INTERNATIONAL INTERCONNECT FORUM FOR SERVICES OVER IP

(i3 Forum)

www.i3forum.org

Routing and Addressing services for International Interconnections over IP (V 1) May 2010

Scope

This document describes the requirements for routing and addressing in an international IP environment.

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1 Introduction

It is difficult to predict the full variety of ways that IP will transform the voice industry in the coming years. Today's principal revenue streams may become less prominent, but the new environment will spawn new services, creating an exciting array of business opportunities. During this transition, the industry will need to overcome technical and interoperability challenges, refine standards, and document best practices before Service Providers become as fluent in IP as they currently are in TDM.

2 Document purpose

Routing and addressing (R&A) for voice services has been traditionally managed mainly with E.164 country codes and blocks of numbers assigned to individual Service Providers (SP). The introduction of competitive carriers to fixed network providers and the development of Number Portability (NP) in many countries have significantly complicated the routing process that international carriers need to use in order to correctly route the call to the distant Service Provider. Beyond voice, the routing of SMS and MMS messages is critically dependent on the knowledge of the distant network owner to ensure delivery of the message. Individual carriers have tackled these problems in ad-hoc ways leading to a non-optimized solution.

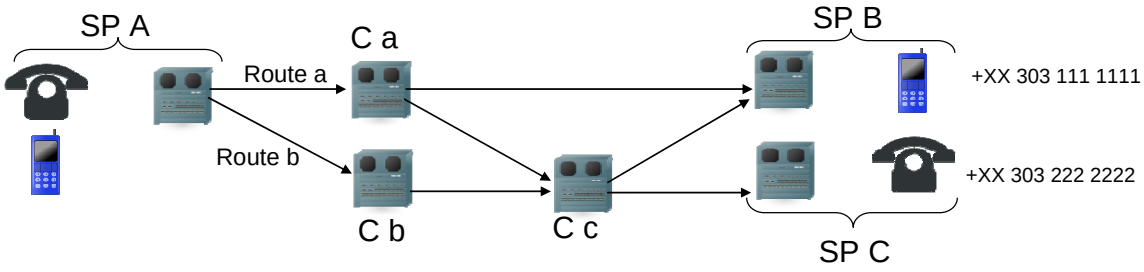
Many countries have developed an infrastructure to manage number portability with specific technical and regulatory solutions. It is not the aim of this document to elaborate on or provide requirements for domestic architectures. For international routing purposes, several companies worldwide provide their own registry solutions to help Carriers and Service Providers to manage or access the number portability information for inclusion into their routing decision processes.

The industry foresees a rapidly increasing rate of number portability implementations worldwide. The launch of new services (beyond simple voice telephony) may further warrant additional specific routing based information on the terminating network, which can also include information based on the terminating device. This evolution calls for a more universal solution to address routing and addressing over international interconnections. The transition from TDM to IP interconnections creates new challenges but also new opportunities to manage Routing and Addressing.

This document aims to explain the needs of carriers and service providers to manage routing and addressing functions within the existing ecosystem, and the technical environment of the international interconnections business. This document does not intend to propose a specific architecture or solution.

3 The existing principles of International Routing and Addressing

3.1 Basic routing decision making for international voice

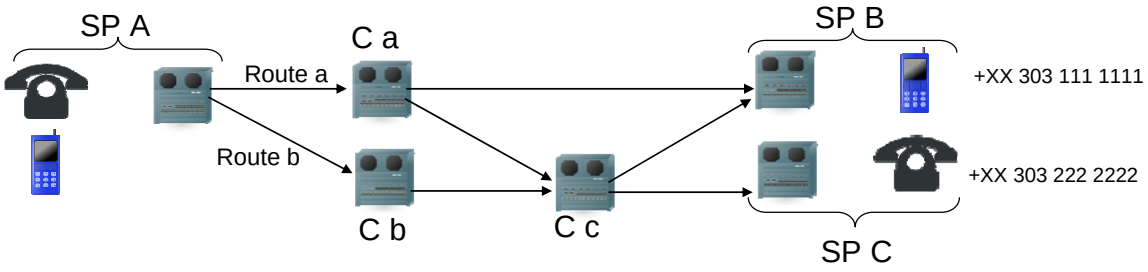


- **Addressing**
  - Service Provider (SP A) wants to know which network or SP currently provides service to + XX 303 111 1111. Normal E.164 code assignments show that the number is in country X and was originally assigned to SP C, but because of portability in country X it is not possible to know if the number currently belongs to SP C or SP B. Because Mobile Termination Rates vary by operator, and in some countries a transit fee is charged for routing to the incorrect operator, it is not possible to know in advance what the cost of termination will be. Eventually, if fixed/mobile portability becomes possible it would also not be possible to know in advance if this was a mobile or fixed phone with potentially more significant cost implications.

