



A Somos Company

Number Information Services

SIP Interface Specification

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Issue	Date	Reason For Issue
1	15-05-17	First Issue
2	18-06-17	Support for customised prefix schemes
3	31-07-18	Added customer web portal
4	05-01-20	Minor updates for clarification
5	05-01-23	Updated to include GNR Validation for A and B, and A Validation including DNO

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1 Introduction

This document describes the SIP query interface to the XConnect Number Information Services (NIS) suite of products.

XConnect offers a number of solutions which enable customers to query our data to discover information about the routing, ownership and status of E.164 Telephone Numbers (TN).

Our Number Information Services are primarily used to support Voice & SMS routing, and applications which require number validation.

In addition to SIP, our services also support ENUM and HTTPS query protocols, as well as batch file processing and data downloads.

Please see our service documentation for further details of NIS technical, operational and commercial features.

2 Modes of operation and services available

Our SIP interface can operate in two different modes (Redirect and Validation) and supports a number of services and query types.

Details of services and Call/SIP message flow are provided later in the document.

2.1 SIP interface operational modes

The SIP interface can operate in two 'modes':

2.1.1 Redirect mode

- In this mode the SIP interface acts as a 'SIP redirect' server to the querying customer network. Customers send a SIP Invite to XConnect and information related to the numbers in the Invite is returned in a SIP 302 response.
- The format of the information returned varies depending on the service and customer configuration.

2.1.2 Validator mode

- In this mode the SIP interface acts like a standard SIP terminator trunk (which will never actually terminate a call) to the querying customer network.
- Customers send a SIP Invite to XConnect to 'Validate' numbers and determine whether the call should be 'allowed' or 'blocked'.
- Rules for 'allow' or 'block' are dependent on the service and customer configuration.
- The SIP interface will return a SIP-503 (allowing the customer to overflow the call to the correct first choice) where the call is 'allowed' and will return a SIP-607 (allowing the customer to fallback the call to their originator) where the call should be 'blocked'.
- From a customer perspective, this mode may be simpler to implement than the redirect mode, as the SIP interface just needs to be added into the customer routing plan ahead of the 'real' terminator.

2.2 Services available via the SIP interface

Our SIP interface supports the following NIS services (these are described in detail later in the document):

- **Number Portability Query (NPQ)** – The NPQ service enables customers to determine the current network owner of the 'To' (RURI) TN sent in the Invite, taking into account number portability.
 - NPQ operates in Redirect mode.
 - The 'Service Provider' owner information is returned in the SIP 302 Contact Header.
- **Global Number Range (GNR) A/B number Validation** – The GNR service allows customers to validate TNs provided in a SIP Invite against the XConnect GNR database.
 - GNR operates in Validator mode.
 - Customers can choose to validate either A number or B number or both depending on SIP interface configuration.
- **A Number Validation (A-Val)** - The A-Val service allows customers to validate A numbers provided in the SIP Invite against both GNR and Do Not Originate lists.
 - Please see coverage for available DNO lists.
 - A-Val operates in Validator mode.

2.2.1 SIP service selection and combining services

The SIP interface allows multiple 'SIP trunks' to be configured from the customer network to our platform so that different services can be applied to different 'trunks'. This allows customers to 'route' specific traffic for specific services depending on their requirements.

It is also possible to combine services on a single SIP trunk for example:

- Use A-Val to validate the A-number before using NPQ to determine the B-number owner.
- Use GNR to screen both A- and B-numbers on the same query.

Each SIP trunk is configured with the specific service (or combination of services) as agreed.

Multiple SIP trunks are created by the customer:

- Sending traffic from a different source IP address allocated by the customer.
- Sending traffic to a different SIP target (the To -RURI) allocated by XConnect.
- Sending traffic with prefix digit(s) in front of the B number (Prefix allocated by XConnect).

XConnect will work with you during the sales and on-boarding process to create a specific design document detailing your specific SIP interface configuration.

2.2.2 Customisation

XConnect's aim is to minimise the operational impact (cost, time, resources) to you of implementing the SIP interface services, and to fit into your existing network architecture and mode of operation as much as possible. Therefore, we'll work with you to understand any customisations to the SIP interface which may ease the implementation and create a 'Statement of Work' for undertaking any such customisation.

