XConnect

A Somos Company

Number Information Services

ENUM Interface Specification

Issue	Date	Reason For Issue
1	30-06-14	First Issue
2	18-12-14	Added SIP message trace example
3	28-04-15	Added http interface
4	30-10-15	Separate documents for each protocol, minor amendments
5	15-12-15	Updated with new ENUM response format
6	07-03-16	NPI field removed, RN for non-US removed
7	15-03-17	Updated for Global Coverage, NPI readded, Service Number type added
8	20-12-17	Updated to include Global Number Range & NPQ (Live) product with cor field, and product selection by domain
9	02-02-18	Updated with Reason Codes
10	22-03-18	Additional reason codes & product options (IR 67 compliance, GNR Fallback)
11	31-07-18	IPSEC access now available in Frankfurt Added customer web portal. Added COR option for NPQ- GC
12	18-03-19	Updated list of Reason Codes
13	07-10-20	Updated List of Reason Codes
14	15-01-21	Added support for Alt CIC Moved reason code table to a new separate document
15	22-07-22	Added Live-Routing and Live-Status services Moved Reason Code and Response code tables to new document General update to service descriptions

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1 INTRODUCTION

This document describes the ENUM query interface to the XConnect Number Information Service (NIS), suite of products.

NIS supports a number of product options where customers can query XConnect to discover information about routing, ownership and status of E.164 Telephone Numbers (TN).

The service is primarily used to support customers' Voice & SMS routing, and applications which require

number validation or subscriber information.

Customers access the NPQ service by querying to XConnect's Global Points of Presence (PoPs). In addition to ENUM, the service also supports SIP and HTTP query protocols.

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

2 ACCESSING THE NIS SERVICE

2.1 IP Access

The NP query service is provided from XConnect PoPs in the US (New York) and Europe (Dublin and Frankfurt). Other PoPs may be added over time.

Access to the service is via the Public Internet and customers should 'connect' to multiple PoPs to

optimise service availability and query latency.

XConnect supports the use of IPSEC VPN connections to secure customer transactions, although this is not mandatory. (Note, for certain applications XConnect may mandate IPSEC encryption to comply with privacy regulations).

Customers will be advised of the target URL/IP addresses for ENUM queries to the relevant PoPs at provisioning time by the XConnect Support team.

2.2 Query Authorisation

Customer queries are authorised by source IP address.

XConnect Support 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 XConnect Support following the standard support process.

3 PRODUCT SELECTION AND CUSTOMISATION

The NIS ENUM query interface supports a number of different products.

Different NIS products will return different responses for a given E.164 number and may have different commercial terms and service characteristics.

In addition to standard products, XConnect can also customise responses to meet particular customer requirements. Customisation can include different data sources, response fields, and service logic.

3.1 Product Selection by ENUM Domain

The NIS Service allows customers to choose which product they want to use, by selecting the appropriate domain within the ENUM query. (Note, customers need to be authorised for each service they wish to use).

The following domains are standard:

ENUM Domain Queried	Product Selected
7.6.5.4.3.2.1.7.1.9.1.npq.xconnect.net	NPQ – Global Coverage
7.6.5.4.3.2.1.7.1.9.1.gnr.xconnect.net	Global Number Range
7.6.5.4.3.2.1.7.1.9.1.live.xconnect.net	NPQ – Live
7.6.5.4.3.2.1.7.1.9.1.lr.xconnect.net	Live Routing
7.6.5.4.3.2.1.7.1.9.1.ls.xconnect.net	Live Status

Where customers have a bespoke configuration, XConnect Support will advise the correct domain to use for their application.

A description of each query type along with example query/response is provided in the 'NIS Response Fields and Values' document available from the XConnect Support or Sales teams.

3.2 Product Options

XConnect provides a number of product options which may not be desirable for all customers (depending on their application and service design). The following options can be activated on a customer account by contacting XConnect Sales or Support (note, certain options may incur additional charges).

3.2.1 Reason Codes

Reason codes provide additional information relating to the handling of the query within the XConnect system. This can include failure reasons (e.g., incorrect number length) and other general information. A list of current reason codes can be found in the 'NIS Response Fields and Values' document available from the customer portal or the XConnect Sales or Support teams.