- **Routing**
  Service Providers and Carriers route calls depending on several parameters which span technical, operational and business considerations. Typically, the routing process proceeds as follows:
  - Service Provider A receives +XX 303 111 1111 from its customer. SP A routing engine identifies that +XX identifies country X.
  - SP A routing engine has two routes available to + XX 303 111 1111, route “a” through Carrier “a” and route “b” through Carrier “b”
  - SP A’s routing decision to use route “a” or “b” depends on multiple variables included in the SP A’s internal company routing algorithm, for example:
    i. Business commitment. Is SP A under a commitment to send X million of minutes to carrier “a” or carrier “b”?
    ii. Business cost optimization. Is the route “b” cheaper versus route “a” to send mobile calls to country X?
    iii. Capacity availability. Is route “b” or “a” overloaded or credit authorization maximized?
    iv. Quality parameters. Are there quality problems on route “a or b”?
    v. Service requested. Is the call to + XX 303 111 1111 used for a special service like video call which only route “a or b” can support?
    vi. Quality requested. Is SP A requesting premium quality with full feature transparency which might only be available on route “a or b”?
    vii. Technology aware. Is SP A requesting a full IP route or a special codec along the chain that only route “a or b” can ensure?

All SPs and Carriers in the chain (SP A, Ca, Cc..) make routing decisions based on multiple parameters provided by addressing information and routing requirements. It is important to note that in today’s international business environment, routing and addressing is not always intended to find the most direct route, but the correct route based on the product sold and on business decisions.

3.2 Basic principles to assign routes in today's international voice networks



- **Today's Routing uses static routes described in a routing table**
  For example:
  - **a.** The wholesale premium high quality traffic to country X goes via route "a" and carrier A
  - **b.** The Wholesale lower cost traffic to country X goes via route "b" and carrier B and carrier C
  - **c.** Some SPs use a more complex routing decision and in some cases use a per-call routing by analyzing the full number, checking for number portability and making decisions accordingly. However, deployment of this solution remains minimal and is dedicated to a few routes within the overall international voice volumes of traffic.

- **In TDM, static routes are often implemented physically in the network.**
  For example
  - **d.** Trunk Xa to send premium traffic
  - **e.** Trunk Yb to send wholesale traffic

- **In IP, SPs and Carriers generally replicate the same individual trunking system, perhaps using prefixes in place of physical trunk groups.**

- **But future full IP implementations could call for a more dynamic and open model**
  - **h.** SPs and Carriers might have to send a call directly to the SP that owns the number, or to the SP that temporarily has the called customer as a roaming customer. .
  - **i.** SPs and Carriers might have to manage a call that is received without a dedicated trunk group or prefix indicating the identity of the calling Service Provider. In this case, the calling number, or CLI, becomes the identifier of the calling SP.

3.3 Information required for routing a call.

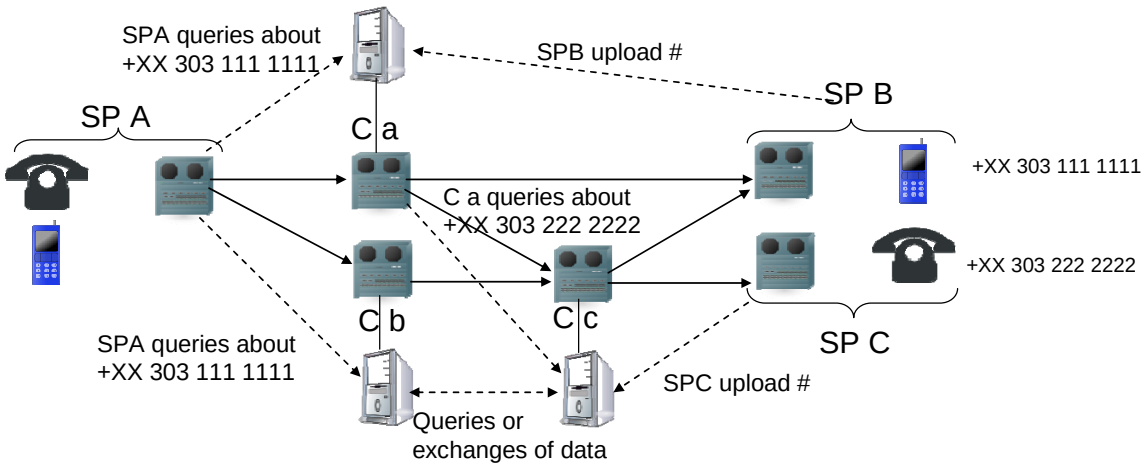
- **Some information that SPA and Carriers in the chain do not know today:**
  - The Network terminating a call for a specific number.
  - In countries with number portability it is not possible to know which SP's network terminates the number called (SPA or SPB). There are solutions for some countries but they vary by country and technology.
  - What type of phone is called (fixed, mobile, VoIP, TDM, wideband, narrow band) and what services it supports.

