Title:	Liaison on IETF RFC 7042bis, IANA Considerations and IETF Protocol and Documentation Usage for IEEE 802 Parameters
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Dear Colleagues,

The IEEE 802.1 Working Group and the IEEE Registration Authority Committee have reviewed the Internet-Draft IETF RFC 7042bis, *IANA Considerations and IETF Protocol and Documentation Usage for IEEE 802 Parameters* (https://datatracker.ietf.org/doc/html/draft-ietf-intarea-rfc7042bis).

Our comments can be found in the attached document. In the document, mark up comments are included, using strike-through and inserted text. There are also comments about the content text using the PDF comment tool.

We recognize value in providing background information for the reader and recommend that a statement be included that the reference sources are the definitive references, e.g., IEEE Std 802, IEEE Std 802.1Q, IEEE Std 802.1AB, and IEEE Std 802.1AC, including any approved amendments and revisions. We note that IEEE Std 802 is currently undergoing revision and we welcome participation in that process.

We look forward to reviewing the next draft of IETF RFC7042bis.

Respectfully submitted,
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                          for IEEE 802 Parameters
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Abstract   •

   Some IETF protocols make use of Ethernet frame formats and IEEE 802
   parameters. This document discusses several aspects of such
   parameters, and their use in IETF protocols, specifies IANA
   considerations for assignment of points under the IANA OUI
   (Organizationally Unique Identifier), and provides some values for
   use in documentation. This document obsoletes RFC 7042.

Status of This Memo

The list of current Internet-Drafts can be accessed at
https://www.ietf.org/1id-abstracts.html. The list of Internet-Draft
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Table of Contents

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1. Introduction

Some IETF protocols use Ethernet or other IEEE 802-related
communication frame formats and parameters [IEEE802]. These include
MAC (Media Access Control) addresses and protocol identifiers. ~~The
IEEE~~The assignment of identifiers for use in IEEE 802 networks is managed by the
IEEE Registration Authority (IEEE RA), which provides a number of tutorials
concerning these parameters
[IEEEtutorials].

~~This document specifies IANA considerations for the assignment of
code points under the IANA OUI (Organizationally Unique Identifier),
including MAC addresses and protocol identifiers, and provides some
values for use in documentation.~~ The IEEE RA has assigned to IANA an
Organizationally Unique Identifier (OUI) and an associated set of MAC addresses.
This document specifies IANA considerations for the assignment of code points
under that IANA OUI, including MAC addresses and protocol identifiers, and
provides some values for use in documentation. As noted in [RFC2606] and
[RFC5737], the use of designated code values reserved for
documentation and examples reduces the likelihood of conflicts and
confusion arising from such code points conflicting with code points
assigned for some deployed use. This document also discusses several
other uses by the IETF of IEEE 802 code points, including IEEE 802
Connectivity Fault Management (CFM) code points [RFC7319] and IEEE
802 Link Local Discovery Protocol (LLDP [802.1AB])
~~Vendor~~Organizationally-Specific TLV Sub-Types
[RFC8520]. It also specifies CBOR tags for MAC addresses and
OUI/CIDs.

1.1 Notations Used in This Document

[RFC8126] is incorporated herein except where there are contrary
provisions in this document. In this document, "IESG Ratification
is used in some cases." IESG Ratification is specified in Section
5.1. It is NOT the same as "IESG Approval" in [RFC8126].

[RFC8126] is incorporated herein except where there are contrary
provisions in this document. This document uses hexadecimal notation. Each octet (that is, 8-bit
byte) is represented by two hexadecimal digits giving the value of
the octet as an unsigned integer. Successive octets are separated by
a hyphen. This document consistently uses IETF ("network") bit
ordering although the physical order of bit transmission within an
octet on an IEEE [802.3] link is from the lowest order bit to the
highest order bit (i.e., the reverse of the IETF's ordering).

In this document:

"AFN"   Address Family Number [RFC4760].

"CBOR"   Concise Binary Object Representation [RFC8949].

"CFM"   Connectivity Fault Management [RFC7319].

"CID"   Company Identifier.

"DSAP"   Destination Service Access Point. See Section 3.

"EUI"   Extended Unique Identifier.

"IAB"   Individual Address Block, not Internet Architecture Board.
          Now called MA-S.

"IEEE"   Institute ~~for~~of Electrical and Electronics
          Engineers <https://www.ieee.org>.

"IEEE-SA" IEEE Standards Association <https://standards.ieee.org>.

"LSAP"   Link-Layer Service Access Point. See Section 3

"MA-L"   MAC Address Block Large~~, commonly referred to as an OUI~~.

"MA-M"   MAC Address Block Medium.

"MA-S"   MAC Address Block Small.

"MAC"   Media Access Control, not Message Authentication Code.

"MAC-48" A 48-bit MAC address. This term is obsolete. If globally
          unique, use EUI-48.

"OUI"   Organizationally Unique Identifier. ~~An OUI is now officially
          called an "MA-L" by the IEEE.~~

"RRTYPE" A DNS Resource Record type [RFC6895].

"SLAP"   IEEE 802 Structured Local Address Plan [802_O&A].

"SSAP"   Source Service Access Point. See Section 3.

"tag"   "Tag" is used in two contexts in this document. For
          "Ethernet tag", see Section 3. For "CBOR tag", see Section
          2.4.

"TLV"   Type, Length, Value.

"**"   The double asterisk symbol indicates exponentiation. For
          example, 2**24 is two to the twenty-fourth power.

1.2 Changes from RFC 7042

   This document obsoletes [RFC7042] and makes the changes listed below.
   However, the completed application template based upon which an IANA
   OUI-based protocol number value was assigned for document use remains
   that in Appendix C of RFC 7042.

o Add information on MA-M (28-bit) and MA-S (36-bit) EUI prefixes
   that the IEEE Registration Authority assigns.

o Add information on the restructuring of the "local" MAC address
   space into four quadrants under the Structured Local Address Plan
   (SLAP [802_O&A]).

o Include the IESG Statement on ~~Ethertypes~~EtherTypes (See Appendix
   B.1) and more detailed IETF procedures for applying to the IEEE
   Registration Authority for an ~~Ethertype~~EtherType for use in a☐TF
   protocol (see Section 5.5).

o Mention that IEEE 802 CFM Codepoints that have been allocated to
   the IETF (see Section 1.5).

o Mention the ~~vendor specific~~Organizationally-Specific LLDP data
   element that has been assigned under the IANA OUI and the
   registry set up for future such assignments (see Section 4.1).

o Clarify minor details in Section 5.1 on Expert Review and IESG
   Ratification.

o Specify CBOR tags for MAC addresses and OUI/CIDs (see Section
   2.4).

o Add a version field requirement for the allocation of protocol
   numbers under the IANA OUI (see Section 3.1).

