Authority and routing registration for CLNS networks

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Abstract

The existence of CLNS routing domains is by now so widespread that a registration of authority and routing policy is desired. Since such a registration for IP networks, the RIPE database, already exists and is widely used, a database for CLNS networks should be set up in a similar way. This article describes the proposed CLNS network objects together with samples of already existing entries and discusses the current state of tools under development to use the database for network operation.

I. Introduction

In the RARE lower layer technology working group for CLNS it was recognised that in order to co-ordinate routing between CLNS routing domains a central registry for such domains was necessary. At the meeting of the working group at the 27th IETF in Amsterdam it was decided to write the registry specification. RIPE NCC offered at this meeting to extend their IP related database to CLNS related objects. At the 17th RIPE meeting in Amsterdam the RIPE database working group accepted the proposal for a CLNS routing-domain object [1]. A few days later RIPE NCC had already modified their whois server to accept this new object and one could start filling the database.

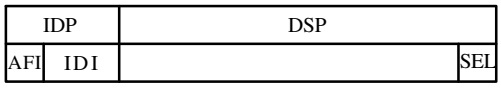
II. Background

This section provides some basic information needed to understand this paper.

II.A. OSI Hierarchical Address Structure

ISO 8348 defines the semantics of the network service access point (NSAP) addresses and the abstract syntaxes in which the semantics of the network address can be expressed [2].

The NSAP consists of the initial domain part (IDP) and the domain specific part (DSP). The IDP consists of an authority and format identifier (AFI) and an initial domain identifier (IDI). The length of IDP is always 3 octets but the length of the DSP can vary from (theoretically) 1 up to 17:



IDP	Initial Domain Part (3 octets)
AFI	Authority and Format Identifier (1 octet)
IDI	Initial Domain Identifier (2 octets)
DSP	Domain Specific Part (1..17)
SEL	NSAP Selector (1 octet)

The AFI specifies the format of the IDI, the network addressing authority responsible for allocating values of the IDI, and the abstract syntax of the DSP. The IDI specifies the addressing subdomain from which values of the DSP are allocated and the network addressing authority responsible for allocating values of the DSP from that domain. The structure and semantics of the DSP are defined by the authority identified by the IDI and can be delegated hierarchically.

ISO 8348 describes seven second-level addressing domains and corresponding IDI formats [2]:

- X.121 for public data networks
- F.69 for telex
- E.163 for the public switched telephone network numbers (PSTN)
- E.164 for ISDN numbers
- ISO Data Country Code (DCC), allocated according to ISO 3166 [3]
- ISO International Code Designator (ICD), allocated according to ISO 6523 [4]
- Local to accommodate the coexistence of OSI and non-OSI network addressing schemes.

II.B. NSAP Allocation

The NSAP assignment is heavily delegated beginning with subdomains under the different AFI values. In the "Internet CLNS world" mostly ISO-ICD (e.g. US GOSIP, HEPnet) and ISO-DCC (Europe) are in use. Detailed information can be found in [5] and [6]. To make data abstraction possible, the assignment of NSAP addresses should be consistent with the actual physical topology of the Internet.

CLNS routing is based on the longest prefix match. In theory it is possible to match at bit-level, but in practice octet boundaries are in use. The intra-domain IS-IS routing protocol allows for information abstraction to be maintained at two levels: systems are grouped into areas, and areas are interconnected to form a routing domain. The inter-domain IDRP routing protocol allows for information abstraction to be maintained at multiple levels by grouping routing domains into Routing Domain Confederations (RDC) and using route aggregation capabilities.

Routing domains which aren't connected or are only connected to one service provider should have a single address prefix assigned. Specifically, this allows the set of all NSAP addresses reachable within a single domain to be fully described via a

single prefix. According to [5] and [6] it is recommended that these domains use an address prefix that identifies their service provider.

The total number of routing domains on a world-wide OSI Internet will once be big enough that additional levels of hierarchical data abstraction beyond the routing domain level will be necessary. IDRP defines Routing Domain Confederations (RDC) and route aggregation to reach this hierarchical data abstraction.