- **What services can carriers not provide today?**
  - By not being able to correctly identify the terminating network for a given number, SPs or Carriers cannot easily provide network destination based routing versus number code based routing. This limits the technical and commercial possibilities such as on-net routing or peering. This is only possible to a few countries or networks and it is not a standard capability in the industry.

- Provide information on the status of the number called to the calling party before and without actually routing the call – presence information. This service is needed for the calling party to make a more educated decision prior to routing.
- Filter TDM or VoIP calls and perform routing based on technology used by the next Carrier, SP, or by the end user. For instance in a full IP environment, it could be useful to identify that a given call is destined for the part of a retail network that is IP and try to retain this call in an IP route to avoid degradation and loss of features during the TDM conversion.
- Verify CLI by ensuring that the CLI sent belongs to the SP that sends it. Assuming that it is possible to identify which network currently owns a telephone number, it would also be possible to recognize if the CLI sent by this network is indeed a valid number owned by the sending network and not a spoof from another network or end-user. While this solution would theoretically work, the associated costs can be significant.
- Guaranteed wideband calls end-to-end if the end devices can support that.

- **The services that could be requested in the future and that are not possible with today's R&A technology**
  - All of the above are not widely possible
  - IMS like services, such as routing the call based on presence information
  - While end-to-end High Definition (HD) voice can be reasonably guaranteed on a direct IP interconnect between two SPs, it becomes unmanageable when a hubbing Carrier is introduced for commercial or interconnect reasons.

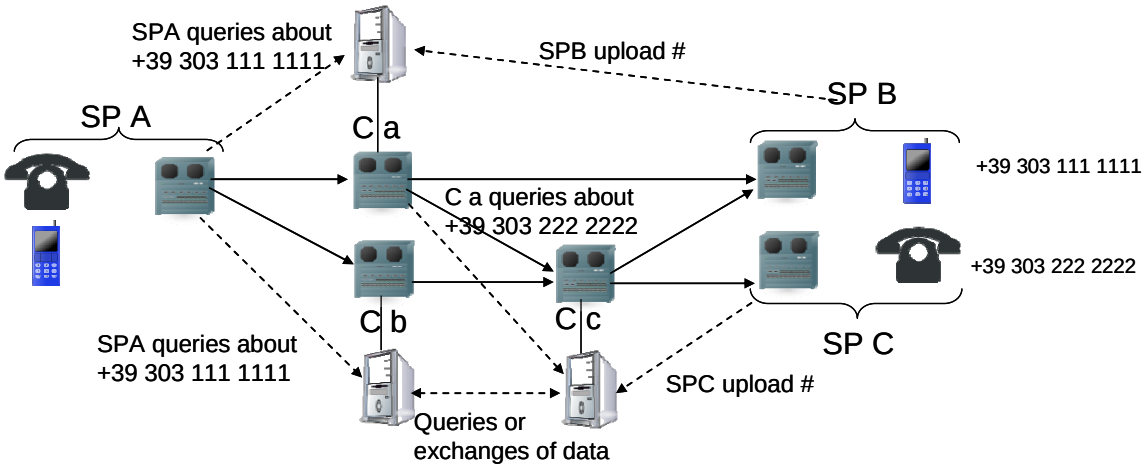
3.4 Routing and addressing database environment



This document does not intend to propose a specific architecture. This example above is just to illustrate some principles if appropriate routing and addressing databases were available to SPs and Carriers in the route all the way back to the originating service provider.

SP A or the downstream carriers Ca and Cb need to make decisions about call routing that are dependent on several factors such as: their available connections, the type of connection (TDM or IP), the nature of their commercial relationships and even the availability of international connections from the switch undertaking the query. The SP/Carriers in the chain need to know two specific things about the number in question – which terminating SP currently serves the telephone number, and what services are supported by the number/associated device. These Carriers and Service Providers need more information to properly route calls other than a simple routing based on a routing address (a URI in IP terms) alone.