1.3 The IEEE Registration Authority

   Originally the responsibility of Xerox Corporation, the
   registration authority for Ethernet parameters ~~is now~~since 1986 has
   been the IEEE Registration Authority, available on the web at
   [IEEEregAuth].

   The IEEE Registration Authority (IEEE-RA) operates under the
   direction of the IEEE Standards Association (IEEE-SA) Board of
   Governors, ~~normally via~~with oversight by the IEEE Registration
   Authority Committee (RAC). The IEEE RAC is a committee of the
   Board of Governors.

   Anyone may apply to that Authority for parameter assignments.
   The IEEE Registration Authority may impose fees or other
   requirements but commonly waives fees for applications from
   standards development organizations. Lists of assignments and
   their holders are downloadable from the IEEE Registration
   Authority site.

1.4 The IANA Organizationally Unique Identifier

   The Organizationally Unique Identifier (OUI) 00-00-5E has been
   assigned to IANA by the IEEE Registration Authority.

   There is no OUI value reserved at this time for documentation, but
   there are documentation code points under the IANA OUI specified
   below.

1.5 CFM Code Points

   ~~The IEEE has allocated~~IEEE Std 802.1Q [802.1Q] allocates two blocks of
   802 Connectivity Fault Management (CFM) code points to the IETF,
   one for CFM OpCodes and one for CFM TLV Types. For further
   information see [RFC7319]. The IANA "Connectivity Fault Management
   (CFM) OAM IETF Parameters" Registry has subregistries for these
   code points. This document does not further discuss these blocks
   of code points.

2. Ethernet Identifier Parameters

Section 2.1 discusses 48-bit MAC identifiers, their relationship to
OUIs and other prefixes, and assignment under the IANA OUI. Section
2.2 extends this to 64-bit identifiers. Section 2.3 discusses other
IETF MAC identifier use not under the IANA OUI. Section 2.4 specifies
CBOR tags for MAC addresses and OUI/CIDs.

> Historical Note: [RAC_OUI] indicates that the IEEE Registration
> Authority Committee was at one time exploring the feasibility of
> defining 128-bit identifiers. [RAC_OUI] is an expired draft that
> also provides additional historic information on [IEEE802]
> registries.

2.1 48-Bit MAC Identifiers, OUIs, and Other Prefixes

48-bit MAC "addresses" are the most commonly used Ethernet interface
identifiers. Those that are globally unique are also called EUI-48
identifiers (Extended Unique Identifier 48). An EUI-48 is structured
into an initial prefix assigned by the IEEE Registration Authority
and additional bits assigned by the prefix owner. Currently there
are three lengths of prefixes assigned as shown in the table below;
however, some prefix bits have special meaning as shown in Figure 1.

Prefix Length in bits	Name	Owner Supplied Bits for EUI-48
24	MA-L (OUI)	24
28	MA-M	20
36	MA-S	12

The bottom four bits, as shown in Figure 1, of the first octet of the
octet 48-bit MAC have special meaning and are referred to below as
the M, X, Y, and Z bits.

```
 0  1  2  3  4  5  6  7  0  1  2  3  4  5  6  7
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| .  .  .  .  Z  Y  X  M| .  .  .  .  .  .  .  .| octets 0&1
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| .  .  .  .  .  .  .  .| .  .  .  .  .  .  .  .| octets 2&3
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| .  .  .  .  .  .  .  .| .  .  .  .  .  .  .  .| octets 4&5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```
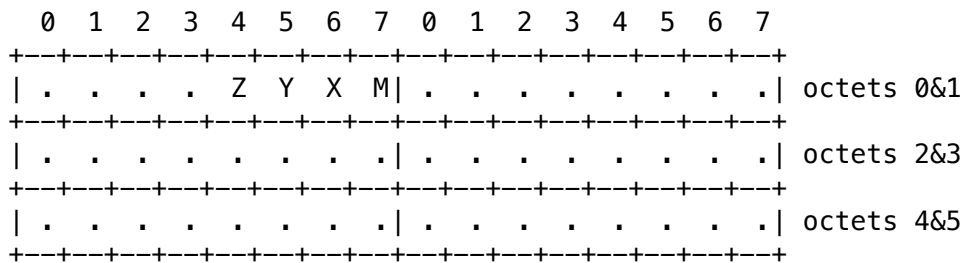
Figure 1. 48-bit MAC Address Structure

Except for cetain combinations of the Z, Y, X and M bits as discussed in
Section 2.1.1 For global addresses, X=0 and, a MAC address begins with 3 octets
or a larger

   initial prefix indicating the ~~asignee~~assignee of the block of MAC
 addresses. This prefix is followed by a sequence of additional octets
 so as to add up to the total MAC address length. For example, the
 IEEE assigns MA-S (MAC Address Block Small), where the first 4 1/2
 octets (36 bits) are assigned, giving the holder of the MA-S 1 1/2
 octets
 (12 bits) they can control in constructing 48-bit MAC addresses;
 other prefix lengths are also available [RAC_OUI].

   An AFN, a DNS RRTYPE, and a CBOR tag have been assigned for 48-bit
 MAC addresses as discussed in Sections 2.4, 5.3 and 5.9

   ~~The IEEE~~IEEE 802 describes ~~its~~ assignment procedures and policies for
   IEEE 802-related identifiers in [802_O&A]. ~~An IEEE tutorial on~~IEEE
   RA documentation on EUIs, OUIs, and CIDs is available at
   ~~[IEEEtutorial]~~[RAC_OUI].

2.1.1 Special First Octet Bits

   Four bits within the initial octet of an IEEE MAC interface
   identifier, such as an EUI-48, have special significance [802_O&A] as
   follows:

   M bit ---- This bit always indicates a group address and is
              frequently referred to as the <mark>group</mark> bit. If it is zero,
              the MAC address is unicast. If it is a one, the address is
              groupcast (multicast or broadcast). This meaning is
              independent of the values of the X, Y, and Z bits.

   X bit ---- This bit ~~was previously called the "local" bit~~ is also called
              the "universal/local" bit. If it is
              zero, the MAC address is a global address under the
              control of the owner of the IEEE assigned prefix.
              Previously, if it was a one, the MAC address was
              considered "local" and under the assignment and control of
              the local network operator (but see Section 2.3). If it is
              a one and if the IEEE 802 Structured Local Address Plan
              (SLAP) is in effect, the nature of the MAC address is
              optionally determined by the Y and Z bits as described
              below.

   Y&Z bits - These two bits have no special meaning if the X bit is
              zero. If the X bit is one then, if the IEEE 802 Structured
              Local Address Plan (SLAP) is in effect, these two bits
              divide the formerly uniform "local" MAC address space into
              four quadrants, as follows and further described below:

                   Y bit Z bit   Quadrant
                   ----- -----   -----------
                     0   0   Administratively Assigned
                     0   1   Extended Local

