             Assignment of System Identifiers for TUBA/CLNP Hosts

Status of this Memo

   This memo provides information for the Internet community. It does
   not specify an Internet standard. Distribution of this memo is
   unlimited.

Abstract

   This document describes conventions whereby the system identifier
   portion of an RFC 1237 style NSAP address may be guaranteed
   uniqueness within a routing domain for the purpose of
   autoconfiguration in TUBA/CLNP internets. The mechanism is extensible
   and can provide a basis for assigning system identifiers in a
   globally unique fashion.

Introduction

   This memo specifies methods for assigning a 6 octet system identifier
   portion of the OSI NSAP address formats described in "Guidelines for
   OSI NSAP Allocation in the Internet" [1], in a fashion that ensures
   that the ID is unique within a routing domain. It also recommends
   methods for assigning system identifiers having lengths other than 6
   octets. The 6 octet system identifiers recommended in this RFC are
   assigned from 2 globally administered spaces (IEEE 802 or "Ethernet",
   and IP numbers, administered by the Internet Assigned Numbers
   Authority, IANA).

   At this time, the primary purpose for assuring uniqueness of system
   identifiers is to aid in autoconfiguration of NSAP addresses in
   TUBA/CLNP internets [2]. The guidelines in this paper also establish
   an initial framework within which globally unique system identifiers,
   also called endpoint identifiers, may be assigned.

Acknowledgments

   Many thanks to Radia Perlman, Allison Mankin, and Ross Callon of for
   their insights and assistance. Thanks also to the Ethernet connector
   to my MAC, which conveniently and quite inobtrusively fell out,
   enabling me to get an entire day's worth of work done without email
   interruptions.

1. Background

   The general format of OSI network service access point (NSAP)
   addresses is illustrated in Figure 1.
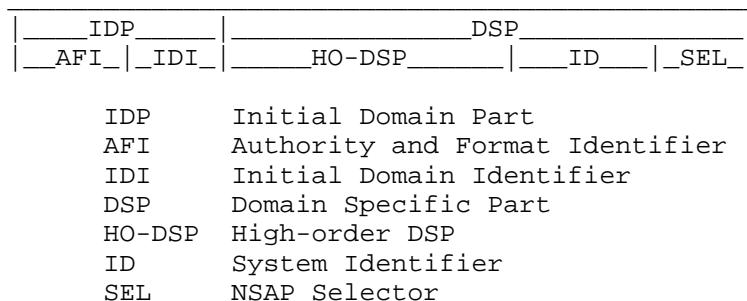
```
    _____
   |_____IDP_____|_____DSP_____|
   |__AFI_|_IDI_|_____HO-DSP_____|___ID___|_SEL_|

          IDP     Initial Domain Part
          AFI     Authority and Format Identifier
          IDI     Initial Domain Identifier
          DSP     Domain Specific Part
          HO-DSP  High-order DSP
          ID      System Identifier
          SEL     NSAP Selector

          Figure 1: OSI NSAP Address Structure.
```

   The recommended encoding and allocation of NSAP addresses in the
   Internet is specified in RFC 1237. RFC 1237 makes the following
   statements regarding the system identifier (ID) field of the NSAPA:

   1. the ID field may be from one to eight octets in length

   2. the ID must have a single known length in any particular
       routing domain

   3. the ID field must be unique within an area for ESs and
       level 1 ISs, and unique within the routing domain for level
       2 ISs.

   4. the ID field is assumed to be flat

   RFC 1237 further indicates that, within a routing domain that
   conforms to the OSI intradomain routing protocol [3] the lower-order
   octets of the NSAP should be structured as the ID and SEL fields
   shown in Figure 1 to take full advantage of intradomain IS-IS
   routing. (End systems with addresses which do not conform may require
   additional manual configuration and be subject to inferior routing
   performance.)

   Both GOSIP Version 2 (under DFI-80h, see Figure 2a) and ANSI DCC NSAP
   addressing (Figure 2b) define a common DSP structure in which the
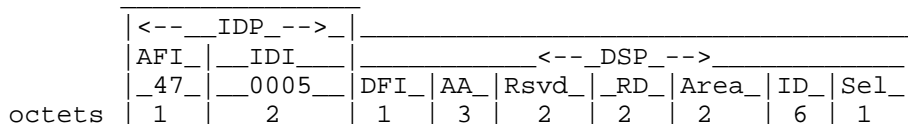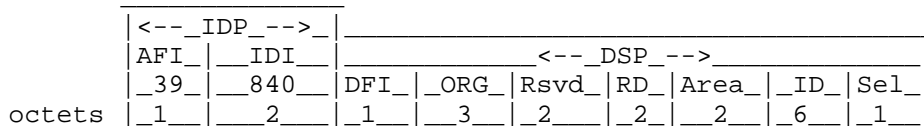   system identifier is assumed to be a fixed length of 6 octets.

```
                 _____
                |<--__IDP_-->_|_____
                |AFI_|__IDI___|_____<--_DSP_-->_____|
                |_47_|__0005__|DFI_|AA_|Rsvd_|_RD_|Area_|ID_|Sel_|
         octets |_1__|___2____|_1__|_3_|__2__|_2__|_2___|_6_|_1__|
```

