legacy and NG PSAPs from location-ported callers. For scenarios where the legacy E9-1-1 infrastructure is in place, with delivery of emergency calls over Traditional MF interfaces to legacy PSAPs, solutions such as upgrading the PSAP to support an Enhanced MF interface may be needed to address limitations in the number of NPAs that can be delivered over a single Traditional MF trunk group. However, as stated above, this is independent of the NNP solution that is deployed.

With respect to NS/EP, priority treatment of TCAP-based PORC queries would need to be maintained in a GR-2982-CORE-based NNP implementation. Further analysis is needed to determine if there are any implications associated with carrier selection based on GUBBs.

#### Policy

The NNP solution described in GR-2982-CORE assumes that existing policies with respect to rate centers and rules related to interLATA call routing are in effect.

GR-2982-CORE supports a billing policy in which end users who call PORC DNs are billed for the call according to the billing policies established by the carrier responsible for transporting the call (e.g., the LEC for “local calls”, the intraLATA toll provider or LEC for “IntraLATA toll calls”, or the IXC for “InterLATA toll calls”).

Calls that are initially routed to the Donor (or its surrogate) and then redirected to the Recipient Switch may need to support other billing policies.

The billing policy supported by GR-2982-CORE also assumes that PORC customers will not incur unusual charges for receiving calls.

#### Interconnection Agreements

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

## NGLRN

### NGLRN Solution Description

The NGLRN solution proposes a new numbering resource (non-geographic area code) to be used for routing numbers (NGLRN) for NNP TNs. Geographic TNs are ported to an NGLRN. The area code of the NGLRN can be used as an indicator to networks that the call may be treated differently. For example it may be an indicator that the call can be billed or routed differently. The NGLRNs would be hosted on a network of IP switches (NGGWs) for call routing and termination. Connectivity to the NGGWs is only offered over IP. NGGW providers would volunteer to offer this function and likely be vetted by an industry body.

The NGLRN solution requires that all carriers have the ability to route to NGLRNs. Carriers may choose to have agreements with transport providers who can route to NGLRNs rather than do it themselves. Otherwise the solution does not require carriers to 1) offer NNP service to their customers, 2) connect directly to NGGWs, nor 3) interface with administrative systems or processes required to enable the solution.

### Impacts

#### TDM/SS7 Network

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

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

The NGLRN solution does not require any changes to TDM/SS7 networks. The only requirement on these networks is the ability to route calls based on an area code, which has always been a basic requirement of all communications networks.

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

#### Call Processing/Network Routing

The NGLRN solution does not require originating queries on all calls nor changes to interLATA call processing.

Some carriers have a requirement to offer their customers a choice of IXC. These carriers also have a requirement to suppress the LNP query on the originating network and pass calls off to the IXC so that the IXC may perform the query. This is referred to as the N-1 query requirement. These carriers also offer their customers’ IXC service. For those calls the carrier can choose to query the call on the originating network because they are both the originating carrier and the N-1 carrier. The number of calls that have an N-1 query requirement has been steadily decreasing.

Carriers that do not have an N-1 query requirement can query the call on their originating network. Alternatively they can choose to contract with a transport provider to handle both transport and LNP queries.

In the NGLRN solution carriers can handle calls the way they do today. That is, if they have an N-1 requirement they can hand calls off to the IXC, if they perform originating queries on all calls they can continue to do that, and if they contract with a transport provider to perform LNP queries they can do that too. The only requirement is that there is an arrangement with a carrier that can handle calls to NGLRNs.

As noted in Clause 8.1.1, it may be more efficient, but not necessary, for the FCC to rescind the N-1 query requirement as well as the interLATA call processing requirement for calls to NNP TNs.

#### NPAC

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

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

#### Number Administration

The NGLRNs will need to be administered by some entity. This could be done by either of the existing administrators, NANPA or the PA, or the industry could choose to select a new administrator.

NGLRNs will have to be allocated to NGGW providers. Service provider and routing information will need to be associated with the NGLRN. This data needs to be available to carriers.

#### Accounting/Billing

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

Carriers that bill on a minutes basis will not need to change billing. Carriers that bill based on distance may choose to bill differently because an NNP customer’s location may not indicate the true distance that the call has traveled. However there are no rules that would restrict them from continuing to bill as they do today.

The NGLRN solution does not propose a method of providing the customer’s geographic location to originating networks. Carriers that choose to bill calls to NNP TNs differently may choose to bill those calls on a minutes basis.

#### PSTN/IP Interworking

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

The NGLRN solution creates an all-IP network of PSTN switches (i.e., the NGGWs) that interface with the TDM/SS7 PSTN via the NGLRN. Calls can flow easily from the TDM/SS7 PSTN to the IP PSTN by routing to the area code of the NGLRN. TDM/SS7 switches would route calls based on the NGLRN area code to a transport network (the carrier’s own or a trading partner’s) that can complete calls to NGLRNs. Carriers can move customers from the TDM/SS7 PSTN to the IP PSTN by porting TNs to NGLRNs.

#### Regulatory Related Services

There is no new functionality required for the NGLRN solution to enable regulatory related services.

Calls to 9-1-1 initiated by NNP TNs would use the pANI solutions deployed for wireless and VoIP service.

Further analysis is needed to determine NS/EP impacts.

#### Policy

The only policy change specific to the NGLRN solution is requiring carriers to have the ability to route to NGLRNs. Carriers may choose to have agreements with transport providers who can route to NGLRNs rather than do it themselves. Otherwise the solution does not require carriers to 1) offer NNP service to their customers, 2) connect directly to NGGWs, nor 3) interface with administrative systems or processes necessary to enable the solution.

Implementing NNP will require the FCC to issue an order lifting the LNP policy that restricts porting to within the same rate center. Carriers are not supposed to port a TN from one rate center to another. To deploy NNP, regardless of the technical solution, the FCC will have to issue an order that rescinds that restriction.

NNP further breaks down the association of TNs to geography. In light of NNP, the industry should consider changing policies regarding N-1 query processing and interLATA call processing for NNP TNs. For more on policy considerations, see Clause 8.1.

##  Internet Interconnection

### Overview

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

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

###  Summary of Impacts

####  SS7 Signaling

No new SS7 capabilities are required. Existing interworking between SS7 ISUP and SIP will suffice.

#### Call Processing

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

#### Network Routing

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

#### NPAC

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

#### Numbering Administration

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

#### Accounting/Billing

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

#### PSTN/IP Interworking

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

#### Regulatory Related Services (Emergency & NS/EP)

Priority arrangements or even separate dedicated interconnection can be provided for Emergency and NS/EP services.

Further analysis is needed to determine NS/EP impacts.

#### Policy

Internet Interconnection requires a redefinition of interconnection obligations.