```
                1      0      Reserved
                1      1      Standard Assigned
```

While a local network administrator can assign any addresses with the
X bit a one, the optional SLAP characterizes the four quadrants of
the "local" address space using the Y and Z bits as follows:

   Administratively Assigned - MAC addresses in this quadrant are
            called Administratively Assigned Identifiers. This is
            intended for arbitrary local assignment, such as random
            assignment; however, see Section 2.3.1.

   Extended Local - MAC addresses in this quadrant are called Extended
            Local Identifiers. These addresses are not actually
            "local" under SLAP. They are available to the
            organization that has been assigned the CID (see Section
            2.1.2) specifying the other 20 bits of the 24-bit prefix
            with X, Y, and Z bits having the values 1, 0, and 1
            respectively.

   Reserved - MAC addresses in this quadrant are reserved for future
            use under the SLAP. Until such future use, they could be
            locally assigned as Administratively Assigned Identifiers
            are assigned but there is a danger that future SLAP use
            would conflict with such local assignments.

   Standard Assigned - MAC addresses in this quadrant are called
            Standard Assigned Identifiers (SAI). ~~It is intended that
            such addresses be assigned and possibly revoked through a
            local protocol.~~ An SAI is assigned by a protocol specified in an IEEE
            802 standard. [IEEE_O&A]. Both IEEE [802.1CQ] and the IETF
            [RFC8947] [RFC8948] have adopted such protocols.

2.1.2 OUIs and CIDs

   MA-L ~~(OUI)~~, MA-M, and MA-S MAC prefixes are assigned with the Local bit
   zero ~~and the Group bit unspecified. Multicast identifiers may be
   constructed by turning on the Group bit and unicast identifiers may be
   constructed by leaving the Group bit zero.~~ The assignee of an OUI is exclusively
   authorized to assign group MAC addresses, with I/G=1, by extending a modified version
   of the assigned OUI in which the M bit is set to 1 [RAC_OUI].

   The Local bit is zero for globally unique EUI-48 identifiers assigned
   by the owner of a MAC-L ~~(OUI)~~ or owner of a longer prefix. If the Local
   bit is a one, the identifier has historically been a local identifier
   under the control of the local network administrator; however, there are
   now recommendations on optional management of the local address space as
   discussed in Section 2.1.1. If the Local bit is a one, the holder of an
   OUI has no special authority over MAC identifiers whose first 3 octets
   correspond to their OUI or the beginning of their longer prefix.

A CID is a 24-bit Company Identifier. It is assigned for
organizations that need such an identifier, that can be used in
place of an OUI, but do not need to assign ~~subsidiary~~ global MAC
addresses. ~~A CID can be recognized by its X and Z bits having the
value 1 and its Y bit having the value 0 (see Figure 1).~~ A CID has
X and Z bits equal to 1 and its Y bit equal to 0 (see Figure 1).

An AFN and a CBOR tag have been assigned for OUI/CIDs as discussed
in Sections 2.4, 5.3 and 5.9

2.1.3 ~~EUI-48~~ Assignments under the IANA OUI

The OUI 00-00-5E has been assigned to IANA as stated in Section 1.4
above. This includes 2**24 ~~EUI-48~~ multicast identifiers from
01-00-5E-00-00-00 to 01-00-5E-FF-FF-FF and 2**24 EUI-48 unicast
identifiers from 00-00-5E-00-00-00 to 00-00-5E-FF-FF-FF.

Of these ~~EUI-48~~ identifiers, the sub-blocks reserved or thus far
assigned are as follows:

Unicast, all blocks of 2**8 addresses thus far:

  00-00-5E-00-00-00 through 00-00-5E-00-00-FF: reserved and require
     IESG Ratification for assignment (see Section 5.1).

  00-00-5E-00-01-00 through 00-00-5E-00-01-FF: assigned for the
     Virtual Router Redundancy Protocol (VRRP) [RFC5798].

  00-00-5E-00-02-00 through 00-00-5E-00-02-FF: assigned for the IPv6
     Virtual Router Redundancy Protocol (IPv6 VRRP) [RFC5798].

  00-00-5E-00-52-00 through 00-00-5E-00-52-FF: used for very small
     assignments. Currently, 4 out of these 256 values have been
     assigned.

  00-00-5E-00-53-00 through 00-00-5E-00-53-FF: assigned for use in
     documentation.

  00-00-5E-90-01-00 through 00-00-5E-90-01-FF: used for very small
     assignments that need parallel unicast and multicast MAC
     addresses. Currently 1 out of these 256 values has been
     assigned.

Multicast:

  01-00-5E-00-00-00 through 01-00-5E-7F-FF-FF: 2**23 addresses
     assigned for IPv4 multicast [RFC1112].

  01-00-5E-80-00-00 through 01-00-5E-8F-FF-FF: 2**20 addresses

assigned for MPLS multicast [RFC5332].

   01-00-5E-90-00-00 through 01-00-5E-90-00-FF: 2**8 addresses being
       used for very small assignments. Currently, 4 out of these 256
       values have been assigned.

   01-00-5E-90-01-00 through 01-00-5E-90-01-FF: used for very small
       assignments that need parallel unicast and multicast MAC
       addresses. Currently 1 out of these 256 values has been
       assigned.

   01-00-5E-90-10-00 through 01-00-5E-90-10-FF: 2**8 addresses for
       use in documentation.

For more detailed and up-to-date information, see the "Ethernet
Numbers" registry at http://www.iana.org.

2.1.4 ~~EUI-48~~ Documentation Values

The following values have been assigned for use in documentation:

   00-00-5E-00-53-00 through 00-00-5E-00-53-FF for unicast and

   01-00-5E-90-10-00 through 01-00-5E-90-10-FF for multicast.

2.1.5 ~~EUI-48~~ IANA Assignment Considerations

~~EUI-48~~ assignments under the current or a future IANA OUI (see
Section 5.6) must meet the following requirements:

   o must be for standards purposes (either for an IETF Standard or
      other standard related to IETF work),

   o must be for a power-of-two size block of identifiers starting
      at a boundary that is an equal or greater power of two,
      including the assignment of one (2**0) identifier,

   o must not be used to evade the requirement for network interface
      vendors to obtain their own block of identifiers from the IEEE,
      and

   o must be documented in an Internet-Draft or RFC.

In addition, approval must be obtained as follows (see the procedure
in Section 5.1):

Small to medium assignments of a block of 1, 2, 4, ..., 32768,
65536 (2**0, 2**1, 2**2, ..., 2**15, 2**16) ~~EUI-48~~ identifiers
require Expert Review (see Section 5.1).

