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NICC Document

Central Numbering Database; DNS Implementation

Note : This standard was originally intended to allow fulfilment of changes to General Condition 18 which were announced by Ofcom via the November 2007 Statement entitled “Telephone number portability for consumers switching suppliers - Concluding Statement”. This change was subsequently set aside by the Competition Appeal Tribunal (Case 1094/3/3/08), and in the April 2010 Statement entitled “Routing calls to ported telephone numbers”, Ofcom concluded that no changes were justified.

However, Ofcom recognised the benefits that a common numbering database approach could bring both to number portability arrangements and to the conservation of geographic numbers, and further concluded that :

> *We consider that a direct routing solution for interconnected fixed networks using such an approach could become viable if and when next generation core network technology is adopted widely by network operators. While the timescale of such adoption is currently uncertain, we would encourage network operators to consider the benefits of incorporating direct routing capability into their next generation network designs.*

Accordingly, whilst NICC Standards cannot warrant what the precise model of usage of a common numbering database for future NGNs will be, this document provides an indication of what was considered appropriate when the issue was considered by NICC, and hence should be borne in mind by network operators when meeting Ofcom’s request to consider direct routeing when designing their NGNs.

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Intellectual Property Rights

Pursuant to the NICC IPR Policy, no investigation, including IPR searches, has been carried out by NICC. No guarantee can be given as to the existence of other IPRs which are, or may be, or may become, essential to the present document.

Foreword

This NICC Document (ND) has been produced by NICC TSG NNA.

1 Scope

The present document specifies the reference implementation for the use of DNS to access the Central Numbering Database.

This specification describes the mapping of record formats between DNS Resource Records and the URIs used in the Central Numbering Database, and the DNS protocol methods corresponding to the required Information Flows.

2 References

For the particular version of a document applicable to this release see ND1610 [11].

2.1 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] NICC ND 1631: “NGN; PSTN/ISDN Service Interconnect; Architecture for usage of Common Numbering Database”

[2] IETF RFC 1034: “Domain Names – Concepts and Facilities”

[3] IETF RFC 1035: “Domain Names – Implementation and Specification”

[4] IETF RFC 1995: “Incremental Zone Transfer in DNS”

[5] IETF RFC 1996: "DNS NOTIFY: A Mechanism for Prompt Notification of Zone Changes"

[6] IETF RFC 2308: “Negative Caching of DNS Queries (DNS NCACHE)”

[7] IETF RFC 2931: “DNS Request and Transaction Signatures (SIG(0)s)”

[8] IETF RFC 3403: “Dynamic Delegation Discovery System (DDDS) Part Three: The Domain Name System (DNS) Database”

[9] IETF RFC 3645: “Secret Key Transaction Authentication for DNS (TSIG)”

[10] IETF RFC 3761: “The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM)”

[11] NICC ND 1610: “Multi-Service Interconnect of UK Next Generation Networks”

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Checkpoint Reference : an encoded date-time that represents a version of a Section of the Central numbering database. Each change to a Section (or set of changes that are taken together) results in a new checkpoint reference.

Section : A portion of the Central Numbering Database that can be downloaded independently of the remainder of it.

Zone : Authoritative information is organized into units called ZONEs, and these zones can be automatically distributed to the name servers which provide redundant service for the data in a zone.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

DNS	the Domain Name System, as described in [2] and [3]
SOA	Start Of Authority [2]
RR	Resource Record [2]

4 Record Mapping

The DNS access protocol for access to the Central Numbering Database **shall** be ENUM-like, that is, it conforms to [10] (other than in the choice of base domain) and the DNS database will return NAPTR Resource Records as defined here.

4.1 Zone Data

Each Section **shall** be maintained as a separate Zone.

The Checkpoint Reference **shall** be implemented using the "Serial Number" field contained within the SOA RR for each Zone.

The Serial Number field **may** contain an unsigned 32-bit integer representing the number of seconds elapsed since a defined start date.

The "Minimum" field of the SOA RR (see [6]) **shall** have a value no greater than Timer T_4 (see Clause 10 of [1]). This field controls negative-cacheing (i.e. cacheing the fact that no record exists) and should be set so as to ensure that the introduction of a new record is propagated at least as quickly as a change to an existing record.

Values for the "Refresh", "Retry" and "Expiry" fields of the SOA RR will be chosen as appropriate and according to best practise for the operation of DNS servers based on the size and volatility of the Zone Data.

4.2 NAPTR Resource Records

Each telephone number in the database will require two records of each form for which it has data (that is, there will be 0, 2, or 4 records for each number). Each intermediate level in the numbering scheme will require one SEND-N form record.