3.5 The complexity of having multiple Routing and Addressing databases.



- **Multiple databases**
  - Service Providers and Carriers need a common syntax to manage data, provision and make requests: this is needed to reduce costs, facilitate implementation and promote wide coverage. This common technology/language between SPs and carriers is independent from what each country and regulator would have decided locally. Different solutions can exist locally, but they should all have a standard interface to exchange data with international operators.

- **Standardization of information**
  - The information that might be required can vary depending on the operators, the business models used and so on. The information can span from number portability information, direct route info, etc. SPs and International Carriers need to identify a clear definition and understanding of which information they need from each other.
  - The examples shown above focus on portability, but extending the model to include direct routing to a VoIP Service Provider, or MVNO for MMS messages, potentially requires the sharing of a more rich suite of information (data) between the end SP and the intermediate carriers.
  - A standardization of the queries and the responses is required.

- **Common language to interpret the data**
  - Depending on the information needed, the data must be provided in a way that is understood by all operators in a uniform or standard manner. The international industry should avoid a multiplication of several approaches that would require specific IT development, and hence likely slow widespread adoption.

- **Commercial models**
  - Several models describe the commercial rules to upload, query and exchange data. Besides commercial considerations, there are also regulatory aspects that warrant consideration. The solution to exchange routing and addressing information should be flexible enough to accommodate several models in order to foster and facilitate adoption.

- **Security and business rules**
  - There must be business rules to secure and securely exchange data. The solutions must clearly consider how these rules can be monitored and enforced.
  - Several risks of fraud and abuse can occur when exchanging data, and these risks must be indentified and solutions put in place to avoid them.

- **Comments on some existing solutions**
  - The GSM Association (GSMA) in their IPX voice model calls for the management of routing and addressing for several reasons such as: direct routing, secure routing for incoming traffic and so on. At the time of this document printing the GSMA has provided draft designs for a DNS-based query hierarchy that would provide a routing address against a query, although at the moment this addressing solution does not yet address all of the carriers needs mentioned in this document. The structure behind this design does not answer the need for a global terminating network ID, (see section 4) needed by operators.
  - The ENUM protocol is a technology that seems to bring a lot of promise for routing and addressing standardization, simplification and scale. However, as it stands today, ENUM does not address the key requirements for international routing and addressing, such as terminating network ID (See section 4), which limits the commercial drivers for its wide adoption within the international voice industry.
  - Private registries as a service to peering members also exists where a registry provider has gathered information from connected service providers (usually VoIP SPs) or domestic portability databases, and offer the results as a query service. The private registries themselves could also exchange data with each other in such a way that a service provider or carrier could contract with one registry provider (entity) for query services and always be assured of getting a fully correct global response (available from other registry providers or entities). This solution is currently limited by the amount of numbers known globally and the extent of cooperation by other registry providers and/or other entities).
  - Finally, there are more co-operative designs and solutions where SPs can enter their data (e.g., numbers) into a shared registry, where the SPs share the data and with other member SPs.

- **Regulatory aspects**
  - Each country has adopted different Rules (Laws) about privacy and the confidentiality of consumer information, which then impacts what information can be shared, particularly outside the country of interest. There is no one approach that can be described here.

4 Carriers' requirements for an international Routing and Addressing

This section describes what a routing and addressing solution should provide to international carriers and Service Providers (referred to as operators or entities). This section also describes the questions that operators could ask within a routing and addressing exchange, as well as the answers that are expected by that asking party.

4.1 High Level Requirements

A querying entity, which can be an International carrier or a Service Provider such as a mobile network or a VoIP service provider, has the following requirements for a query response:

- The identity of the network currently serving that telephone number (Service Provider0 using a globally agreed identification format. If portability is active in that country, then the response should take portability into account. If portability is not active, then the response would simply be the assigned/authorized holder of the block of numbers associated with the queried number.
- The identity of any virtual user of the telephone number, which could be a network-free VoIP service provider (such as Vonage or Skype), or potentially a corporation or enterprise able to take direct international termination of that call (on a commercial and regulatory basis). Note in some jurisdictions, these players are not the assigned/authorized holder of the block of numbers (or individual numbers) under their use/control.
- A standard solution for the response that would meet all potential needs would be for the query provider (e.g., registry provider) to always return three answers in a strict sequence – Virtual Operator : Ported-to-Network : Number Block Holder. Depending on the intent of the querying operator and the service being routed, the operators internal switch or routing intelligence will choose to use the response required from the three provided based upon its internal needs. If an answer is not available (ie no virtual operator, or the number has not been ported), the string would be an agreed NULL character.
- In the longer term, a different query format could return the capabilities of the access device (the phone or customer device) in terms of services supported. The industry is currently far from being able to resolve this requirement, but it should be borne in mind as a requirement.

