**Contribution**

**TITLE:** Replacement text to be considered for current Section 6 of the IP Interconnection Routing document (IPNNI-2014-00083R005 – clean version), entitled “Interoperability between Aggregate and Per-TN approaches”, which discusses how interworking may take place between service providers using different routing approaches. The following text contains edits to the current introductory text, sub-sections 6.1-6.3, as well as revisions, as requested, for sub-section 6.4.

**SOURCE\*:** Neustar

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**ABSTRACT**

Section 6 of the Interconnection Routing document currently outlines draft text where some service providers may agree on the use of aggregate routing data and others may agree on the use of per-TN routing data. This contribution provides edits to the current Section 6 text, as well as offers one solution approach for supporting both forms of routing data on an individual service provider basis and builds on the industry NPAC and other commercial services that have been in place for more than five years, primarily in the support of ubiquitous, industry SMS routing. The solution text, sub-section 6.4, has been revised per requests from the NNI Task Force at the 8/7 face-to-face meeting in Washington, DC.

**NOTICE**

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# Interoperability Between Aggregate and Per-TN Routing Data Approaches

This section discusses how the two previously discussed carrier routing approaches can co-exist (or potentially interwork) with each other.

When considering interworking between carriers it is important to recognize that the interconnection process has a number of steps that are common. For example:

1. Interconnection agreements are formally negotiated between carriers on a bilateral basis. This negotiation process will lead to a formal agreement between the carriers on a number of key points related to the interconnection, including an agreed to mechanism for exchanging routing data. As a result, there is no need to define an approach where two carriers with arbitrary preferences interconnect and exchange data without first agreeing on the approach each will use.
2. Under all scenarios being considered, carriers will use data from a variety of sources as input to their internal BSS/OSS to build and maintain an internal database for routing calls/sessions. Each carrier uses their own system, with their own algorithm(s) for this, and it is therefore out of scope for this NNI Task Force. The routing data defined in this document is an important enabler for interconnection, but it is just one of the data sources used by the carrier to construct their own routing tables.

The key thing that differs between the proposed solutions is what specific data is to be exchanged between carriers as part of interconnection negotiation. This is an important aspect that has already been discussed in this document and assumed for this interworking section. Specifically, this section covers the case where carriers prefer to use different approaches and outlines a series of intermediate options that discuss potential industry “middle ground” positions.

## Routing Data From an Aggregate SP To a Per-TN SP

There are several possibilities for how the per-TN SP may arrange to route to the Aggregate SP.

First, the Per-TN SP may simply agree to implement aggregate-based routing as described in Section 4.

The second alternative is to transform the aggregate routing data into a per-TN representation. In the basic case, a per-TN SP receives the aggregate data and then creates individual TN records in its routing server based on that data. For example, if an AOCN to SBC IP address mapping is provided, the per-TN SP uses associated industry data to map the AOCN into the set of TNs the aggregate SP is offering for IP traffic exchange. This involves determining the set of NPA-NXXs and/or thousands blocks under the AOCN, creating a record for each TN, and then continuously removing records for numbers that have ported or pooled away from the aggregate SP and adding records for numbers ported or pooled into an LRN that is associated with the AOCN (i.e., has an NPA-NXX with the code holder AOCN of the aggregate SP). Thus, it is the responsibility of the Per-TN SP to update the record set based on changes in industry data. Note that the expanded data set may include records for unallocated numbers. Except for misdials, these records would not be accessed.

The expansion described above could also be performed by a third party, either on behalf of the per-TN SP or the aggregate SP depending on business arrangements.

In a special case, the third party could be a registry operator and the aggregate data could be delivered to the registry operator by the aggregate provider. Because the registry could distribute data to multiple per-TN providers, records would not include IP addresses as these would be target service provider specific. The records, however, could map TNs to a supplied SIP URI with a generic host name keyed to the aggregation element provided in the bilateral exchange. For example, a SIP URI containing the hostname AOCN “<aocn>.<spname>.net” might be used in the registry records. The per-TN provider could then populate the TN records in its routing server as described in Section 5 and resolve the hostname in its local DNS with records that match the hostname to the IP address associated with the corresponding AOCN in the bilateral data exchange.

## Routing Data From a Per-TN SP To an Aggregate SP

There are likewise several possibilities for how an aggregate SP may route to the per-TN SP.