The result of the hierarchical data abstraction on different levels is, that a NSAP address can be assembled from several prefixes owned by different organisations.

II.C. BIS database

The RARE lower layer technology working group for CLNS created a database, stored in a flat file for International Boundary Intermediate Systems (BIS). This file has been managed by Juha Heinanen, FUNET, during the CLNS pilot and can be retrieved by anonymous ftp or anon ftam from nic.switch.ch:network/clns/database/bis.db. During the pilot phase this file complied with the needs because only a few, very active, persons and organizations have been involved. An object of a boundary intermediate system contains the following information:

```
Name:       swieug.switch.ch
NET:        39.756f.1111.1111.0100.0001.6001.1300.5911.5001.00
IXI address: 20432830000
NSAP served: 39.756f.1111, 47.0020
IDRP:       static to EuropaNET/CLNS service
Contact:    Thomas.Brunner@switch.ch
```

II.D. Common IP practice

Requests for IP network numbers from organizations within Europe are handled by the RIPE NCC located in Amsterdam. IP networks are currently divided in class A, B or C, based on a fix netmask per class defined by the two most significant bits. CIDR (Classless Inter-Domain Routing) will remove the concept of class A, B and C networks providing a new representation of the destination address as a combination of an address and a mask. All assigned IP networks in the Internet are stored in network objects of NIC databases maintained by MERIT Inc., SRI International and RIPE NCC.

Intra-domain IP routing in the Internet is based on Autonomous Systems (AS) exchanging routing information with other ASes using Exterior Routing Protocols (EGP). An Autonomous System (AS) is a group of IP networks having a single clearly defined routing policy which is run be one or more network operators. Inside ASes IP packets are routed using one or more Interior Routing Protocols (IGP). AS Information's are also stored in the same whois databases [8] as IP networks.

II.E. RIPE database

One of the activities of RIPE is to maintain a database of European IP networks, AS numbers, DNS domains and their contact persons and other information needed for the technical co-ordination of IP networks. The information held on this database is available to the public for the purpose of co-ordinating IP networking. The master copy of the database is maintained centrally by the RIPE NCC and can be accessed via a whois server [7] on host **whois.ripe.net**. At the 17th RIPE meeting in Amsterdam in January 1994 the database working group accepted to open the database also for non-IP related information, e.g. CLNS objects.

Database entries are ASCII text. Information related to one topic, e.g. an AS number, are stored in objects. An object contains a series of <attribute> <value> pairs. Attributes have two character names. Attribute-values are stored on a single line of the form:

*aa: vvvvvvvvvv

where aa is the attribute name and vvvvvvvvvv is the attribute value. If an attribute value, like an address, has several lines, multiples of these lines may appear.

The database can be interrogated using the whois utility [7].

III. Draft CLNS object

The draft document "CLNS routing-domain object for the RIPE database" [1] contains a definition for an object which can be used to describe some general information of a CLNS routing domain such as NSAP prefix, name, description and responsible persons. It can also be used to describe routing policies comparable to IP domains (AS's) as defined in the paper RIPE-81 [8]. The attributes describing routing policy will be used to build routing tables for static routing and to verify existing routes with the described policy. It is planned to enhance already existing tools for IP to serve theses tasks, e.g. **prtraceroute** from the PRIDE project.

III.A. Object Description

The following valid entry from the RIPE database is used to explain the attributes of a CLNS routing-domain object ('whois -h whois.ripe.net 39.756f.1111'):

```
dom-prefix  39.756f.1111
dom-name:   SWITCHlan-CLNS
descr:      SWITCH CLNS routing domain. Switzerland
bis:        39.756f.1111.1111.0100.0001.6001.1300.5911.5001.00
            39.528f.1103
bis:        39.756f.1111.1111.0100.0001.4580.1920.6518.5130.00
            47.0020
dom-in:     39.528f.1103 200 ANY AND NOT 47.0020
            AND NOT 39.
dom-in:     47.0020 100 47.0020 39.380f
dom-out:    39.528f.1103 39.756f.1111 47.0020 39.380f
dom-out:    47.0020 39.756f.1111 39.528f.1103
default:    39.528f.1103 10
admin-c:    Thomas Brunner
tech-c:     Marcel Wiget
guardian:   wiget@chx400.switch.ch
remark:     this entry may change sometimes
changed:    wiget@chx400.switch.ch 940131
source:     RIPE
```