Large assignments of 131072 (2**17) or more ~~EUI-48~~ identifiers
require IESG Ratification (see Section 5.1).

2.2 64-Bit MAC Identifiers

IEEE also defines a system of 64-bit MAC identifiers including
EUI-64s. EUI-64 identifiers are currently used as follows:

o In a modified form to construct some IPv6 interface identifiers
as described in Section 2.2.1

o In IEEE Std 1394 (also known as FireWire and i.Link)

o In IEEE Std 802.15.4 (also known as ZigBee)

o In [InfiniBand]

Adding a 5-octet (40-bit) extension to a 3-octet (24-bit) ~~OUI (MA-L),~~
assignment or a shorter extension to longer assigned prefixes [RAC_OUI]
so as to total 64 bits, produces an EUI-64 identifier under that OUI
or longer prefix. As with EUI-48 identifiers, the first octet has the
same special low order bits.

An AFN, a DNS RRTYPE, and CBOR tag have been assigned for 64-bit MAC
addresses as discussed in Sections 2.4, 5.3, and 5.9.

The discussion below is almost entirely in terms of the "Modified"
form of EUI-64 identifiers; however, anyone assigned such an
identifier can also use the unmodified form as a MAC identifier on any
link that uses such 64-bit identifiers for interfaces.

2.2.1. IPv6 Use of Modified EUI-64 Identifiers

MAC-64 identifiers are used to form the lower 64 bits of some IPv6
addresses (Section 2.5.1 and Appendix A of [RFC4291] and Appendix A
of [RFC5214]). When so used, the MAC-64 is modified by inverting the
X (Local/Global) bit to form an IETF "Modified EUI-64 identifier".
Below is an illustration of a Modified EUI-64 unicast identifier
under the IANA OUI, where aa-bb-cc-dd-ee is the extension.

02-00-5E-aa-bb-cc-dd-ee

The first octet is shown as 02 rather than 00 because, in Modified
EUI-64 identifiers, the sense of the X bit is inverted compared with
EUI-48 identifiers. It is the globally unique values (universal
scope) that have the 02 bit on in the first octet, while those with
this bit off are typically locally assigned and out of scope for
global assignment.

The X (Local/Global) bit was inverted to make it easier for network
operators to type in local-scope identifiers. Thus, such Modified
EUI-64 identifiers as 1, 2, etc. (ignoring leading zeros) are local.
Without the modification, they would have to be
02-00-00-00-00-00-00-01, 02-00-00-00-00-00-00-02, etc. to be local.

As with 48-bit MAC identifiers, the ~~01~~M-bit on in the first octet
indicates a group identifier (multicast or broadcast).

When the first two octets of the extension of a Modified EUI-64
identifier are FF-FE, the remainder of the extension is a 24-bit
value as assigned by the OUI owner for an EUI-48. For example:

    02-00-5E-FF-FE-yy-yy-yy
or
    03-00-5E-FF-FE-yy-yy-yy

where yy-yy-yy is the portion (of an EUI-48 global unicast or
multicast identifier) that is assigned by the OUI owner (IANA in this
case). Thus, any holder of one or more EUI-48 identifiers under the
IANA OUI also has an equal number of Modified EUI-64 identifiers that
can be formed by inserting FF-FE in the middle of their EUI-48
identifiers and inverting the Local/Global bit.

In addition, certain Modified EUI-64 identifiers under the IANA OUI
are reserved for holders of IPv4 addresses as follows:

    02-00-5E-FE-xx-xx-xx-xx

where xx-xx-xx-xx is a 32-bit IPv4 address. The owner of an IPv4
address has both a unicast- and multicast-derived EUI-64 address.
Modified EUI-64 identifiers from

    02-00-5E-FE-F0-00-00-00 to 02-00-5E-FE-FF-FF-FF-FF

are effectively reserved pending the specification of IPv4 "Class E"
addresses [RFC1112]. However, for Modified EUI-64 identifiers based
on an IPv4 address, the Local/Global bit should be set to correspond
to whether the IPv4 address is local or global. (Keep in mind that
the sense of the Modified EUI-64 identifier Local/Global bit is
reversed from that in (unmodified) MAC-64 identifiers.)

2.2.2 EUI-64 IANA Assignment Considerations

   The following table shows which Modified EUI-64 identifiers under the
   IANA OUI are reserved, assigned, or available as indicated. As noted
   above, the corresponding MAC addresses can be determined by
   complementing the 02 bit in the first octet. In all cases, the
   corresponding multicast 64-bit MAC addresses formed by complementing
   the 01 bit in the first octet have the same status as the modified
   64-bit unicast address blocks listed below.

      02-00-5E-00-00-00-00-00 to 02-00-5E-0F-FF-FF-FF-FF reserved

      02-00-5E-10-00-00-00-00 to 02-00-5E-10-00-00-00-FF assigned for
         documentation use

      02-00-5E-10-00-00-01-00 to 02-00-5E-EF-FF-FF-FF-FF available for
         assignment

      02-00-5E-F0-00-00-00-00 to 02-00-5E-FD-FF-FF-FF-FF reserved

      02-00-5E-FE-00-00-00-00 to 02-00-5E-FE-FF-FF-FF-FF assigned to
         IPv4 address holders as described above

      02-00-5E-FF-00-00-00-00 to 02-00-5E-FF-FD-FF-FF-FF reserved

      02-00-5E-FF-FE-00-00-00 to 02-00-5E-FF-FE-FF-FF-FF assigned for
         holders of EUI-48 identifiers under the IANA OUI as described
         above

      02-00-5E-FF-FF-00-00-00 to 02-00-5E-FF-FF-FF-FF-FF reserved

   The reserved identifiers above require IESG Ratification (see Section
   5.1) for assignment. IANA EUI-64 identifier assignments under the
   IANA OUI must meet the following requirements:

      o must be for standards purposes (either for an IETF Standard or
         other standard related to IETF work),

      o must be for a power-of-two size block of identifiers starting
         at a boundary that is an equal or greater power of two,
         including the assignment of one (2**0) identifier,

      o must not be used to evade the requirement for network interface
         vendors to obtain their own block of identifiers from the IEEE,
         and

      o must be documented in an Internet-Draft or RFC.

   In addition, approval must be obtained as follows (see the procedure
   in Section 5.1):

      Small to medium assignments of a block of 1, 2, 4, ..., 134217728,
         268435456 (2**0, 2**1, 2**2, ..., 2**27, 2**28) EUI-64
         identifiers require Expert Review (see Section 5.1).

      Large assignments of 536870912 (2**29) or more EUI-64 identifiers
         require IESG Ratification (see Section 5.1).

2.2.3 EUI-64 Documentation Values

   The following blocks of unmodified 64-bit MAC addresses are for
   documentation use. The IPv4-derived addresses are based on the IPv4
   documentation addresses [RFC5737], and the MAC-derived addresses are
   based on the EUI-48 documentation addresses above.