                 Figure 2 (a): GOSIP Version 2 NSAP structure.

```
                 _____
                |<--__IDP_-->_|_____
                |AFI_|__IDI__|_____<--_DSP_-->_____|
                |_39_|__840__|DFI_|_ORG_|Rsvd_|RD_|Area_|_ID_|Sel_|
         octets |_1__|___2___|_1__|__3__|_2___|_2_|__2__|_6__|_1__|
```

                    IDP   Initial Domain Part
                    AFI   Authority and Format Identifier
                    IDI   Initial Domain Identifier
                    DSP   Domain Specific Part
                    DFI   DSP Format Identifier
                    ORG   Organization Name (numeric form)
                    Rsvd   Reserved
                    RD   Routing Domain Identifier
                    Area   Area Identifier
                    ID   System Identifier
                    SEL   NSAP Selector

                 Figure 2(b): ANSI NSAP address format for DCC=840

2. Autoconfiguration

   There are provisions in OSI for the autoconfiguration of area
   addresses. OSI end systems may learn their area addresses
   automatically by observing area address identified in the IS-Hello
   packets transmitted by routers using the ISO 9542 End System to
   Intermediate System Routing Protocol, and may then insert their own
   system identifier. (In particular, RFC 1237 explains that when the ID
   portion of the address is assigned using IEEE style 48-bit
   identifiers, an end system can reconfigure its entire NSAP address
   automatically without the need for manual intervention.) End systems
   that have not been pre-configured with an NSAPA may also request an
   address from an intermediate system their area using [5].

2.1 Autoconfiguration and 48-bit addresses

   There is a general misassumption that the 6-octet system identifier
   must be a 48-bit IEEE assigned (ethernet) address. Generally
   speaking, autoconfiguration does not rely on the use of a 48-bit
   ethernet style address; any system identifier that is globally

administered and is unique will do. The use of 48-bit/6 octet system
identifiers is "convenient...because it is the same length as an 802
address", but more importantly, choice of a single, uniform ID length
allows for "efficient packet forwarding", since routers won't have to
make on the fly decisions about ID length (see [6], pages 156-157).
Still, it is not a requirement that system identifiers be 6 octets to
operate the the IS-IS protocol, and IS-IS allows for the use of IDs
with lengths from 1 to 8 octets.

3. System Identifiers for TUBA/CLNP

Autoconfiguration is a desirable feature for TUBA/CLNP, and is viewed
by some as "essential if a network is to scale to a truly large size"
[6].

For this purpose, and to accommodate communities who do not wish to
use ethernet style addresses, a generalized format that satisfies the
following criteria is desired:

o the format is compatible with installed end systems
  complying to RFC 1237

o the format accommodates 6 octet, globally unique system
  identifiers that do not come from the ethernet address space

o the format accommodates globally unique system identifiers
  having lengths other than 6 octets

The format and encoding of a globally unique system identifier that
meets these requirements is illustrated in Figure 3:

```
    Octet 1      Octet 2      Octet 3 ...      Octet LLL-1  Octet LLLL
+-----------+-----------+-----------+- ...-+-----------+-----------+
| xxxx TTGM | xxxx xxxx | xxxx xxxx |      | xxxx xxxx | xxxx xxxx |
+-----------+-----------+-----------+- ...-+-----------+-----------+
```
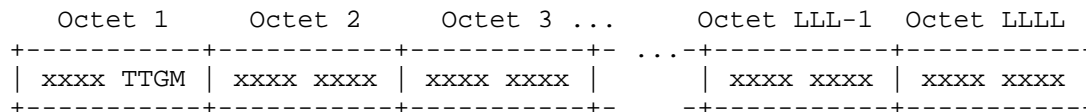
             Figure 3. General format of the system identifier

