ATIS/SIP Forum NNI Task Force
April 30, 2014

**Contribution**

**TITLE:** The Current Routing Solution Description

**SOURCE\*: Verizon**

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**ABSTRACT**

This document illustrates some of the mechanisms currently in use and/or being deployed to facilitate the exchange of VoIP traffic between North American service providers. It provides a proposed solution for the ATIS/SIP Forum NNI Task Force that can be used immediately without any modifications to industry databases by all North American service providers.

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# Introduction

This solution is in use today and utilizes existing routing data provisioned in the NPAC and LERG to identify TNs that are part of a group of numbers covered under an IP interconnection agreement. The “Groups” most commonly used are the AOCNs, OCNs, Switch CLLIs, NPA-NXXs and LRNs assigned to and identified by the interconnecting partner during IP interconnection planning. SP preferences for physical interconnection locations and the corresponding ingress SBC IP addresses are also exchanged. The Groups allow call processing to determine if a called TN is covered under an IP interconnection agreement, and if so, the IP interconnection partner’s preferred points of ingress.

This solution has several strengths in that it is implementable now with relatively low cost, is flexible and has high availability in that all data required for real time call processing resides within the service provider’s network. This solution supports IP interconnection between service providers that have access to Country Code 1 (CC1) routing data, as is distributed via the NPAC and LERG. It can co-exist with solutions that provide similar interconnection globally; e.g., the GSMA IPX routing framework defined in GSMA IR.67.

Listed below are some requirement considerations and benefits of using the current solution:

* Implementable Now - Many SP core networks are IP based and utilize an internal “routing service” to determine how to forward service requests. Each SP is free to determine when to implement a "routing service” solution appropriate for their business and operational needs. SPs have options given vendors are actively engaged in providing solutions of this nature. This solution does not require development of new standards.
* Flexibility - This current solution can work in a hybrid TDM / IP environment, an all IP network, and co-exist with a global solution involving external databases and/or registries. Movement of numbers in and out of the Groups (e.g., due to porting) is reflected in modifications to the routing data (NPAC and LERG) for which procedures and distribution mechanisms are already in place. It does not require changes to the information exchanged between network operators. Also, this solution may accommodate other types of groupings.
* Accommodates VoIP Providers - This current solution accommodates VoIP providers that cannot be directly assigned numbering resources, but rely upon their SP partners to obtain TNs on their behalf. In some instances, the SP partner has published in the NPAC “secondary LRNs” by utilizing the last four digits of an LRN the SP owns to uniquely identify groups of TNs served by the VoIP provider. Establishing groups for this purpose allow VoIP providers to IP interconnect directly with other networks. This has many potential benefits, including reducing the need for transcoding and providing support for advanced services not supported by the PSTN.
* Performance and Availability - Since all the data needed to identify and route calls via an IP interconnect are held within an SP’s network, call processing does not rely upon the availability of external database queries to complete call processing. This reduces delay, improves reliability and allows SPs to optimize the performance of their networks independently.

# Scalability - The solution described here can be accommodated by commercially available routing (DNS and ENUM) infrastructure. The administrative overhead associated with managing the routing data (NPAC and LERG) depends in part on how the NPAC/LERG routing data is obtained and managed. In a configuration where this is supported via a service bureau, that process is automated and overhead to the SP is relatively small. There is labor associated with managing the information exchanged directly with interconnected networks, however by design that data is small and does not change frequently. Operational experience from networks where this solution is deployed indicates that the workload is not excessive and scales well as additional interconnects are established.

# Routing Flow

An Example of the Current Solution Call Flow is shown below in Figure Current-1:

Figure Current-1

1. Pat (non-roaming subscriber of SP1) makes a session request (e.g., places a call) to Mike (subscriber of SP2). SP1’s network provides originating services based on Pat’s subscription.
2. SP1’s application server queries its routing service in real time using the called number to determine how to forward the request. The routing service first portability corrects the called number, and then determines that it is not subscribed to SP1. It then checks to see whether it has an IP interconnection with the network to which the called number is subscribed and if so, what mechanism “grouping mechanism” has been agreed with that network. Finally, it checks to see whether the called number is a member of a group to which calls may be sent via the IP-NNI.