First, the per-TN provider may simply agree to provide aggregate routing data. Aggregate data may include TNs beyond those for which the per-TN SP prefers for IP interconnection. For example, a wireless SP that has both VoLTE (IP) and GSM/UMTS (non-IP) subscribers that are not distinguished from a NANP data construct view may simply provide mappings from, for example, its AOCNs to its SBC IP addresses. This will result in some VoLTE originated calls transiting the IP interconnection even though they are destined for GSM/UMTS subscribers.

A second possibility is that the aggregate SP will accept per-TN information to populate its routing server even though it prefers to provide routing information for its own TNs on an aggregate basis. The per-TN data could be provided through a third party or a registry operator.

## Registry Supporting Both Aggregate and Expanded per-TN Routing Data

In this case, the aggregate input would map a NANP construct to a SIP URI rather than a set of IP addresses (as discussed in Section 6.1 above). Bilateral negotiation would then provide the URI to IP address mappings. A Registry could retain this aggregate input, and make it available to SPs that prefer aggregate input via an interface to be defined. It could also expand this aggregate input and make it available to SPs that prefer per-TN data.

## Using the Industry NPAC For Expanded per-TN Routing Data

### Overview

The solution introduced in this section assumes that some service providers will agree to use an aggregate routing data approach and others a per-TN routing data approach. The solution identifies just one potential “middle ground” for industry consideration. It leverages the industry NPAC and approved North American Numbering Council (NANC) governance change orders designed to facilitate routing transition to next generation networks. The solution further draws on established practices and commercial third party offerings which have been enabling ubiquitous Short Message Service (SMS) routing, for example, across a broad range of specialized use cases. Specifically, this solution focuses on an approach for supporting the provisioning of both aggregate and per-TN level routing data into the industry NPAC and distributing it all at a per-TN level for consumption by any authorized service provider.

### High Level Description

A key difference between the two currently proposed routing data approaches in Sections 4 and 5 is the granularity of information to be provisioned (shared) and managed by each service provider’s routing service. However, once some service providers agree to use a per-TN data approach, then all other participating service providers will most likely need the capability to manage the associated per-TN data in their respective routing services.

The following solution is just one way to support the provisioning of both per-TN and aggregate routing data in the industry NPAC and builds on various third party services and published APIs that primarily support ubiquitous industry SMS routing today. The following description assumes that certain one-time activities previously discussed and common across both proposed routing data approaches have already taken place between service providers (e.g., IP connectivity established). This solution supports both per-TN and aggregate routing data input and expands the latter for direct provisioning into the industry NPAC.

It should be noted that this solution can support the industry NPAC in the role of either a Tier 1 (i.e., routing data in a format that identifies service provider Tier 2 servers – see also Section 5.2) or Tier 2 (i.e., routing data in a format that identifies an interconnect SBC, or I-SBC, domain, where the specific “trunk group” or “route” is ultimately designed through a bi-lateral service provider information exchange – see also Section 5.1). The remainder of this solution description assumes a Tier 2 role, where the routing data to be exchanged in the industry NPAC is in the form of a SIP URI like “sip:<telephone number>@sbc1.sp1.com”. However, the solution doesn’t rely on just this specific URI format.

### Provisioning

Generally, the NPAC Location Routing Number (LRN) for ported telephone numbers or NANP NPA-NXX for native telephone numbers is used to route calls between service providers. Similarly, the NPAC Service Provider IDentification (SPID) or NANP Operating Company Number (OCN) is typically used to route text messages between service providers. Over the past five years or so, multiple commercial wireless use cases have arose where the SPID or OCN associated with a particular telephone number in these recognized authoritative databases (after port-correction) was not sufficient for routing within the ecosystem. Further, these authoritative databases, at the time, were limited in their support of such use cases. Consequently, several commercial third party services were introduced to support these use cases while they work hand-in-hand with the recognized authoritative databases.

The key constraint in the industry NPAC has since been removed through one NANC governance change order that allows native telephone numbers and associated information to be stored in the industry NPAC. The PSTN to IP transition use case and others being discussed are analogous to those that have naturally evolved around text messaging where additional information beyond an NPAC LRN or NANP NPA-NXX is required in support of routing. The provisioning flow summarized below uses the industry NPAC in support of the use case(s) minimally discussed within this NNI Task Force. Specifically, it proposes to use the industry-approved VOICE URI field that is one field of many in the existing, standard industry NPAC database record. Further, it leverages at least one established commercial third party service to provision and maintain NPAC database records with URI field data inherently synchronized with aggregate routing data input.