   Unicast values for Documentation Use:

      00-00-5E-EF-10-00-00-00 to 00-00-5E-EF-10-00-00-FF general

      00-00-5E-FE-C0-00-02-00 to 00-00-5E-FE-C0-00-02-FF and
      00-00-5E-FE-C6-33-64-00 to 00-00-5E-FE-C6-33-64-FF and
      00-00-5E-FE-CB-00-71-00 to 00-00-5E-FE-CB-00-71-FF IPv4 derived

      00-00-5E-FF-FE-00-53-00 to 00-00-5E-FF-FE-00-53-FF EUI-48 derived

      00-00-5E-FE-EA-C0-00-02 and
      00-00-5E-FE-EA-C6-33-64 and
      00-00-5E-FE-EA-CB-00-71 IPv4 multicast derived from IPv4 unicast
         [RFC6034]

   Multicast values for Documentation Use:

      01-00-5E-EF-10-00-00-00 to 01-00-5E-EF-10-00-00-FF general

      01-00-5E-FE-C0-00-02-00 to 01-00-5E-FE-C0-00-02-FF and
      01-00-5E-FE-C6-33-64-00 to 01-00-5E-FE-C6-33-64-FF and
      01-00-5E-FE-CB-00-71-00 to 01-00-5E-FE-CB-00-71-FF IPv4 derived

      01-00-5E-FE-EA-C0-00-02 and
      01-00-5E-FE-EA-C6-33-64 and
      01-00-5E-FE-EA-CB-00-71 IPv4 multicast derived from IPv4 unicast
         [RFC6034]

      01-00-5E-FF-FE-90-10-00 to 01-00-5E-FF-FE-90-10-FF EUI-48 derived

2.3 Other 48-bit MAC Identifiers Used by the IETF

   There are two other blocks of 48-bit MAC identifiers that are used by
   the IETF as described below.

2.3.1 Identifiers with a '33-33' Prefix

   All 48-bit multicast MAC identifiers prefixed "33-33" (that is, the
   2**32 multicast MAC identifiers in the range from 33-33-00-00-00-00
   to 33-33-FF-FF-FF-FF) are used as specified in [RFC2464] for IPv6
   multicast. In all of these identifiers, the Group bit (the bottom
   bit of the first octet) is on, as is required to work properly with
   existing hardware as a multicast identifier. They also have the
   Local bit on but any Ethernet using standard IPv6 multicast should
   note that these addresses will be used for that purpose. These
   multicast MAC addresses fall into the Administratively Assigned SLAP
   quadrant (see Section 2.1.1).

      Historical notes: It was the custom during IPv6 design to use "3"
      for unknown or example values and 3333 Coyote Hill Road, Palo
      Alto, California, is the address of PARC (Palo Alto Research
      Center, formerly "Xerox PARC"). Ethernet was originally specified
      by the Digital Equipment Corporation, Intel Corporation, and Xerox
      Corporation. The pre-IEEE [802.3] Ethernet protocol has sometimes
      been known as "DIX" Ethernet from the first letters of the names
      of these companies.

2.3.2 The 'CF Series'

   The Informational [RFC2153] declared the 3-octet values from CF-00-00
   through CF-FF-FF to be "OUIs" available for assignment by IANA to
   software vendors for use in PPP [RFC1661] or for other uses where
   vendors do not otherwise need an IEEE-assigned OUI. When used as
   48-bit MAC prefixes, these values have all of the Z, Y, X (Local),
   and M (Group) special bits at the bottom of the first octet equal to
   one, while all IEEE-assigned OUIs thus far have the X and M bits zero
   and all CIDs have bits Y and M zero; thus there can be no conflict
   between CF Series "OUI"s and IEEE assigned OUI/CIDs. Multicast MAC
   addresses constructed with a "CF" series OUI would fall into the
   standard assigned SLAP quadrant (see Section 2.1.1). The Group bit is
   meaningless in PPP. To quote [RFC2153]: "The 'CF0000' series was
   arbitrarily chosen to match the PPP NLPID 'CF', as a matter of
   mnemonic convenience." (For further information on NLPIDs, see
   [RFC6328].)

      CF-00-00 is reserved, and IANA lists multicast identifier

   CF-00-00-00-00-00 is used for Ethernet loopback tests.

   In over a decade of availability, only a handful of values in the CF
   Series have been assigned. (See "Ethernet Numbers"
   <http://www.iana.org/assignments/ethernet-numbers> and "PPP Numbers"
   <http://www.iana.org/assignments/ppp-numbers>).

2.3.2.1 Changes to RFC 2153

   The IANA Considerations in [RFC2153] were updated as follows by the
   approval of RFC 5342 and remain so updated (no technical changes have
   been made):

   o Use of these 'CF Series' identifiers based on IANA assignment
      was deprecated.

   o IANA was instructed not to assign any further values in the 'CF
      Series'.

2.4 CBOR Tags

   The Concise Binary Object Representation (CBOR [RFC8949]) is a data
   format whose design goals include the possibility of very small code
   size, fairly small message size, and extensibility. In CBOR, a data
   item can be enclosed by a CBOR tag to give it some additional
   semantics identified by that tag.

   IANA has assigned TBD1 as the CBOR tag to indicate a MAC address. The
   enclosed data item is a byte string. The length of the byte string
   indicates whether a 48-bit (6 byte) or 64-bit (8 byte) MAC address is
   encoded. Should some other multiple of 8 bits length MAC addresses be
   used in the future, such as a 128-bit (16 byte) MAC address, the TBD1
   tag will be used.

   IANA has assigned TDB2 as the CBOR tag to indicate an OUI, CID, or
   "CF" series organizational identifier. The enclosed data item is a
   byte string of length 3 to hold the 24-bit OUI or CID (see Section
   2.1.2).

3. Ethernet Protocol Parameters

   Ethernet protocol parameters provide a means of indicating the
   contents of a frame -- for example, that its contents are IPv4 or
   IPv6.

   There are two types of protocol identifier parameters that can occur
   in Ethernet frames after the initial MAC adddress destination and
   source identifiers:

   ~~Ethertypes~~EtherTypes: These are 16-bit identifiers appearing as the initial
      two octets after the MAC destination and source (or after a
      tag), which, when considered as an unsigned integer, are equal
      to or larger than 0x0600. (See Figure 2.) [802_O&A] specifies
      two ~~Ethertypes~~EtherTypes for local, experimental use: 0x88B5 and
      0x88B6.
   LSAPs: These are 8-bit protocol identifiers that occur in pairs
      immediately after an initial 16-bit (two-octet) remaining frame
      length, which is in turn after the MAC destination and source
      (or after a tag). Such a length must, when considered as an
      unsigned integer, be less than 0x5DC, or it could be
      mistaken as an ~~Ethertype.~~EtherType. LSAPs occur in pairs where
      one is intended to indicate the source protocol handler
      (SSAP) and one the destination protocol handler (DSAP);
      however, use cases where the two are different have been
      relatively rare. (See Figure 3 where the CTL field value of
      3 indicates datagram service.)