3.1 IEEE 802 Form of System Identifier

The format is compatible with globally assigned IEEE 802 addresses,
since it carefully preserves the semantics of the global/local and
group/individual bits. Octet 1 identifies 2 qualifier bits, G and M,
and a subtype (TT) field whose semantics are associated with the
qualifier bits. When a globally assigned IEEE 802 address is used as
a system identifier, the qualifier bit M, representing the
multicast/unicast bit, must always be set to zero to denote a unicast
address. The qualifier bit G may be either 0 or 1, depending on

whether the individual address is globally or locally assigned. In
these circumstances, the subtype bits are "don't care", and the
system identifier shall be interpreted as a 48-bit, globally unique
identifier assigned from the IEEE 802 committee (an ethernet
address). The remaining bits in octet 1, together with octets 2 and
3 are the vendor code or OUI (organizationally unique identifier), as
illustrated in Figure 4. The ID is encoded in IEEE 802 canonical
form (low order bit of low order hex digit of leftmost octet is the
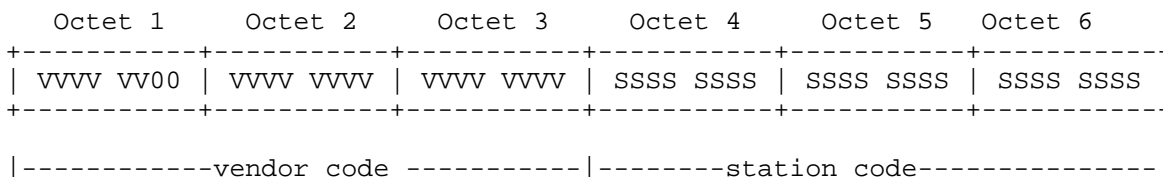first bit transmitted).

```
   Octet 1      Octet 2      Octet 3      Octet 4      Octet 5    Octet 6
+-----------+-----------+-----------+-----------+-----------+-----------+
| VVVV VV00 | VVVV VVVV | VVVV VVVV | SSSS SSSS | SSSS SSSS | SSSS SSSS |
+-----------+-----------+-----------+-----------+-----------+-----------+

|------------vendor code -----------|--------station code--------------|
```

            Figure 4. IEEE 802 form of system identifier

4. Embedded IP Address as System Identifier

   To distinguish 48-bit IEEE 802 addresses used as system identifiers
   from other forms of globally admininistered system identifiers, the
   qualifer bit M shall be set to 1. The correct interpretation of the M
   bit set to 1 should be, "this can't be an IEEE 802 multicast address,
   since use of multicast addresses is by convention illegal, so it must
   be some other form of system identifier". The subtype (TT) bits
   illustrated in Figure 3 thus become relevant.

   When the subtype bits (TT) are set to a value of 0, the system
   identifier contains an embedded IP address. The remainder of the 48-
   bit system identifier is encoded as follows. The remaining nibble in
   octet 1 shall be set to zero. Octet 2 is reserved and shall be set
   to a pre-assigned value (see Figure 5). Octets 3 through 6 shall
   contain a valid IP address, assigned by IANA. Each octet of the IP
   address is encoded in binary, in internet canonical form, i.e., the
   leftmost bit of the network number first.

```
   Octet 1      Octet 2       Octet 3      Octet 4      Octet 5    Octet 6
+-----------+-----------+-----------+-----------+-----------+-----------+
| 0000 0001 | 1010 1010 | aaaa aaaa | bbbb bbbb | cccc cccc | dddd dddd |
+-----------+-----------+-----------+-----------+-----------+-----------+

|-len&Type--|--reserved-|---------IP address------------------------|
```
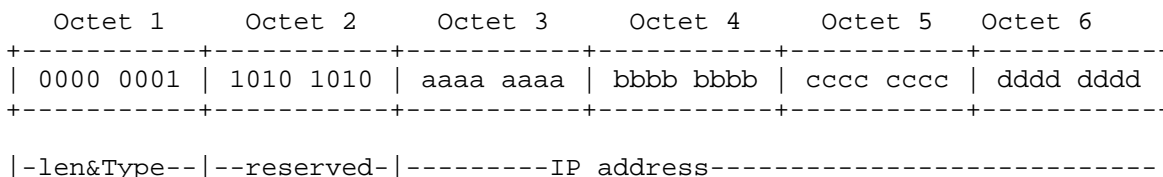
            Figure 5. Embedded IP address as system identifier

As an example, the host "eve.bellcore.com = 128.96.90.55" could retain
its IP address as a system identifier in a TUBA/CLNP network. The
encoded ID is illustrated in Figure 6.

```
   Octet 1      Octet 2      Octet 3      Octet 4      Octet 5    Octet 6
+-----------+-----------+-----------+-----------+-----------+-----------+
| 0000 0001 | 1010 1010 | 1000 0000 | 0110 0000 | 0101 1010 | 0011 0111 |
+-----------+-----------+-----------+-----------+-----------+-----------+

|-len&Type--|--reserved-|---------IP address-------------------------|
```

                 Figure 6. Example of IP address encoded as ID

H 2 "Other forms of System Identifiers"

   To allow for the future definition of additional 6-octet system
   identifiers, the remaining subtype values are reserved.