3.2.2 GNR Response on Remote Query Failure

For certain NPQ-GC destinations and all NPQ-Live queries, XConnect generates a remote query to a third-party provider.

In the event the third-party provider fails to respond, XConnect will provide a 'Supplier Timeout' Reason Code (if the customer has reason codes active) or 'DNS Error' (SERVFAIL or NXDOMAIN) response with no number information.

GNR Fallback allows customers to receive GNR information when a Remote Supplier Timeout occurs, rather than the 'not found' response. The response will indicate that a GNR response (rather than NPQ- GC or NPQ-Live) has been provided by setting the NPDI flag to 'false' and providing a specific Reason Code (for Customers with that option activated).

3.2.3 Carrier of Record Information in NPQ-GC Response

Customers can request that Carrier of Record information (which is normally provided in the GNR response) is also added to the NPQ-GC response. This allows customers to see both the Carrier of Record and Current Carrier information.

3.2.4 Alternate Carrier Identification Code (ACIC)

Telephone Numbers (TNs) can be 'owned' or 'served' by more than one 'Service Provider' (SP) simultaneously.

For example, a TN may be part of a number range allocated to SP A (the carrier of record), be ported to SP B (the number/network owner) and be served by a reseller of SP B, SP C (the service provider).

Examples would be MVNO or Over the Top (OTT) providers which use underlying numbers allocated to other networks.

Where data is available, XConnect identify these MVNO or OTT Service Providers via the 'Alternate CIC'

field (acic) within an NPQ-GC response.

The Alt CIC field is a standard Carrier Identification Code number representing the Service Provider.

Details of CIC number to Carrier name mapping are available via the XConnect CIC list, downloadable via the customer portal.

Customers must subscribe to the Alt CIC option to receive this additional SP identifier.

Note, coverage for ACIC is limited to where information is available. Please contact XConnect Sales for the latest list of countries.

4 QUERY TYPES AND EXAMPLE QUERY/RESPONSES

The following sections describe the various query services available through the XConnect ENUM interface.

Explanations of the fields and field values returned for each query type can be found the 'NIS Response Fields and Values' document available from the customer portal or the XConnect Sales or Support teams.

4.1 Global Number Range Query

The GNR query runs against the XConnect Global Number Range database which is continually maintained from national regulator data, industry body data and traffic testing/customer feedback.

The GNR database is also available via download, and customer portal GUI.

The GNR query 'checks' that the number queried is:

- Correctly formatted (i.e., conforms to E.164 standards)
- Is the correct number length (i.e., falls between the min/max digits for the range)
- Is part of a positively allocated number range (i.e., the range has been allocated to a Service Provider by the national regulator – known as the Carrier of Record or COR)

The GNR product is typically used for basic number validation (e.g., for customer sign-ups, OBR A- number validation, B-number fraud analysis) and baseline routing where Number Portability based routing information is not required.

Note – GNR checks that a number is within a positively allocated number range, and **not** that an individual number is positively allocated to a subscriber.

4.1.1 Example GNR Query/Response

The following shows an example ENUM GNR query/response to a 'valid' number:

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45303
;; flags: qr rd ; qd: 1 an: 1 au: 0 ad: 0
;; QUESTIONS:
;; 5.4.3.2.7.7.7.1.0.2.1.gnr.xconnect.net., type = NAPTR, class = IN