3 Accessing the SIP Interface

3.1 IP access and Points of Presence

The SIP Interface is provided from XConnect Points of Presence (PoPs) currently deployed in the US (New York), Europe (Dublin and Frankfurt) and Asia (Mumbai and Singapore).

Access to the service is via the Public Internet, and customers should create SIP trunks to multiple PoPs to optimise service availability and query latency.

IP-Sec VPN connectivity can be supported for customers wanting to encrypt the traffic stream.

3.2 Query authorisation

Customer queries are authorised by source IP address.

The XC Support Team will request the IP address of all customer query sources (and the PoPs they would like to access) at provisioning time.

Any changes to source addresses should be advised to the XConnect NOC following the standard support process.

4 SIP Interface services with ladder diagrams

4.1 B-Number Portability Query (NPQ)

The NPQ service checks the B-number presented in the SIP Invite against XConnect Number Portability data sources and returns the current network owner for the number (note this includes both ported and non-ported numbers).

Typically, NPQ is used to enable network based (rather than prefix based) routing to improve quality, reduce costs or support advanced features (e.g., HD voice).

The NPQ service operates in SIP Redirect mode and will return a Contact Header in a SIP 302 operation which contains an identifier for the owning network.

Note: while NPQ for any country could be supported by the SIP interface, it is anticipated that only XConnect Onboard countries (i.e. countries where XConnect has integrated the national central database into the NIS platform) are likely to support the latency requirements for real-time voice traffic.

4.1.1 B-NPQ Successful Query

Figure 1 below shows the signalling flow for a B-NPQ service SIP query which successfully returns the Service Provider owner.

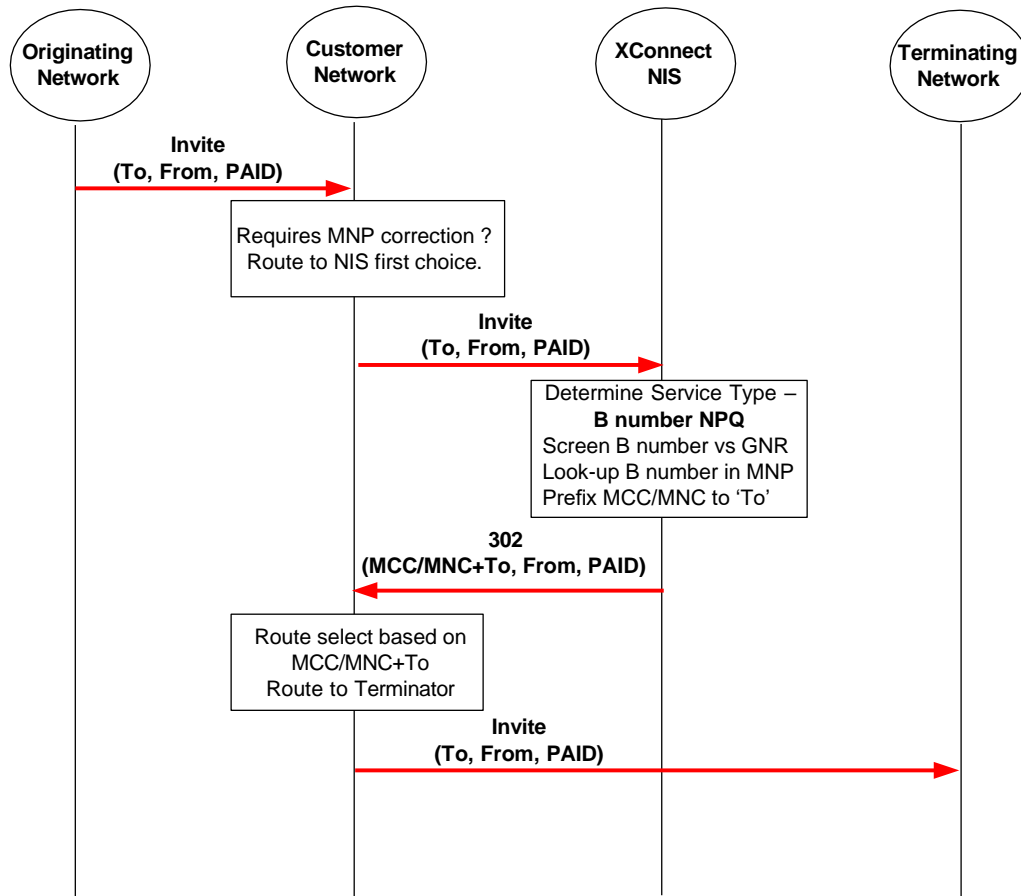


Figure 1 – B NPQ Successful Query

On receiving a call which requires B-Number Portability correction, the customer network sends the SIP Invite to the relevant XConnect SIP trunk.