III.A.1 dom-prefix

Defines a unique routing domain, characterised by a NSAP prefix, within a certain prefix hierarchy. In contrast to the draft [1] it was decided during 17th RIPE meeting to use dots in NSAP's for readability: The first field being two hex digits (= AFI), followed by groupings of four hex digits (although the last group may have less than four). This attribute is indexed and can be searched by a whois client. Substring searches are not possible with the current whois implementations and this leaves a problem when looking for a given NSAP for the longest-match routing domain. A little program is needed to query the database iteratively with the NSAP shortened by digits.

III.A.2 dom-name

One word description of the routing domain. This field is indexed and can be searched by a whois client.

III.A.3 descr

A short description of the organization and its location. Format: free text, one line per entry, multiple lines in sequence.

III.A.4 BIS

Boundary intermediate system (NSAP of BIS router with NSEL=00) and the domain prefix of the connected routing domain. If the same BIS is connected to multiple routing domains directly, multiple lines are used. The notation of NSAP's is the same as above for dom-prefix.

III.A.5 dom-in

Description of accepted routing domain prefixes, from other domain BIS. Analogue to "as-in" in [8].

Format: <dom-prefix> <cost> <routing policy expression>

For every dom-prefix in the BIS attribute there should be a dom-in entry. <dom-prefix> is the routing domain prefix of the remote BIS. <cost> is a relative cost to discriminate between different routes to the same domain. The lowest cost gives the most preferred route. <routing policy expression> can be expressed in the following way's

- list of "dom-prefixes"
- keyword 'ANY'
- a logical expression of dom-prefixes and keywords operators: AND, OR, NOT and parenthesis to group rules.

III.A.6 dom-out

Routing domain prefixes announced to other BIS's. This attribute is analogue to the "as-out" tag in [8]. Two fields, <dom-prefix> and <routing policy expression> are used and have the same description as the "dom-out" tag above.

III.A.7 default

This tag indicates how default routing is done. Two fields, <dom-prefix> and <cost>, are used. <dom-prefix> again is the prefix of the domain of the peering BIS. <cost> indicates which default path is preferred if more than one dynamic route exists.

III.A.8 admin-c & tech-c

These attributes contain information of the administrative and technical contact persons. The name or NIC-handle given here will be expanded automatically by the whois server if the person is registered with a person object in the database.

III.A.9 guardian

E-mail and/or postal address of the domain guardian is stored in this attribute. It has been recently inserted into several objects of the RIPE database to prevent unauthorised changes of important objects. If an unauthorised person performs changes in a guarded object, then an e-mail will be sent automatically to the guardian of the changed object. This attribute has become important by the possibility to make updates and changes in the RIPE database by an automatic e-mail responder (send e-mail to <auto-dbm@ripe.net>).

III.A.10 changed

Who (e-mail address) and when (yymmdd) somebody has made the last change in the object is stored.

III.A.1 source

This attribute contains for the time being always 'RIPE'. This attribute will be important in the future if the database will be expanded to a distributed database.

IV. Current state

The very flexible whois server software is written by RIPE NCC staff in perl. Only a few days

after the 17th RIPE meeting the database was ready to accept CLNS objects. But by editing and submitting entries some questions popped up:

- Who owns an object entry, the owner of the prefix delegator or the user?
- Should the database hold also administrative domain prefixes, e.g. AFI values?

The current implementation with only one CLNS object does mix different topics like routing information and prefix-owner together, which are separated in the IP world. IP keeps the following information:

- Registration of IP addresses and AS information
- Registration of Routing policy
- Registration of Aggregation policy

CLNP objects ought to have a format as close to IP objects as possible. Then tools might get shared if the only thing one has to change in tools is the external call of network system programs, e.g. ping -> clnping and traceroute -> iso traceroute.