```
      0  1  2  3  4  5  6  7  0  1  2  3  4  5  6  7
   +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
   |  Source MAC Address                       ///
   +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
   |  Destination MAC Address                  ///
   +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
   | ~~Ethertype~~EtherType, greater than or equal to 0x0600   |
   +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
   |  Protocol Data                            ///
   +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```
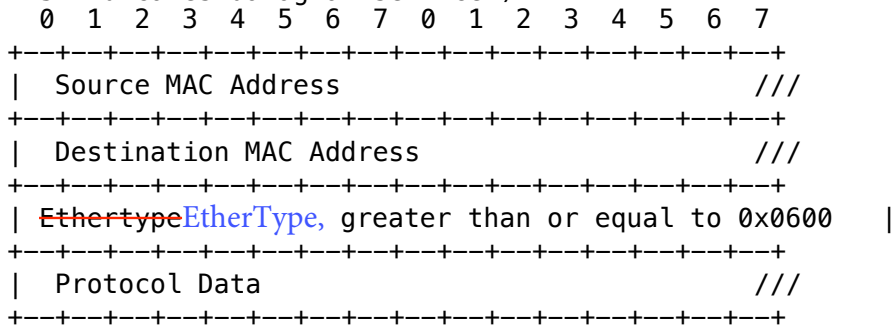
               Figure 2. ~~Ethertype~~EtherType Frame Protocol Labeling

```
  0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
 +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
 | Source MAC Address                        ///|
 +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
 | Destination MAC Address                   ///|
 +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
 | Frame length, less 0x5DC                     |
 +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
 | DSAP                | SSAP                    |
 +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
 | CTL = 3             | Protocol Data        ///|
 +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```
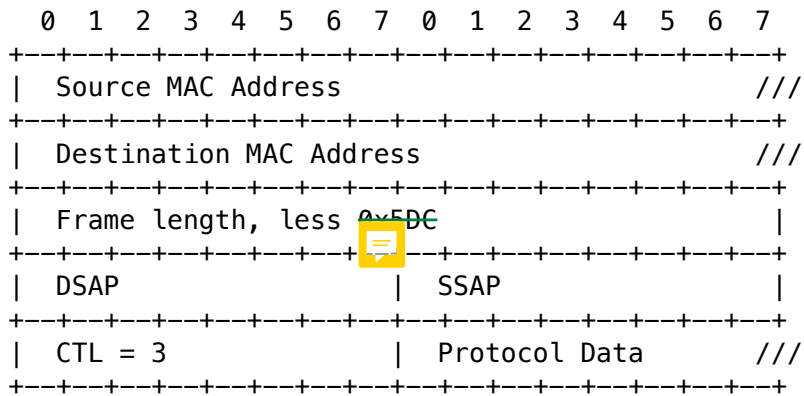
                 Figure 3. LSAP Frame Protocol Labeling

  The concept has been extended to labeling by Ethernet "tags". An Ethernet tag in this
sense is a prefix whose type is identified by an ~~Ethertype~~EtherType that is then followed
by either another tag, an ~~Ethertype~~EtherType, or an LSAP (Link–Layer Service Access Point)
protocol indicator for the "main" body of the frame, as described below. Traditionally,
in the [802_O&A] world, tags are a fixed length and do not include any encoding of their
own length. Any device that is processing a frame cannot, in general, safely process
anything in the frame past an ~~Ethertype~~EtherType it does not understand. An example is the
C–Tag (formerly the Q–Tag) [802.1Q]. It provides customer VLAN and priority information
for a frame.

  Neither ~~Ethertypes~~EtherTypes nor LSAPs are assigned by IANA; they are assigned by the IEEE
Registration Authority [IEEEregAuth] (see Section 1.3 above and Appendix B). However,
both LSAPs and ~~Ethertypes~~EtherTypes have extension mechanisms so that they can be used with
five–octet Ethernet protocol identifiers under an OUI, including those assigned by IANA
under the IANA OUI.

  When using the IEEE 802 Logical Link Control (LLC) format (Subnetwork Access Protocol
(SNAP)) [802_O&A] for a frame, an OUI–based protocol identifier can be expressed as
follows:

  xx–xx–AA–AA–03–yy–yy–yy–zz–zz

  where xx–xx is the frame length and, as above, must be small enough not to be confused
with an ~~Ethertype~~EtherType; "AA" is the LSAP that indicates this use and is sometimes
referred to as the SNAP Service Access Point (SNAP SAP); "03" is the LLC control octet
indicating datagram service; yy–yy–yy is an OUI; and zz–zz is a protocol number, under
that OUI, assigned by the OUI owner. ~~The five–octet length for such OUI–based protocol
identifiers was chosen so that, with the LLC control octet ("03"), the result is 16–bit
aligned.~~

When using an Ethertype to indicate the main type for a frame body,
the special "OUI Extended Ethertype" 88-B7 is available. Using this
Ethertype, a frame body can begin with

    88-B7-yy-yy-yy-zz-zz

where yy-yy-yy and zz-zz have the same meaning as in the SNAP format
described above.

It is also possible, within the SNAP format, to use an arbitrary
Ethertype. Putting the Ethertype as the zz-zz field after an all-
zeros OUI (00-00-00) does this. It looks like

    xx-xx-AA-AA-03-00-00-00-zz-zz

where zz-zz is the Ethertype.

(Note that, at this point, the 802 protocol syntax facilities are
sufficiently powerful that they could be chained indefinitely.
Whether support for such chaining is generally required is not
clear, but [802_O&A] requires support for

    xx-xx-AA-AA-03-00-00-00-88-B7-yy-yy-yy-zz-zz

although this could be more efficiently expressed by simply
pinching out the "00-00-00-88-B7" in the middle.)

As well as labeling frame contents, 802 protocol types appear within
NBMA (Non-Broadcast Multi-Access) Next Hop Resolution Protocol
[RFC2332] messages. Such messages have provisions for both two-octet
Ethertypes and OUI-based protocol types. 16-bit Ethertypes also occur
in the Generic Router Encapsulation (GRE [RFC2784]) header.

3.1 Ethernet Protocol Assignment under the IANA OUI

Two-octet protocol numbers under the IANA OUI are available, as in

    88-B7-00-00-05-qq-qq

or

    xx-xx-AA-AA-03-00-00-5E-qq-qq

where qq-qq is the protocol number.

A number of such assignments have been made out of the 2**16 protocol
numbers available from 00-00-5E-00-00 to 00-00-5E-FF-FF (see [IANA]).
The extreme values of this range, 00-00-5E-00-00 and 00-00-5E-FF-FF,