- Customer routing determines which B-number destinations are sent to XConnect, with the XConnect SIP trunk for the relevant service being placed into first choice for the route for the relevant destinations.
- The service can support multiple B-number destinations on the same SIP trunk if required, as agreed at provisioning time.
- Any B-number sent which is not for an agreed country will be rejected.

On receiving the SIP Invite from the customer SIP trunk the NIS platform:

- Authenticates the traffic based on source IP address.
- Determines which services are applicable to this SIP trunk (in this case B-NPQ and which destinations are allowed).
- Looks at the B-number presented in the To RURI (note this should be in E.164 format).
- Checks the B-number is 'valid' against the XConnect Global Number Range database (in this case the number is valid).

- Checks the number against the XConnect Number Portability data for the destination (in this case the number is found in the NP database) and retrieves the current Service Provider data, including MCC/MNC (note, this includes both ported and non-porting numbers).

The SIP interface returns a SIP 302 (Moved Temporarily) to the customer network:

- The SIP 302 contains a contact header which is made up of the B-number prefixed with the MCC/MNC of the current Service Provider.

On receiving the SIP 302 with the new Contact header the customer network selects the appropriate terminator for the MCC/MNC and B-number destination based on their routing rules.

Example SIP Trace – B-Number NPQ

The following shows an example SIP trace for the B-Number NPQ service.

Customer SIP Invite to XC NP Service

INVITE sip:393248799233@IP:5060;user=phone SIP/2.0

Via: SIP/2.0/UDP IP:5060;branch=z9hG4bKiiicjf205ovhikfdr0b0.1

Call-ID: zu7hfh3102dxh304zu0f14z779hz4x3u@SoftX3000

From: <sip:3267645802@IP:5060;user=phone>;tag=4fhl249x-CC-23

To: <sip:393248799233@IP:5060;user=phone>

CSeq: 1 INVITE

Max-Forwards: 67

P-Asserted-Identity: <IP:5060;user=phone>

Contact: <sip:3267645802@IP:5060;transport=udp;user=phone>

Allow:

INVITE,ACK,OPTIONS,BYE,CANCEL,REGISTER,INFO,PRACK,SUBSCRIBE,NOTIFY,UPDATE,MESSAGE,REFER^M

User-Agent: Huawei SoftX3000 V300R010

XC NP Query Service Response

SIP/2.0 302 Moved Temporarily

Via: SIP/2.0/UDP IP:5060;branch=z9hG4bKiiicjf205ovhikfdr0b0.1

Call-ID: zu7hfh3102dxh304zu0f14z779hz4x3u@SoftX3000

From: <sip:3267645802@IP:5060;user=phone>;tag=4fhl249x-CC-23

To: <sip:393248799233@IP:5060;user=phone>

CSeq: 1 INVITE^M

Contact: <sip:+22210393248799233@IP>

Content-Length: 0^M

Options for SIP Contact Header

As shown above the standard for SIP Contact header address is to prefix the B-number with the MCC/MNC of the current SP.

XConnect is open to alternative options which may include RN= where the RN value is the MCC/MNC or the Carrier Identification Code (CIC) of the Service Provider.

XConnect will work with you to determine what format of the contact header address is most appropriate for the customer network.

4.1.2 B NPQ – Number Invalid or Not Found.

Figure 2 below shows the SIP signaling flow for a B-NPQ service query where the B-number is either invalid against the XConnect GNR database or cannot be resolved by the Number Portability database.

Please note, in either case a SIP 404 –Not Found is returned and the customer will route the call based on their default routing rules.