In this example the SP1 routing service finds that the called number is subscribed to SP2, that SP2 uses LRNs to define groups of numbers to which calls may be sent by SP1 via the IP-NNI, and that the called number is associated with such a group. The SP1 routing service supplies the ingress point (SBC-2) through which SP2 has requested that session requests directed to members of this group enter its network. It may also, depending on implementation, identify a corresponding egress point (SBC-1) from SP1’s network.

1. The application server modifies the session request such that it identifies SBC-2 and (if applicable) SBC-1 in SIP ROUTE headers, and forwards the resulting session request onward. Its L3 processing resolves the host portion of the topmost ROUTE header (using DNS) to the IP address of SBC-1.
2. SBC-1 removes the topmost ROUTE header (which identifies itself) and forwards the session request based on the next one (which identifies SBC-2). To do so it resolves (using DNS) the host portion of that header, yielding the IP address of SBC-2.
3. SBC-2 removes the topmost ROUTE header (which identifies itself) and admits the message to SP2’s network, forwarding it to an application server, and eventually to Mike. How SP2 performs these functions is SP specific.

# Provisioning

Provisioning is shown below in Figure Current-2:

Figure Current-2

In this provisioning example, SP1 provisions its routing service and DNS based upon information provided in the interconnection agreement. In this example, LRNs are correlated in the routing service to SBC interconnect address’ (points of ingress) into SP2’s network. In DNS, IP addresses are correlated with domain names.

The information provided by SP2 includes:

1. A “group identifier”. (All the TNs associated in the NPAC and LERG with that group, LRNs in this example, are covered by the IP interconnection agreement between SP1 and SP2).
2. SP2’s preferences for the point(s) in its network through which signaling messages addressed to TNs associated with the indicated group, should enter.

**Summary**

In summary, routing data coupled with IP interconnection partner preferences are used to enable independent real-time routing services within the networks of service providers electing to implement IP interconnection; using existing technology that accommodates both traditional and VoIP SPs. The result is a flexible routing solution that can accommodate IP transition and function on a stand-alone basis or as part of a broader routing structure in an all IP environment.

