Internet Code Point (ICP) Assignments for NSAP Addresses

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Abstract

   This document is intended to accomplish two highly inter-related
   tasks: to establish an "initial" Internet Code Point (ICP) assignment
   for each of IPv4 and IPv6 address encoding in Network Service Access
   Point (NSAP) Addresses, and to recommend an IANA assignment policy
   for currently unassigned ICP values. In the first task, this
   document is a partial replacement for RFC 1888 -- particularly for
   section 6 of RFC 1888. In the second task, this document
   incorporates wording and specifications from ITU-T Recommendation
   X.213 and further recommends that IANA use the "IETF consensus"
   assignment policy in making future ICP assignments.

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1. Introduction

   Section 6 of RFC 1888 [1888] previously provided for assignment of
   the initial Internet Code Point (ICP) value '0' for encoding an IPv6
   address in a Network Service Access (or Attachment) Point [NSAP]
   address. RFC 1888 also defined multiple means for restricted
   encoding of an NSAP address in an IPv6 address.

   The means RFC 1888 defined for encoding NSAP addresses in IPv6
   address format was heavily annotated with warnings and limitations
   that apply should this encoding be used. Possibly as a result, these
   encodings are not used and appear never to have been used in any IPv6
   deployment. In addition, section 6 contains minor errors. As a
   result of these various considerations, RFC 1888 [1888] has been
   obsoleted and declared Historic by RFC 4048 [4048].

   It is the belief of the authors of this document that the errors in
   section 6 of RFC 1888 resulted -- at least in part -- because the
   ITU-T specification [X.213] that originally assigned Authority and
   Format Identifier (AFI) '35' to IANA was not freely publicized, nor
   was it incorporated or explained using the mechanism commonly used in
   the IETF, i.e., an RFC.

   It is therefore part of the purpose of this document to provide that
   explanation.

   In addition, because there are other documents that refer to the IPv6
   ICP assignment in RFC 1888, it is necessary for the errors in section
   6 of RFC 1888 to be corrected, irrespective of the RFC's ultimate
   status.

   Finally, no previous RFC (including RFC 1888) has ever formalized an
   assignment of an IPv4 ICP. This may have been in part because of a
   lack of formal definition of an IANA assignment policy for ICP values
   under the IANA-allocated AFI ('35').

   This document replaces section 6 of RFC 1888 in defining the ICP for
   IPv6 address encoding in an NSAP address, and it formalizes the ICP
   assignment for IPv4 address encoding in an NSAP address.

1.1. Conventions

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [2119].

1.2. Acronyms and Terminology

```
AFI   - Authority and Format Identifier
BCD   - Binary Coded Decimal
DSP   - Domain Specific Part
IANA  - Internet Assigned Numbers Authority
ICP   - Internet Code Point
IDI   - Initial Domain Identifier
IDP   - Initial Domain Part
IETF  - Internet Engineering Task Force
ISO   - International Organization for Standardization
NSAP  - Network Service Access (or Attachment) Point (often NSAPA)
NSAPA - NSAP Address; 20-Octet Address Format
OSI   - Open Systems Interconnection
RFC   - Request For Comments
WIP   - Work In Progress
```

2. IANA Considerations

An ITU-T Recommendation [X.213] has allocated two AFIs designating
IANA as the assignment authority. One of these two AFIs ('34') is
allocated for assignment of NSAPA in Decimal Numeric Format. This
document does not address allocation for this AFI as it is not clear
what use (if any) can be made of this encoding format at this time.
The other AFI ('35') is to be used for binary encoding except as
noted below.

The NSAPA format consists of an Initial Domain Part (IDP) and Domain
Specific Part (DSP). The IDP, in turn, consists of an Authority and
Format Identifier (AFI) and an Initial Domain Identifier (IDI). The
AFI is defined to be a binary octet, and the IDI is defined to be a
four decimal digit number encoded in two octets using Binary Coded
Decimal format. Each nibble of the IDI is used to represent a
decimal digit, using binary value '0000' through '1001'.

In assigning allocation authority for AFI '35' to IANA, the ITU-T
Recommendation [X.213] specifies that the two-octet IDI will be used
to hold an Internet Code Point (ICP) that, because of the decimal
encoding, MUST be in the decimal range from '0' to '9999'.

The ITU-T recommendation assumes the assignment of ICP '0' (zero) for
IPv6 address encoding in a Network Service Access Point Address
(NSAPA, or often NSAP). In addition, ITU-T assumed that IANA would
assign an ICP for IPv4 address encoding in an NSAPA and X.213 assumed
that the ICP value for this purpose would be '1'.

In an NSAPA, the DSP is the remaining octets after the IDP. For AFI
'35', this is 17 octets having a format as defined by IANA or as
defined by another party and published with IANA consent.

IANA, as the authority responsible for AFI '35', SHOULD NOT assign an
ICP unless there is a corresponding defined, and published, format at
the time of the code point assignment.

The IANA has assigned the following ICP values:

```
    ICP Value    Address Encoding   Format Definition
    ----------   ----------------   ----------------------------
       '0'            IPv6          RFC 4548, section 3.2
       '1'            IPv4          RFC 4548, section 3.1
```

Remaining decimal values '2' through '9999' MUST be assigned on an
IETF consensus basis [2434].