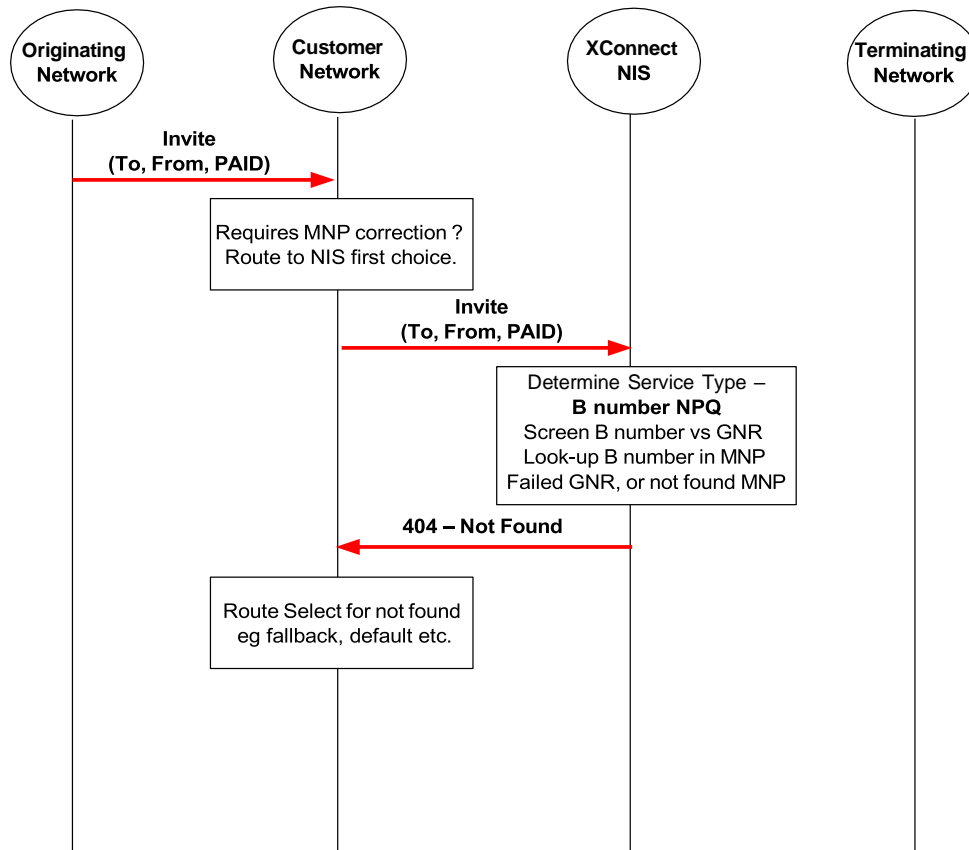


Figure 2 – B-NPQ Flow – B-Number Fails GNR screening or Not Found in MNP database.

4.2 Global Number Range (GNR) Validation Query

The GNR Validation query checks either A- or B-numbers, or both, against the XConnect Global Number Range database.

The GNR database contains number range records for all E.164 numbers and includes for each range:

- The minimum and maximum length for numbers within the range
- The allocation status of the range
- Other attributes include number type, Carrier of Record, MCC/MNC etc.

GNR query is typically used to validate numbers for fraud prevention, OBR surcharge avoidance or regulatory compliance.

The GNR Validation query operates in Validator mode returning either a 'Valid' response (as standard a SIP 503) or 'Invalid' response (as standard a SIP 607).

Please Note – the GNR Validation service validates that a number is part of an allocated range and is the correct length, it does not validate that an individual number is allocated to a subscriber or is 'working'.

4.2.1 GNR Validation Query – Valid

Figure 3 below shows the SIP flow for a GNR Validation query which is checking both the A- and B-number presented in the SIP Invite.