The NAPTR RRs returned from the database shall be the functional equivalent of the following:

```
    $ORIGIN 4.3.2.1.4.4.cdb.uktel.org.uk.
;; PSTN form records
0.9.8.7.6.5   IN NAPTR 1000 1000 "u" "E2U+pstn:tel" "!^.*$!tel:URI!" .
*.0.9.8.7.6.5 IN NAPTR 1000 1000 "u" "E2U+pstn:tel" "!^.*$!tel:URI!" .
;; IMS form records
0.9.8.7.6.5   IN NAPTR 1000 1000 "u" "E2U+pstn:sip" "!^.*$!sip:URI!" .
*.0.9.8.7.6.5 IN NAPTR 1000 1000 "u" "E2U+pstn:sip" "!^.*$!sip:URI!" .
;; SEND-N form records
8.7.6.5       IN NAPTR 1000 1000 "u" "E2U+pstndata:send-n" "!^.*$!pstndata:URI!" .
```

That is:

- The searched domain shall be generated using the rules of [10] section 2.4, except that step 4 shall use the base domain `cdb.uktel.org.uk`.
- For telephone numbers, one record shall be an exact match for the telephone number, while the other shall be a wildcard catching all longer queries (corresponding to overdialling).
- For intermediate levels, the record shall be an exact match for the prefix sequence.
- For dead-end levels, the record shall be a wildcard catching all queries beginning with that sequence or an exact match, depending on the record contents.

- The *order* and *preference* fields **shall** have the value 1000.
- The *flags* field **shall** have the value "u" (case insensitive), indicating that this record generates the final URI. The DDDS loop mechanism **shall not** be used.
- The *service* field **shall** have the value "E2U+pstn:sip" for the IMS form records, "E2U+pstn:tel" for the PSTN form records and "E2U+pstndata:send-n" for the SEND-N form records.
- The *regexp* field **shall** generate a URI of the form specified in Annex A of [1]. It should use the exclamation mark ("!") for the delimiter and a pattern that matches the entire string ("^.*$") unless there is an explicit reason to do otherwise; users of the database **shall not** assume that either of these apply.
- The *replacement* field **shall** be empty in accordance with [8].

5 Information Flows

The Transaction Identity **shall** be implemented using the ID field of the DNS protocol message (see [3], Section 4.1.1).

Each response from the Central Numbering Database **shall** be authoritative and flagged as such by having the "Authoritative Answer" (AA) bit set in the response header.

For the purposes of error checking, except where specified otherwise, all DNS protocol messages **shall** be cryptographically signed with TSIG [9] or SIG0 [7].

It should be noted that DNS message sizes **may** exceed the limits allowable for UDP messages and therefore CPs **shall** ensure that their networks also support TCP communications for DNS messages to and from the Central Numbering Database.

5.1 Real Time Retrieval Function - Reference Point D_3

To perform this function the CP **shall** issue a standard DNS request for NAPTR Resource Records as per clause 4.2 and the Central Numbering Database **shall** respond accordingly.

The D_3 "time to live" response value shall map directly to the DNS TTL value returned in the NAPTR Resource Records.

For performance reasons the DNS protocol request and response messages for this function **shall not** be cryptographically signed.

5.2 Change Notification Function - Reference Point D_1

On any change of data within a Section the Checkpoint Reference for that Section **shall** be updated and the Central Numbering Database **shall** send a DNS NOTIFY [5] message to each of the CP DNS servers that are subscribed to that Section.

The NOTIFY message **shall** contain the name of the DNS Zone to which it applies. The RDATA field of the NOTIFY message **shall** contain the new SOA record, which in turn contains the current Checkpoint Reference.

The CP DNS server **shall** send back a "NOTIFY" response message to confirm that it has received the Change Notification from the Central Numbering Database to allow the Central Numbering Database to remove the CP DNS server from its retransmit queue. (See [5] Section 3.3).

5.3 Bulk Retrieval Function - Reference Point D_2

5.3.1 Full Section Transfers

A CP **may** request a copy of the full zone data for a Section at any time by sending a DNS AXFR [2] request to the Central Numbering Database.

The Central Numbering Database **shall** respond to the AXFR request by returning a full copy of the most recent version of that zone in standard AXFR response format.

The SOA RR contained in the AXFR response **shall** contain the current Checkpoint Reference which the CP **shall** use for future Incremental Transfers.

Each CP who wishes to maintain a local copy of a Section **shall** first perform a Full Section Transfer to obtain the initial zone data. Additionally a CP **may** perform a Full Section Transfer at any time (e.g. in order to recover from a corrupted database).

5.3.2 Incremental Transfers

In response to a NOTIFY message a CP DNS server **shall** send a DNS IXFR [4] request to the Central Numbering Database.

This request **shall** contain the last Checkpoint Reference known to the CP DNS server.

The Central Numbering Database **shall** then respond with an IXFR response containing all of the changes between the specified Checkpoint Reference and the most recent version of the Zone. No other changes **shall** be included.

The IXFR response **shall** contain an SOA RR containing the latest Checkpoint Reference.

As specified in [4], if the Central Numbering Database is unable to perform an Incremental Transfer (perhaps because the CP supplied Checkpoint Reference is too old) then the response from the Central Numbering Database shall contain the same data as if a Full Load had been requested.

History

Document history		
<Version>	<Date>	<Milestone>
1.1.1	April 2008	Initial issue
1.1.2	October 2010	Updated to align with IETF Send-N draft (-02)
1.1.3	November 2010	Warning regards regulatory status updated