are reserved and require IESG Ratification for assignment (see
Section 5.1). New assignments of protocol numbers (qq-qq) under the
IANA OUI must meet the following requirements:

   o   the assignment must be for standards use (either for an IETF
       Standard or other standard related to IETF work),

   o   the protocol must include a version field at a fixed offset or
       an equivalent marking such that later version can be indicated
       in a way recognizable by earlier versions,

   o   it must be documented in an Internet-Draft or RFC, and

   o such protocol numbers are not to be assigned for any protocol
       that has an Ethertype. (Either that Ethertype can be used
       directly or, in the LSAPs case, using the SNAP SAP and putting
       an all-zeros "OUI" before the Ethertype as described above.)

   In addition, the Expert Review (or IESG Ratification for the two
   reserved values) must be obtained using the procedure specified in
   Section 5.1.

3.2 Documentation Protocol Number

   0x0042 is a protocol number under the IANA OUI (that is,
   00-00-5E-00-42) to be used as an example for documentation purposes.

4. Other OUI-Based Parameters

Some IEEE 802 and other protocols provide for parameters based on an OUI beyond those discussed above. Such parameters commonly consist of an OUI plus one octet of additional value. They are ~~usually~~ called "Organizationally-Specific" ~~"vendor specific" parameters, although "organization specific" might be more accurate~~. They would look like

     yy-yy-yy-zz

where yy-yy-yy is the OUI and zz is the additional specifier. An example is the Cipher Suite Selector in IEEE [802.11].

Values may be assigned under the IANA OUI for such other OUI-based parameter usage by Expert Review except that, for each use, the additional specifier values consisting of all zero bits and all one bits (0x00 (00-00-5E-00) and 0xFF (00-00-5E-FF) for a one-octet specifier) are reserved and require IESG Ratification (see Section 5.1) for assignment; also, the additional specifier value 0x42 (00-00-5E-42) is assigned for use as an example in documentation.

Assignments of such other IANA OUI-based parameters must be for standards use (either for an IETF Standard or other standard related to IETF work) and be documented in an Internet-Draft or RFC. The first time a value is assigned for a particular parameter of this type, an IANA registry will be created to contain that assignment and any subsequent assignments of values for that parameter under the IANA OUI. The Expert may specify the name of the registry.

If different policies from those above are required for such a parameter, a BCP or Standards Track RFC should be adopted to update this BCP and specify the new policy and parameter.

4.1 LLDP IETF ~~Vendor~~ Organizationally-Specific TLV Type

An example of such an "other IANA OUI based parameter" is specified in [RFC8520]. This provides for a ~~"vendor based"~~ Organizationally-Specific TLV type for announcing a Manufacturer Usage Description (MUD) Uniform Resource Locator (URL) in the IEEE Link Local Discover Protocol (LLDP [802.1AB]). Additional IETF use of code points in this space have been proposed [BGPlldp]. (See also Section 5.8.)

5. IANA Considerations

   This document concerns IANA considerations for the assignment of
   Ethernet parameters in connection with the IANA OUI and related
   matters.

      Note: The "IETF OUI Ethernet Numbers" IANA web page is for
      registries of numbers assigned under the IANA OUI while the "IEEE
      802 Numbers" IANA web page has Informational lists of numbers
      assigned by the IEEE Registration Authority.

   This document does not create any new IANA registries.

   The MAC address values assigned for documentation and the protocol
   number for documentation were both assigned by [RFC7042].

   No existing assignment is changed by this document.

5.1 Expert Review and IESG Ratification

   This section specifies the procedure for Expert Review and IESG
   Ratification of MAC, protocol, and other IANA OUI-based identifiers.
   The Expert(s) referred to in this document shall consist of one or
   more persons appointed by and serving at the pleasure of the IESG.

   The procedure described for Expert Review assignments in this
   document is consistent with the IANA Expert Review policy described
   in [RFC8126].

   While finite, the universe of MAC code points from which Expert-
   judged assignments will be made is felt to be large enough that the
   requirements given in this document and the Experts' good judgment
   are sufficient guidance. The idea is for the Expert to provide a
   light sanity check for small assignments of EUI identifiers, with
   increased scrutiny by the Expert for medium-sized assignments of EUI
   identifiers and assignments of protocol identifiers and other IANA
   OUI-based parameters. However, it can make sense to assign very
   large portions of the MAC identifier code point space. (Note that