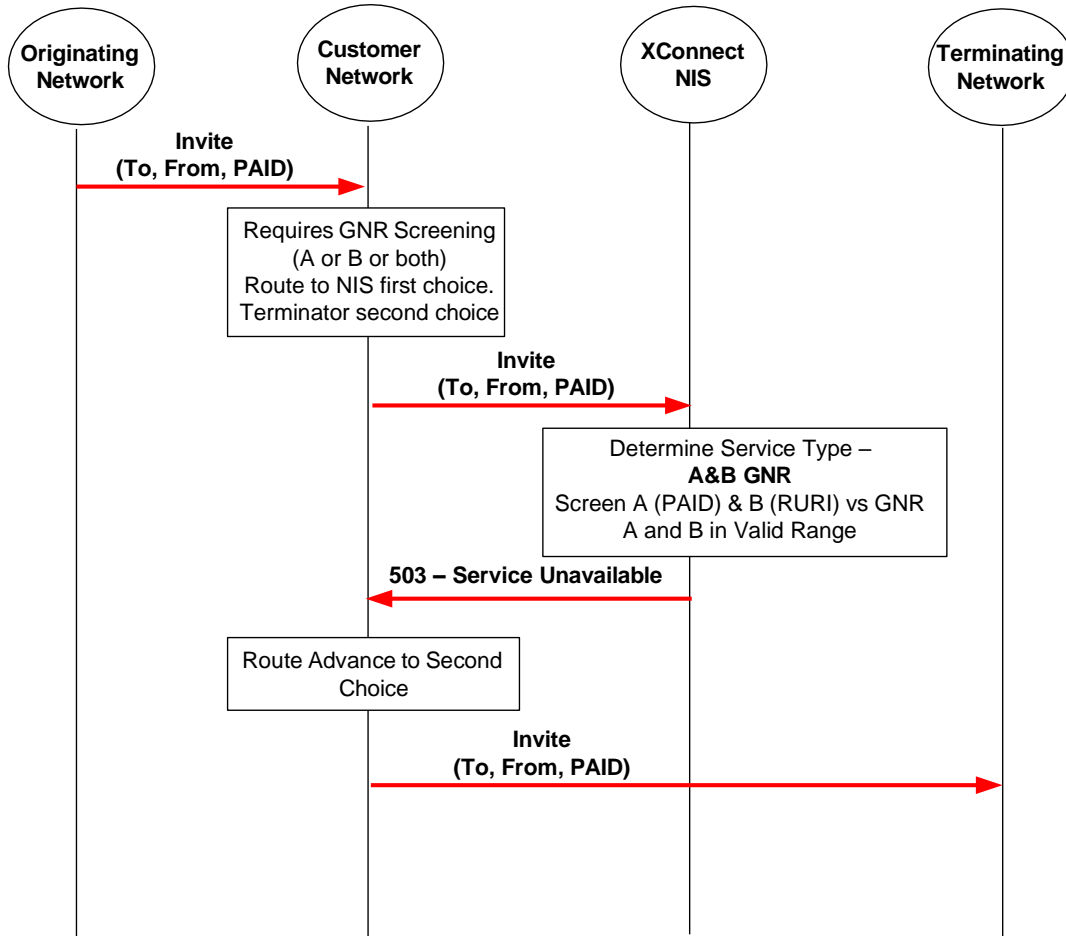


Figure 3 – GNR Validation Query SIP Flow – Valid Number

On receiving a call which requires GNR Validation, the customer network sends the SIP Invite to the relevant XConnect SIP trunk.

- Customer routing determines which B-number destinations are sent to XConnect, with the XConnect SIP trunk for the relevant service being placed into first choice for the route for the relevant destinations (with the 'real' terminators being in second choice).
- The system allows for either only A, only B or both numbers to be validated on a particular trunk. In this example the customer has chosen to validate both.
- Any A- or B-number sent on this trunk will be validated irrelevant of destination/origination country. If you want to screen different destinations differently or split A/B validation can set up multiple SIP trunks.

On receiving the SIP Invite from the customer SIP trunk the NIS platform:

- Authenticates the traffic based on source IP address.
- Determines which services are applicable to this SIP trunk (in this case A- and B-number GNR validation).
- Retrieves the B-number presented in the To RURI (note, this should be in E.164 format) and the A-number presented in the PAID Header.
 - Note the A-number presented in the FROM header is not checked.
- The system screens the A-number, then the B-number against the GNR database.
 - Checks that the number is part of an allocated range and has the correct length for that range.
 - Note if the A-number fails Validation then the B-number is not screened.
- In this example flow both the A- and B-number are valid.

The SIP interface returns a SIP 503 – Service Unavailable to the customer network.

On receiving the SIP 503 the customer network 'route advances' to the second-choice terminator (which is the real first choice terminator) and complete the call.

4.2.2 GNR Validation – either A- or B-number 'Invalid'

Figure 4 below shows an example SIP flow for a GNR Validation query where either the A- or B-number is 'Invalid'.