There is an ongoing discussion on the list about this topic.

V. Remarks

This paper was written April 20, 1994. Between this date and the presentation during INET'94 / JENC5 in Prague the object can change. The presentation will show the latest news.

For information about CLNS in Europe please contact/join the distribution list of the RARE CLNS co-ordination group <wg-llt-clns@rare.nl>. Send a request to <wg-llt-clns-request@rare.nl> to join the list. Everybody is invited to join this group.

List of abbreviations

AFI	Authority and Format Identifier
AS	Autonomous System. A collection of network under a common administration sharing a common routing strategy.
BIS	Boundary Intermediate System
CLNP/CLNS	Connectionless Network Protocol/ Service. An OSI network-layer protocol/service that does not require a circuit to be established before data is transmitted. CLNP is the OSI equivalent of IP.
DCC	ISO Data Country Code (ISO 3166)
DSP	Domain Specific Part of an NSAP address
ES-ES	End System to Intermediate System. OSI protocol that defines how end systems (hosts) announce themselves to intermediate systems (routers).
GOSIP	Government OSI Profile. A government procurement specification for OSI protocols.
HEPnet	High-Energy Physics network.
ICD	ISO International Code Designator (ISO 6523)
IDI	Initial Domain Identifier of NSAP
IDRP	IS-IS Interdomain Routing Protocol.
IDP	Initial Domain Part of NSAP
IP	Internet Protocol
ISDN	Integrated Services Digital Network
IS-IS	Intermediate System to Intermediate System. OSI link-state hierarchical routing protocol based on DECnet Phase V routing whereby intermediate systems (routers) exchange routing information based on a single metric to determine network topology.
NIC	Network Information Center
NSAP	Network Service Access Point.
RARE	Réseaux Associes pour la Recherche Européenne.
RDC	Routing Domain Confederations (part of IDRP)
RIPE	Réseaux IP Européens. RIPE is a collaborative organization open to all European Internet service providers.
RIPE NCC	RIPE Network Coordination Centre
SEL	NSAP Selector

References

[1] H. Steenman, "CLNS routing-domain object for the RIPE database", Jan 94, RIPE draft-dom-prefix-object.

[2] ISO/IEC, "Information Processing Systems - Data Communications - Network Service Definition", International Standard 8348, 1992.

[3] ISO/IEC, "Codes for the Representation of Names of Countries", International Standard 3166, ISO/IEC JTC 1, Switzerland, 1984.

[4] ISO/IEC, "Data Interchange - Structures for the Identification of Organization", International Standard 6523, ISO/IEC JTC 1, Switzerland, 1984.

[5] R. Colella, E. Garden, R. Callon, "Guidelines for OSI NSAP Allocation in the Internet", RFC 1237, 1991.

[6] R. Callon, E. Gardner, Y. Rekhter, "Guidelines for OSI NSAP Allocation in the Internet", draft-ietf-osinsap-allocation-01.txt, 1993.

[7] K. Harrenstien, M. Stahl, E. Feinler, "NICNAME/WHOIS", RFC 954, 1985.

[8] T. Bates, J-M. Jouanigot, D. Karrenberg, P. Lothberg, M. Terpstra, "Representation of IP Routing Policies in the RIPE Database" RIPE-81, Feb 1993.

Author information

Marcel Wiget joined SWITCH in 1991 after he received his diploma in electrical engineering at the Federal Institute of Technology ETH Zurich. He belongs to the SWITCHlan group where he is involved in IP and CLNS networking operations and is responsible for ATM pilot activities at SWITCH. Currently he chairs the RARE CLNS coordination group.

Henk Steenman participates in the RARE CLNS coordination group since 1992 and is the author of the "Proposal for CLNS routing domain object for the RIPE database". He is employed by SARA at it's network operations centre where his main work is concerned with IP networking operations.