On the basis of the response to the query, the operator, with knowledge of the capabilities in terms of reach, price, quality available and need, functionality or other commercial constraint, would be able to choose the most appropriate route for the call or session, and via internally provisioned routing tables, would identify the correct routing address for the call.

The other major requirement to consider is the SLA for speed of response to a query and also for the accuracy of the response (frequency of update). This document is not defining the exact response time, but it is important that any query and response should not add any significant delay to the establishment of the call or session, especially in an international environment where the source of the data may be thousands of miles away. Therefore, it could become necessary to minimize the information update and the delay to get responses by having local caches. However, different type of needs for response times and accuracy will exist in the market and should be addressed with different SLAs and products to meet these needs.

4.2 Examples of Questions and Answers within a standard international routing and addressing exchange.

Question 1. Which network terminates this E.164 number directly and without any transit?

- There are two types of networks that may be able to terminate a call or session to an E.164 number depending on the regulatory and/or commercial agreements in place. A licensed operator (referred to as operator) will have been assigned a block of numbers (although the specific number may have been ported to a second operator), and then a licensed virtual service provider (VoIP or MVNO) may have the commercial rights to also terminate calls to the same ported number. In both cases, both the original number assignee and the ported-to MVNO (or a VoIP Provider's network) are able to terminate the session without transit via another carrier. For instance:
    i. SPA is a mobile operator licensed in a country to provide cellular services to retail customers. SPA is the terminating network for all its own retail customers.
    ii. If SPA hosts an MVNO, if the MVNO is not authorized to manage (buy and sell traffic) outgoing and incoming traffic on its own, and has to always go through SPA which then terminates calls domestically or internationally, then SPA is the terminating network of the MVNO numbers. If the MVNO has the right to manage its own solution for incoming and outgoing calls for the customers of the ported numbers, then the MVNO is the terminating network for its numbers.
    iii. As described in ii above, there is a valid scenario where both the MVNO and SPA can terminate calls or messages to a number and so the Routing and Addressing systems must be able to handle multiple responses to a query as explained in the High Level Requirements. Similarly, the provisioning of such systems must have sufficient control to avoid invalid entries into the database.
- The answer needs to be in a form of a worldwide unique, standard and public network identifier for the carrier and/or service provider in question and the routing logic of the originating carrier will identify the most appropriate routing.

Question 2. Is your network the terminating network (or exclusive transit provider to this network) for this E.164 number?

- The answer is in a form of Yes or No.

Question 3. Which E.164 number(s) do you terminate on your network?

- The answer needs to be in a form of a list, in a unique public standard format. Updates can be full or incremental only. This is normally for provisioning purposes only, where permitted. For example, an operator replicating the registry to build a local copy of the relevant information to permit faster querying (and routing).

Question 4. Which services are enabled with this number?

- Possible services such as VoIP, Fax, SMS, MMS, videocalls, HD calls, mobile phone, fixed phone
- Codecs (here it will be the standard identifier including the codecs recommended by the i3forum)
- The answer to this question should be in a form of a standard list. Updates can be full or incremental only. As above, this is mainly for provisioning reasons.

Question 5. Is this E.164 number able to handle this service type?

- VoIP, Fax, SMS, MMS, videocalls, mobile phone, fixed phone. These are just examples, whether or not they would be used depends only on commercial needs. This is only to illustrate that the standard for this question must be flexible to accommodate changes.
- Codecs (here it will be the standard identifier including the codecs recommended by the i3forum)
- The answer to this question should be in a form of Yes or No

The Query/Response solution needs to be scalable in order to facilitate the addition of new services and associated requests as they become pertinent.

Question 6. Implementation of business rules around the sharing of information

- Be able to identify, authenticate, authorize an authorized operator (query requester) to get answers based on pre-established business rules such as:
  i. Requester A can get answers for single request, or can get a full list.
  ii. Requester A can get information for Network B, C… but not for network F,G..
  iii. Requester A can get information about network identifier, but not for other elements such as services enabled etc…
- The solution to implement and manage business rules needs to be scalable in order to facilitate the addition of new rules as they become pertinent.

Question 7. Reporting information to be provided (by the query provider) if required.

- Reporting has to be in common format for further data processing.
- Number of requests asked by requester A
  i. # of total positive and negative answers per network, and per type
  ii. # times of lists updates per network
- SLAs and QoS indicators need to be further developed.

5 Conclusion

There is a need for a standard Routing and Addressing approach that answers all the technical, business and regulatory requirements. The i3Forum will continue working with the different industry players, standards bodies and vendors to help define and implement interoperable technical and commercial solutions.