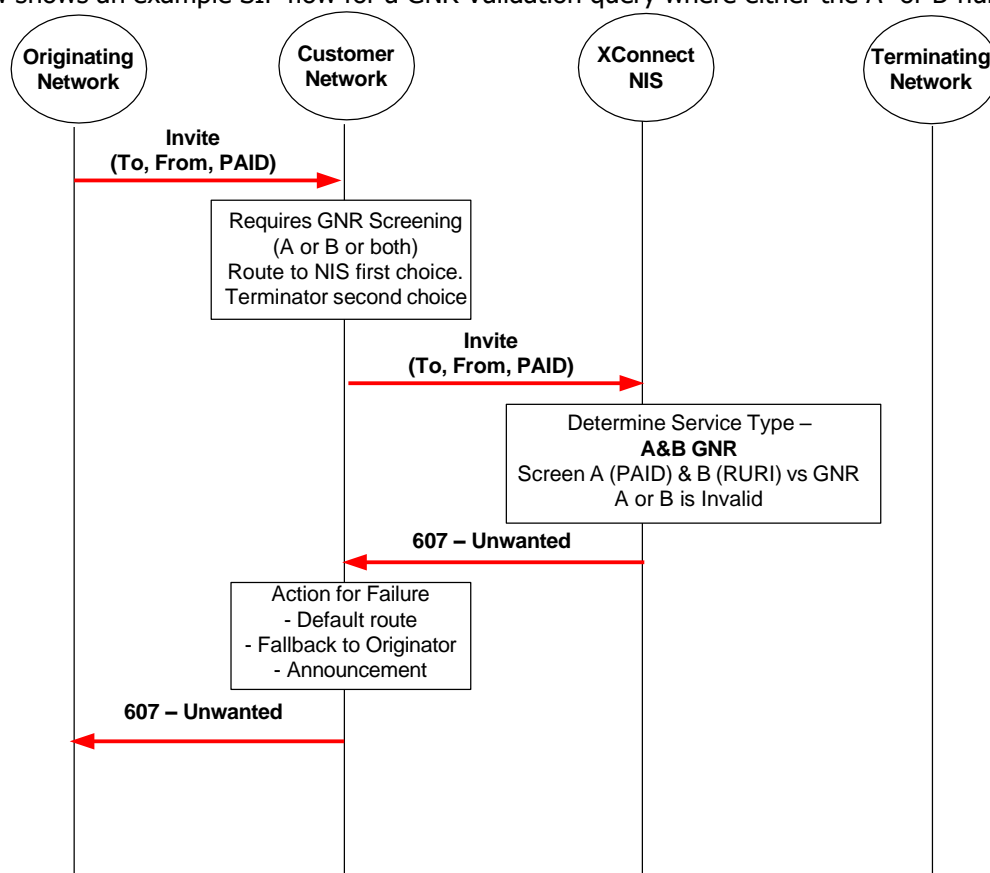


Figure 4 – GNR Validation Query – A- or B-number invalid

In this case, either the A or the B-number is found to be Invalid vs GNR.

- The A-number presented in the PAID header is checked first, if this is Invalid then the B-number will not be checked.

If either the A- or the B-number is Invalid the NIS SIP interface returns a SIP 607 – Unwanted back to the customer network.

On receiving the SIP 607 the customer network treats the call depending on the customer requirements and routing plan e.g.

- 'Falls back' the call to the originator with a SIP 607 or other SIP response.
- Provides an announcement or other treatment.
- Routes to a 'default' terminator.

4.2.3 SIP responses returned

As standard, the SIP interface returns a SIP 503 for 'Valid' numbers and a SIP 607 for Invalid numbers.

XConnect will be happy to consider alternative SIP responses which may better suit your network (e.g. a SIP 603 for Invalid).

4.3 A-Number validation query (including DNO list screening)

The A-number validation with DNO query, screens A-numbers against both the XConnect GNR database (as described in section 4.2) and national Do Not Originate (DNO) lists.

A number validation with DNO is typically used to meet regulatory requirements such as the FCC Robocalling mandates, and UK OFCOM's UK number screening rules, with other countries expected to follow suit.

Please see XConnect coverage lists for available DNO screening country lists.

In future, XConnect expects to add additional specific A-number screening criteria (for example, numbers which are assigned as MSRNs or GTs) to the 'Invalid' list.

A-Val query operates in SIP Validator mode.