 **Evaluation Matrix**

|  |  |  |
| --- | --- | --- |
|  | **Criteria** | **Current Solution** |
| 1 | Specify interconnection information with finer granularity than the service provider level; specify different interconnection attributes for different groupings of a service providers numbers. For example, one per NPA/XXX or LRN, One per TN, alternative routes, etc. | The current solution can use groupings based on multiple group identifiers – e.g., OCN, LRN, NPA-NXX and Switch CLLI. Other grouping can be accommodated based on bilateral agreement. Each grouping can be associated with multiple ingress points for reliability. |
| 2 | Provide a mechanism for aggregation of routing information above the individual number level. For example, CO Code, NPA/NXX-X level | The current solution uses groupings based on multiple group identifiers - OCN, LRN, NPA-NXX and Switch CLLI. Other grouping can be accommodated based on bilateral agreement. |
| 3 | Provide a mechanism to get some insight into the service capabilities of destinations in advance of routing a call. |  Capability discovery is in general supported using the mechanisms defined by GSMA (Presence or SIP Options). Those mechanisms may be independent of or integrated with, this solution. For example in an integrated configuration the routing service might perform capability discovery prior to responding to the application server. One of the strengths of this solution is that it offers SPs wide latitude with respect to the implementation within their own networks. |
| 4 | Support the ability to provide GETS. | Supported |
| 5 | A mechanism for terminating carriers to identify different interconnection points (for a given group of TNs) depending on the originating carrier. | Yes. Since the information associating ingress points with groups of TNs is exchanged on a bilateral basis, service providers have the freedom to provide different information to each interconnected network. Furthermore the fact that different information is provided to different networks, is not divulged (as it might be, were such an exchange made via a 3rd party or registry). |
| 6 | The service provider connecting to the terminating provider selects the interconnect point, consistent with preferences identified by the terminating carrier. | Supported. |
| 7 | The ability to exchange routing data between carriers in bulk. | There is no need for bulk distribution of routing data, beyond the mechanisms that already exist for dissemination of routing data (NPAC and LERG). Service providers use existing processes and industry databases to identify groupings of data. A small amount of information is exchanged between service providers to map groups to interconnection points.  |
| 8 | The ability to query a locally cached copy within each carrier, rather than always having to query the terminating carrier. | Supported. All routing data is accessible in real time in each service provider’s network. |
| 9 | Level of dependence on "CO codes", even during the transition. | CO Codes or other identifiers may be used as a grouping mechanism, subject to bilateral agreement between interconnecting operators.  |
| 10 | What external bodies are required to modify existing arrangements, systems, etc.? | No modifications to existing arrangements or systems are required. This solution is immediately deployable, and in fact deployed.Enhancements, if desired, would be dependent on existing industry processes to modify NPAC and LERG. |
| 11 | Any solution must have a clear path to move to a global solution. | Can co-exist with a global solution. The routing service described herein can utilize external databases such as are typically required in a global solution.In one possible solution, a service provider might use the solution described here to interconnect with some other service providers in CC1; and use the “global solution” to interconnect to the rest. By interconnecting his routing service to the external databases used by the “global solution”, the service provider could make this evolution transparent to his call processing logic.Other forms of integration, e.g., using the “global solution” as a backup route for destinations supported by the solution described here, or migrating from the solution described here to 100% use of the “global solution’, are also possible. Each service provider is free to make such plans independently; constrained only by the terms of existing interconnect agreements. |
| 12 | The approach picked by this group must provide good solution for the end state all-IP network while maintaining backward compatibility (or interworking) during the transition. | The solution described herein provides an efficient solution for both the proposed end state and the transition to that state. |
| 13 | Compatibility for solutions for non-E.164 Public User Identities. | The solution described herein is based on use of E.164 numbers for subscriber identification. It could be extended to non-E.164 numbers but doing so would require creation of a mechanism to define groupings that today are derived from information in the NPAC and LERG. |
| 14 | What updates need to be done throughout the network for each option, and what is the estimated complexity of that? Impact on: | - |
| 15 |          Time to implement - common infrastructure | In use today |
| 16 |          Existing industry systems | In use today |
| 17 |          Existing service provider systems | In use today |
| 18 |          The need for additional industry systems and interfaces | None required |
| 19 |          Call setup time | No Impact - local queries minimize call setup time |
| 20 |          Signaling traffic | Minimized - no impact |
| 21 |          Increase of vulnerability of security | Minimized - no impact |
| 22 |          Network elements | No impact |
| 23 | Reliability and scalability. | Experience to date indicates this is sufficiently scalable to support interconnection within CC1 and highly reliable because all the real time infrastructure is within the originating SP network. |
| 24 | Support for secure tunnels and open Internet routing. | Yes / Yes |
| 25 | Solution must be synchronized with number portability. | Solution uses the NPAC for to identify SP for ported numbers |
| 26 | Solution cannot be tied to historical geography of numbering plan. | Accommodates geography but is not dependent on geography |
| 27 | Registration in common industry databases should only be made by the current service provider of record or an authorized agent for the service provider of record | This is done today |
| 28 | There is a need for service providers to exchange information for both primary and alternate routes. | Multiple ingress SBCs can be specified if agreed in the Interconnection Agreement. This is normally the case. |
| 29 | A solution cannot require additional significant investment to legacy systems. | No enhancements to legacy systems are required. This solution is currently in use by multiple service providers. |