3. Initial Allocations and Uses

This document continues the ICP assignment and format definition as
previously defined in RFC 1888, and it formalizes the allocation of
ICP value '1' for IPv4 encoding and the format to be used. The
sections below describe the specific IPv4 and IPv6 address encoding
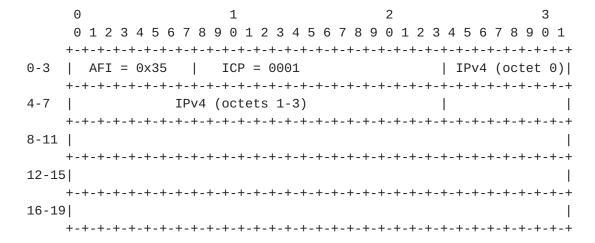formats.

3.1. IPv4 Address Encoding in an NSAPA

If it is required, for whatever reason, to embed an IPv4 address
inside a 20-octet NSAP address, then the following format MUST be
used. Note: alignment is an artifact of existing NSAPA usage.

A specific possible use of this embedding is to express an IP address
within the ATM Forum address format. Another possible use would be
to allow Connectionless Network Protocol (CLNP) packets that
encapsulate IPv4 packets to be routed in a CLNP network using the
IPv4 address architecture. Several leading octets of the IPv4
address could be used as a CLNP routing prefix.

An NSAPA with an AFI value of '35' and an ICP value of '1' (one)
encodes a 4-octet IPv4 address in the first 4 octets of the DSP. The
last 13 octets of the DSP are unspecified in this document. To
maintain compatibility with both NSAP format and IPv4 addressing,
these octets MUST be present, but have no intrinsic significance for
IPv4. The default values for the unspecified octets is zero.

```
       0                   1                   2                   3
       0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
0-3   |   AFI = 0x35    |   ICP = 0001               | IPv4 (octet 0)|
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
4-7   |               IPv4 (octets 1-3)             |               |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
8-11  |                                                             |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
12-15 |                                                             |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
16-19 |                                                             |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   An NSAPA with the IANA AFI code and ICP set to '1' (one) is converted
   to an IPv4 address by stripping off the first 3 and the last 13
   octets. If the NSAP-addressed contents are passed to a higher layer,
   the last 13 octets SHOULD be presented to the higher layer as well.

   If an NSAP address using this encoding is used for routing in an IPv4
   routing architecture, only the 4-octet IPv4 address MAY be
   considered.

3.2. IPv6 Address Encoding in an NSAPA

   If it is required, for whatever reason, to embed an IPv6 address
   inside a 20-octet NSAP address, then the following format MUST be
   used. Note: alignment is an artifact of existing NSAPA usage.

   A specific possible use of this embedding is to express an IP address
   within the ATM Forum address format. Another possible use would be
   to allow CLNP packets that encapsulate IPv6 packets to be routed in a
   CLNP network using the IPv6 address architecture. Several leading
   octets of the IPv6 address could be used as a CLNP routing prefix.

   An NSAPA with an AFI value of '35' and an ICP value of '0' (zero)
   encodes a 16-octet IPv6 address in the first 16 octets of the DSP.
   The last octet of the DSP is a selector. To maintain compatibility
   with both NSAP format and IPv6 addressing, this octet MUST be
   present, but it has no intrinsic significance for IPv6. Its default
   value is zero, but other values may be used as specified for any
   specific application. For example, this octet may be used to specify
   one of 255 possible port numbers.

```
        0                   1                   2                   3
        0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 0-3   |   AFI = 0x35   |   ICP = 0000                  | IPv6 (octet 0)|
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 4-7   |               IPv6 (octets 1-4)                               |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 8-11  |               IPv6 (octets 5-8)                               |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 12-15 |               IPv6 (octets 9-12)                              |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 16-19 |       IPv6 (octets 13-15)                 |                   |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

An NSAPA with the IANA AFI code and ICP set to '0' (zero) is
converted to an IPv6 address by stripping off the first 3 octets and
the 20th octet. If the NSAP-addressed contents are passed to a
higher layer, the last octet SHOULD be presented to the higher layer
as well.

If an NSAP address using this encoding is used for routing in an IPv6
routing architecture, only the 16-octet IPv6 address MAY be
considered.

4. Security Considerations

The NSAP encoding of IPv4 and IPv6 addresses is compatible with the
corresponding security mechanisms of RFC 4301 [4301], hence this
document introduces no new security exposure in the Internet.

5. References

5.1. Normative References

   [4301]   Kent, S. and K. Seo, "Security Architecture for the Internet
            Protocol", RFC 4301, December 2005.

   [2119]   Bradner, S., "Key words for use in RFCs to Indicate
            Requirement Levels", BCP 14, RFC 2119, March 1997.

   [NSAP]   International Organization for Standardization, "Information
            technology - Open Systems Interconnection - Network service
            Definition", ISO/IEC 8348:2002, 2002.

   [X.213] ITU-T Recommendation X.213, X-Series Recommendations, Data
            Networks and Open Systems Communications, October, 2001.

   [2434]   Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA
            Considerations Section in RFCs", BCP 26, RFC 2434, October
            1998.

5.2. Informative References

   [1888]   Bound, J., Carpenter, B., Harrington, D., Houldsworth, J.,
            and A. Lloyd, "OSI NSAPs and IPv6", RFC 1888, August 1996.

   [4048]   Carpenter, B., "RFC 1888 Is Obsolete", RFC 4048, April 2005.

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