4.3.1 A-Val – A Number is Valid and not on DNO list

Figure 5 below shows a SIP flow for a A-Validation query where the A-number is Valid and not on a DNO list.

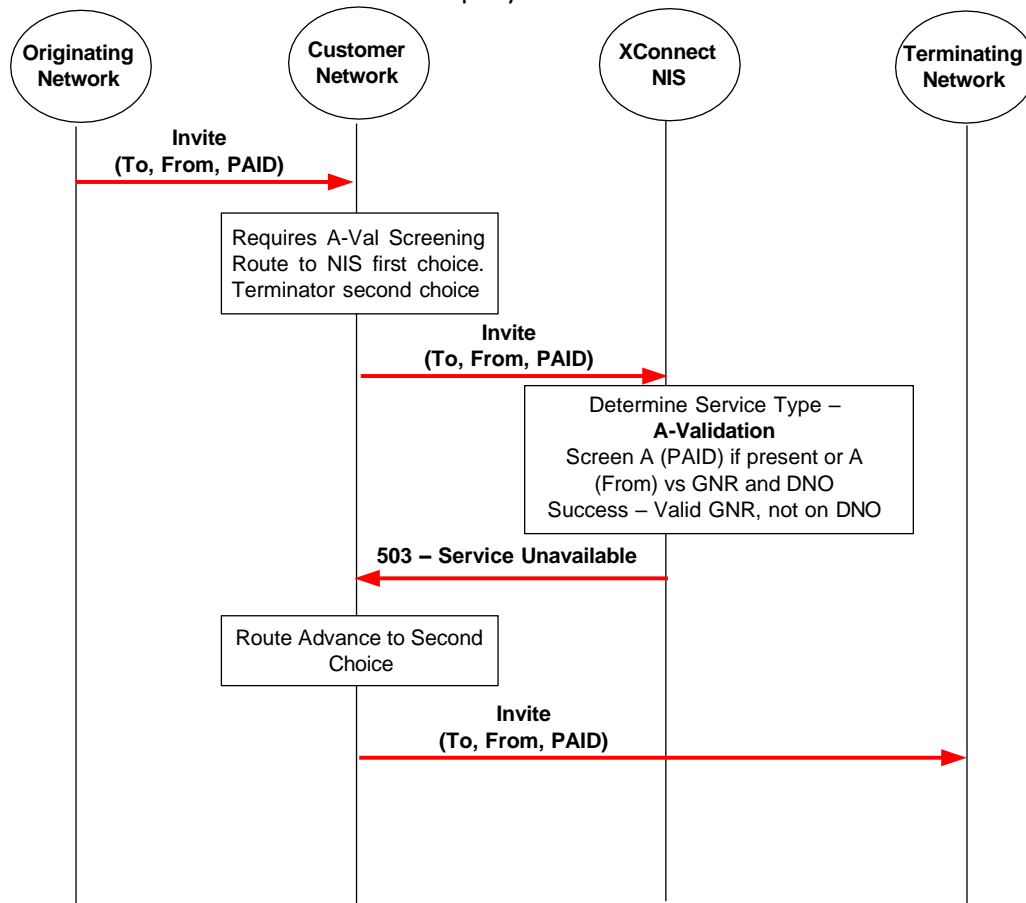


Figure 5 – A-Val Query – Number Valid and Not on DNO List

On receiving a call which requires A-Validation, the customer network sends the SIP Invite to the relevant XConnect SIP trunk.

- Customer routing determines which B-number destinations are sent to XConnect for A-Validation, with the XConnect SIP trunk for the relevant service being placed into first choice for the route for the relevant destinations (with the 'real' terminators being in second choice).
- The system checks all A-numbers presented against GNR and DNO lists.

On receiving the SIP Invite from the customer SIP trunk the NIS platform:

- Authenticates the traffic based on source IP address.
- Determines which services are applicable to this SIP trunk (in this case A-Validation).
- Retrieves the A-number to be validated. **Note:**
 - If the PAID header is present, the A-number presented in PAID will be used for Validation.
 - If there is no PAID header, the A-number presented in the FROM address is used for Validation.
- The system screens the A-number:
 - Checks against the GNR database that the number is part of an allocated range, and has the correct length for that range.
 - Checks against available/subscribed DNO lists to see if the number is marked as DNO.