;; ANSWERS:
5.4.3.2.7.7.7.1.0.2.1.xconnect.net. 60 NAPTR  100  10 "u" "E2U+pstn:tel"
"!^.*$!tel:                        12017772345;                        cor=6088;cc=us;cn=
BROADWING%20COMMUNICATIONs;nt=wireline;rc=000!"
```

Note:

- For invalid numbers a suitable reason code will be returned identifying the reason the GNR query 'failed' and all other fields will not be included.

4.2 NPQ – Global Coverage Query

The NPQ-GC product returns information about the Service Provider which currently serves the queried <u>Telephone Number</u>, taking into account <u>Number Portability</u>.

The NPQ-GC product uses Number Portability data from a variety of sources (primarily Number Portability Central Databases (CDBs)), to provide global coverage for any E.164 number.

Please see the NPQ-GC coverage sheet for a breakdown of the NPQ-GC data source type for each country.

Note:

- The NPQ-GC product will return a routing result whether the number is ported or not, and also whether the country queried has Number Portability or not. Global Number Range data is used to provide information for non-ported numbers, and countries with no portability.
- Queried numbers are first checked against the GNR database for validity before NPQ resolution. 'Invalid' numbers will be returned with an appropriate reason code.

NPQ-GC is typically used to support SMS or voice call routing where knowing the 'serving' network for the B-number before routing provides cost or quality benefits for traffic termination.

4.2.1 Example NPQ-GC Query/Response

The following shows an example ENUM NPQ-GC query/response to a ported number.

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45303

;; flags: qr rd ; qd: 1 an: 1 au: 0 ad: 0

;; QUESTIONS:

;; 7.6.5.4.3.2.1.7.1.9.1.xconnect.net., type = NAPTR, class = IN


;; ANSWERS:

7.6.5.4.3.2.1.7.1.9.1.xconnect.net. 60 NAPTR  100  10 "u" "E2U+pstn:tel"

"!^.*$!tel:
19171234567;npdi;npi;rn=18479428118;cic=6664;cc=us;cn=SPRINT%20SPECTRUM;nt=wireless;
mcc=310;mnc=120!"
```

Note:

- NPI being present indicates that the number is currently ported.
- If the NPQ-GC query 'fails' to return routing information a suitable reason code will be returned highlighting the failure reason.
- If customers have the 'Fallback to GNR' option enabled, routing information based on GNRdata will be returned, NPDI will not be present and a suitable Reason Code will be returned.
- Not all fields will be returned depending on the nature of the number, destination and query success (e.g., MCC/MNC may not be returned if a number is not associated with a mobile network provider).

4.2.2 Example NPQ-GC Response Including ACIC

The following shows an example response to a number which has an Alt CIC in addition to the CIC. (This is a customer option and only available in certain markets).

```
!^.*$!tel:+522211008749;cc=MX;cic=188;cn=RADIOMOVIL%20DIPSA,S.A.%20DE%20C.V.;mcc=334
;mnc=020;acic=003;amcc=334;amnc=020;npdi;nt=wireless;rc=000!
```

Note:

- If there is no Alt-CIC associated with a TN, then acic, amcc, amnc, will not be provided.

4.3 NPQ – Live Query

The NPQ-Live product is based on live MNO Home Location Register (HLR) look-ups, and is therefore suitable for applications which require 'real-time' updated information for routing vs NPQ-GC which is typically MNP database based with 24 hour updates from the MNP database provider.

In addition to routing information NPQ-Live returns HLR status information including, for example, if the number is 'unknown' or 'absent' in the mobile network. This can be used to 'validate' numbers before transacting with the end-user customer (e.g., before sending an SMS, or calling from a call centre etc.).

As the NPQ-Live product is based on HLR responses (which are controlled by the destination MNO), coverage is limited to mobile numbers only and coverage varies by country and network.

Note – due to the nature of HLR queries, NPQ-Live coverage is provided as 'best efforts' and coverage

may change intermittently outside of XConnect's control.

Please also note – while NPQ-Live will continue to be supported, new customers will be signed up to the new Live-Routing or Live-Status queries which provide improved performance vs NPQ-Live.

4.3.1 NPQ-Live Example Query/Response

The following shows a successful NPQ-Live query/response.

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45303

;; flags: qr rd ; qd: 1 an: 1 au: 0 ad: 0

;; QUESTIONS:

;; 7.6.5.4.3.2.1.7.1.9.1.npql.xconnect.net., type = NAPTR, class = IN



;; ANSWERS:

  7.6.5.4.3.2.1.7.1.9.1.xconnect.net. 60 NAPTR  100  10 "u" "E2U+pstn:tel"