Figure 1 below highlights the provisioning and distribution aspects of the solution. For illustrative purposes and in an attempt to just give the reader an introduction to how the solution can work, the aggregate routing data input is assumed to be in the form of an NPA-NXX (a native NANP 6-digit code or 6-digit LRN). Further, SP1 has agreed to use the per-TN routing data approach while SP2 wants to provision routing data at an aggregate level.



Figure 1: Provisioning

1. SP1 and SP2 negotiate bilateral IP interconnection and exchange. In support of routing data exchange, each provides an agreed to mapping of IP address records (A/AAAA records) to FQDNs (or URI domains) corresponding to their respective I-SBCs. Each SP then provisions these records into their respective local DNS. An example of such a mapping for one URI domain could be:

|  |  |
| --- | --- |
| **URI Domain** | **IP Address** |
| sbc1.sp1.com | 138.34.23.3 |
| sbc1.sp1.com | 182.36.12.1 |
| sbc1.sp1.com | 58.23.12.90 |

1. SP1 populates the NPAC VOICE URI field in the associated subscription version (SV) record through its SOA (or equivalent) as new numbers are provisioned or existing numbers become available for IP interconnection. Again, the routing data to be exchanged is assumed, for this description, to be in the form of a SIP URI like “sip:<telephone number>@sbc1.sp1.com”.
2. SP2 shares aggregate routing data with an established third party service. For example,
   1. SP2 designates LRN 508-332 for IP interconnection.
   2. The associated ingress SBC domain is “sbc1.sp2.com”.
   3. SP2 establishes a Letter of Authorization (LOA) with the third party supporting this solution (if such an LOA doesn’t already exist).
   4. The LRN/ingress SBC domain/Action is then shared with the third party service over one of several published APIs (e.g., a flat file with a row “508332,sbc1.sp2.com,A” where “A”=Add).
3. The third party service for SP2 expands aggregate routing data input and manages as per-TN VOICE URI field data in the industry NPAC on behalf of SP2. For one example use case,
   1. Third party service interprets row “508332,sbc1.sp2.com,A” in a shared flat file and generates the associated industry NPAC provisioning actions. For example,
      1. 15 numbers (SV records) were found to exist in the industry NPAC with LRN 508332XXXX
      2. 15 Modify actions are then generated to add “sip:<telephone number>@sbc1.sp2.com” to the VOICE URI field for these SV records
   2. At a configured interval (e.g., every 15 minutes), check for new numbers with LRN 508332XXXX and generate associated Modify actions. Note that there is no action required for those numbers that are no longer associated with this LRN.
4. SP1 and SP2 download per-TN VOICE URI field data from each other (along with other existing NPAC data for number portability) through its LSMS (or equivalent).
5. SP1 and SP2 extract per-TN VOICE URI field data from each other (along with other existing NPAC data for number portability) and provision it into their respective internal route servers. Note that the details of how this routing data gets represented and used are specific to SP1 and SP2.

### Call Flow

Figure 2 below illustrates a call flow with the proposed solution. For illustrative purposes, SP2 initiates a call (session) to SP1:



Figure 2: Call Flow

1. SP2 customer dials destination number on SP1 network.
2. SP2 S-CSCF queries internal route server and SP2 route server responds back to S-CSCF with a port-corrected SIP URI containing the hostname of an agreed upon SP1 interconnect SBC.
3. SP2 S-CSCF resolves this hostname in the SIP URI through its local DNS to obtain the IP address of the SP1 interconnect SBC.
4. A SIP INVITE is sent to SP2 interconnect SBC that has layer 3 connectivity to the SP1 interconnect SBC.
5. The SIP INVITE is forwarded to the SP1 interconnect SBC.
6. SP1 interconnect SBC forwards the SIP INVITE to the SP1 S-CSCF.
7. SP1 S-CSCF terminates the call to its customer.

### Summary

The solution proposed above is just one potential “middle ground” for industry consideration. It is instantiated over existing industry NPAC infrastructure and conforms to approved/adopted change orders. Using the industry NPAC to support the PSTN to IP transition use case (and others being discussed) also allows inherent data synchronization with number portability information. Further, the solution has built-in support for local downloads/caches of routing data. The solution is transparent to service providers who agree to use the per-TN routing data approach. For service providers who agree to use the aggregate routing data approach, the associated aggregate routing data (e.g., native NPA-NXX, LRN) can be shared through an established third party, expanded, provisioned and updated (on their behalf) as per-TN routing data in the industry NPAC. This per-TN routing data can then be directly consumed by any participating service provider.