- In this example flow the A-number is 'Valid' and is not on DNO.
- Note – where DNO lists do not exist for the country the number belongs to, only the GNR check is performed.

The SIP interface returns a SIP 503 – Service Unavailable to the customer network.

On receiving the SIP 503 the customer network 'route advances' to the second-choice terminator (which is the real first choice terminator) and complete the call.

4.3.2 A-Validation – A number is Invalid or on a DNO list

Figure 6 below shows a SIP flow for A-Validation query where the A-number is Invalid or on a DNO list.

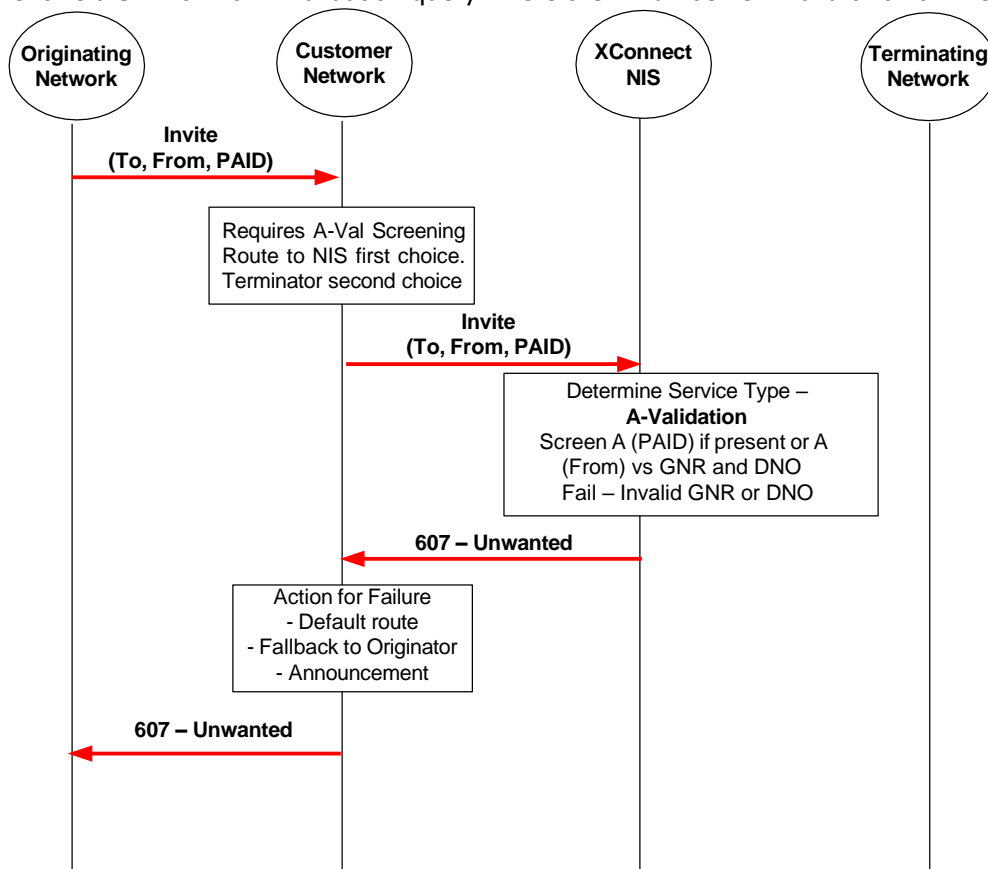


Figure 6 – A Validation Query- A-Number is invalid or on DNO list

In this case, either the A-number is either invalid when screened against GNR, or is on a national DNO list.

Note that if the A number is Invalid vs the GNR database it is not screened against DNO.

The NIS SIP interface returns a SIP 607 – Unwanted back to the customer network.

On receiving the SIP 607 the customer network treats the call depending on the customer requirements and routing plan e.g.

- 'Falls back' the call to the originator with a SIP 607 or other SIP response.
- Provides an announcement or other treatment.
- Routes to a 'default' terminator.

4.3.3 SIP Responses Returned

As standard the SIP interface returns a SIP 503 for 'Valid' numbers and a SIP 607 for Invalid numbers. XConnect will be happy to consider alternative SIP responses which may better suit your network (e.g. a SIP 603 with 'contact details' known as a SIP 603+ may become a 'standard' for US DNO screening).