   It is also possible to identify system identifiers with lengths other
   than 6 octets. Communities who wish to use 8 octet identifiers (for
   example, embedded E.164 international numbers for the ISDN ERA) must
   use a GOSIP/ANSI DSP format that allows for the specification of 2
   additional octets in the ID field, perhaps at the expense of the
   "Rsvd" fields; this document recommends that a separate Domain Format
   Indicator value be assigned for such purposes; i.e., a DFI value that
   is interpreted as saying, among other things, "the system identifier
   encoded in this DSP is 64-bits/8 octets. The resulting ANSI/GOSIP DSP
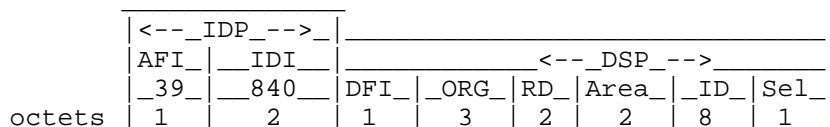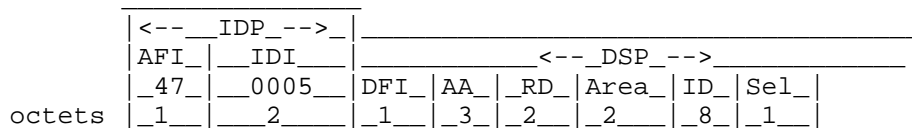   formats under such circumstances are illustrated in Figure 7:

```
              _____
             |<--_IDP_-->_|_____
             |AFI_|__IDI__|_____<--_DSP_-->_____|
             |_39_|__840__|DFI_|_ORG_|RD_|Area_|_ID_|Sel_|
      octets |_1__|___2___|_1__|__3__|_2_|__2__|_8_|_1__|
```

       Figure 7a: ANSI NSAP address format for DCC=840, DFI=foo

```
              _____
             |<--__IDP_-->_|_____
             |AFI_|__IDI___|_____<--_DSP_-->_____|
             |_47_|__0005__|DFI_|AA_|_RD_|Area_|ID_|Sel_|
      octets |_1__|___2____|_1__|_3_|_2__|_2___|_8_|_1__|
```

                    IDP   Initial Domain Part
                    AFI   Authority and Format Identifier
                    IDI   Initial Domain Identifier
                    DSP   Domain Specific Part
                    DFI   DSP Format Identifier
                    AA   Administrative Authority
                    RD   Routing Domain Identifier
                    Area   Area Identifier
                    ID   System Identifier
                    SEL   NSAP Selector

        Figure 7b: GOSIP Version 2 NSAP structure, DFI=bar

   Similar address engineering can be applied for those communities who
   wish to have shorter system identifiers; have another DFI assigned,
   and expand the reserved field.

5. Conclusions

   This proposal should debunk the "if it's 48-bits, it's gotta be an
   ethernet address" myth. It demonstrates how IP addresses may be
   encoded within the 48-bit system identifier field in a compatible
   fashion with IEEE 802 addresses, and offers guidelines for those who
   wish to use system identifiers other than those enumerated here.

6. References

   [1] Callon, R., Gardner, E., and R. Colella, "Guidelines for OSI NSAP
       Allocation in the Internet", RFC 1237, NIST, Mitre, DEC, June
       1991.

   [2] Callon, R., "TCP and UDP with Bigger Addresses (TUBA), A Simple
       Proposal for Internet Addressing and Routing", RFC 1347, DEC,
       June 1992.

   [3] ISO, "Intradomain routing protocol for use in conjunction with
       ISO 8473, Protocol for providing the OSI connectionless network
       service", ISO 10589.

   [4] ISO, End-system and intermediate-system routing protocol for use
       in conjunction with ISO 8473, Protocol for providing the OSI
       connectionless network service, ISO 9542.

   [5] ISO, "End-system and intermediate-system routing protocol for use
       in conjunction with ISO 8473, Protocol for providing the OSI
       connectionless network service. Amendment 1: Dynamic Discovery
       of OSI NSAP Addresses End Systems", ISO 9542/DAM1.

   [6] Perlman, R., "Interconnections: Bridges and Routers", Addison-
       Wesley Publishers, Reading, MA. 1992.

7. Security Considerations

   Security issues are not discussed in this memo.

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