  "!^.*$!tel:19171234567;cc=us;nt=wireless;mcc=310;mnc=120;rc=000!"
```

Note:

- If the NPQ-Live query 'fails' to return routing information, a suitable reason code will be returned highlighting the failure reason.
- Mapping of the HLR query 'status' response (e.g., if a subscriber is unknown) will be reflected in the reason code field, and no routing information is returned (e.g., MCC and MNC fields will not be present).

4.4 Live Routing and Live Status Query

The Live-Routing and Live-Status queries use 'live' data sources to provide information on the current

Service Provider and 'status' of mobile TNs.

Live information may be derived from MNO HLR queries, MNO APIs, or other 'live' data sources – depending on the country and specific mobile network 'serving' the TN.

The aim of the Live services is to provide current information rather than information derived from MNP

databases or other 'non-live' numbering information sources. There are two variants of the Live service:

- **Live Routing**
  - o Returns the current Service Provider for the TN based on a remote query.
  - o If the remote query fails, the system will provide the best routing information available to XConnect e.g., from Global Number Range data.
- **Live Status**
  - o Provides all the information from the Live-Routing query, with additional information on subscriber status e.g., Unknown or Absent, as derived from the network data source.

Please note that Live-Routing and Live-Status queries are expected to replace the current NPQ-Live service for new customers.

4.4.1 Live Services – Coverage

The nature of live services (particularly when HLR query service are used) means that coverage, performance and capacity is variable and can change frequently depending on the actions of the Mobile networks.

XConnect attempts to mitigate this by using a wide range of 'live' data source providers in an attempt to maximise coverage at the individual MNO network level. This includes periodic testing of every mobile network across every 'live' data provider to find the 'best' current coverage and query routing plan.

However, certain networks (or numbers within a network) may be unreachable and data accuracy returned by the network can vary. **Live services are therefore provided on a 'best-efforts' basis.**

On request, XConnect can provide a network based (MCC/MNC) coverage list for live services, which includes the latest round of test results showing tested coverage.

4.4.2 Live Routing and Live Status Query/Response Examples

The Live-Routing query returns the current Service Provider serving the TN along with other validation and routing information, as shown below:

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45303

;; flags: qr rd ; qd: 1 an: 1 au: 0 ad: 0

;; QUESTIONS:

;; 7.6.5.4.3.2.1.7.1.9.1.lr.xconnect.net., type = NAPTR, class = IN


;; ANSWERS:

7.6.5.4.3.2.1.7.1.9.1.xconnect.net. 60 NAPTR  100  10 "u" "E2U+pstn:tel"

"!^.*$!tel:19171234567;cc=us;nt=wireless;mcc=310;mnc=120;nv=000;npdi;npi;rc=000!"
```

The Live-Status query adds information on TN status, as received from the live data source, as shown below:

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45303

;; flags: qr rd ; qd: 1 an: 1 au: 0 ad: 0

;; QUESTIONS:

;; 7.6.5.4.3.2.1.7.1.9.1.ls.xconnect.net., type = NAPTR, class = IN


;; ANSWERS:

7.6.5.4.3.2.1.7.1.9.1.xconnect.net. 60 NAPTR  100  10 "u" "E2U+pstn:tel"

"!^.*$!tel:19171234567;cc=us;nt=wireless;mcc=310;mnc=120;nv=000;ns=000;npdi;npi;rc=000!"
```

The only difference between Live-Routing and Live-Status response and functionality is the addition of the NS= (Number Status) field in the Live-Status response. This allows XConnect to differentiate services where live data sources provide routing information but not status information.

Customers who require both routing and status information should use the Live-Status query, customers only interested in routing information should use the Live-Routing query.

Please see the 'XConnect NIS Response fields and Values' document for definition and value of each field.

Note:
- The NV (number validation) field shows the validation of the number against XConnect Global Number Range data. If the NV field in not 000 (i.e., a valid number) then routing and status fields will not be provided.
- If the remote query to the MNO network 'fails' to provide routing information, it will be provided based on XConnect Global Number Range data. NPDI will not be present and an appropriate Reason Code will be presented.

5 CUSTOMER WEB PORTAL

Through our web portal, our customers have the ability to do the following, depending on services purchased:

- Raise support tickets and information requests to the XConnect NOC
- Access reports on NIS query usage
- Generate individual test queries
- Generate batch queries
- Access the GNR download and GNR GUI features
- Access the latest product documentation
- Access the latest Carrier Identification Code list, which contains CIC to Carrier Name mappings
- Request additional Portal Logins

Web portal access is provided to a named individual only. Additional logins can be requested via the portal, or by contacting XConnect support.