   existing assignments include one for 1/2 of the entire multicast IANA
   EUI-48 code point space and one for 1/16 of that multicast code point
   space.) In those cases, and in cases of the assignment of "reserved"
   values, IESG Ratification of an Expert Review approval recommendation
   is required as described below. The procedure is as follows:

      The applicant always completes the appropriate template from
         Appendix A below and sends it to IANA <iana@iana.org>.

IANA always sends the template to an appointed Expert. If the
Expert recuses themselves or is non-responsive, IANA may choose
an alternative appointed Expert or, if none is available, will
contact the IESG.

In all cases, if IANA receives a disapproval from an Expert
selected to review an application template, the application
will be denied. The Expert should provide a reason for refusal
which IANA will communicate back to the applicant.

If the assignment is based on Expert Review:

If IANA receives approval and code points are available,
IANA will make the requested assignment.

If the assignment is based on IESG Ratification:

The procedure starts with the first steps above for Expert
Review. If the Expert disapproves the application, they
simply inform IANA who in turn informs the applicant that
their request is denied; however, if the Expert believes the
application should be approved, or is uncertain and believes
that the circumstances warrant the attention of the IESG,
the Expert will inform IANA about their advice, and IANA
will forward the application, together with the reasons
provided by the Expert for approval or uncertainty, to the
IESG. The IESG must decide whether the assignment will be
granted. This can be accomplished by a management item in
an IESG telechat as is done for other types of requests. If
the IESG decides not to ratify a favorable opinion by the
Expert or decides against an application where the Expert is
uncertain, the application is denied; otherwise, it is
granted. The IESG will communicate its decision to the
Expert and to IANA. In case of refusal, the IESG should
provide a reason which IANA will communicate to the
applicant.

5.2 IANA Web Page Changes

For clarity and parallelism with the IANA "IEEE 802 Numbers" web
page, the IANA "Ethernet Numbers" web page is re-named the "IANA OUI
Ethernet Numbers" web page.

As this document replaces [RFC7042], references to [RFC7042] in IANA
registries on both the IANA IEEE 802 Numbers web page and the IANA
IETF OUI Ethernet Numbers web pages will be replaced by references to
[this document]. Other IANA web page references to [RFC7042] are not
changed.

5.3 MAC Address AFNs and RRTYPEs

   IANA has assigned Address Family Numbers (AFNs) for MAC addresses as
   follows:

           AFN   Decimal   Hex   Reference
         ----------   -------   ------   ---------
         48-bit MAC   16389   0x4005   [RFC7042]
         64-bit MAC   16390   0x4006   [RFC7042]
         24-bit OUI   16391   0x4007   [RFC7961]

         MAC/24   16392   0x4008   [RFC7961]
            Lower 24 bits of a 48-bit MAC address

         MAC/40   16393   0x4009   [RFC7961]
            Lower 40 bits of a 64-bit MAC address

   IANA has assigned DNS RRTYPEs [RFC6895] for MAC addresses as follows:

                               RRTYPE Code
          Data   Mnemonic Decimal   Hex   Reference
        ----------   -------- ------- ------   -----------
        48-bit MAC   EUI48   108   0x006C   [RFC7043]
        64-bit MAC   EUI64   109   0x006D   [RFC7043]

5.4 Informational IANA Web Page Material

   IANA maintains an informational listing on its web site concerning
   Ethertypes, OUIs, and multicast addresses assigned under OUIs other
   than the IANA OUI. The title of this informational registry is "IEEE
   802 Numbers". IANA will update that informational registry when
   changes are provided by or approved by the Expert(s).

5.5 Ethertype Assignment Process

   Applying to the IEEE Registration Authority for an Ethertype needed
   by an IETF protocol ~~is a fairly simple clerical process but~~ requires
   IESG approval as stated in Appendix B. To minimize confusion, this
   proces will normally be done by the primary expert for the
   informational IANA 802 Numbers Ethertype registry (see Section 5.2).

   After IESG approval of the protocol requiring an Ethertype, the IESG
   should refer the matter to IANA. In any case, IANA will ask the IANA
   IEEE 802 Numbers Ethertype registry to execute the IEEE Ethertype
   assignment request process.

5.6 OUI Exhaustion

   When the available space for either multicast or unicast EUI-48
   identifiers under OUI 00-00-5E has been 90% or more exhausted, IANA
   should request an additional OUI from the IEEE Registration Authority
   for further IANA assignment. The appointed Expert(s) should monitor
   for this condition and notify IANA.

5.7 IANA OUI MAC Address Table

   No changes are made by this document to the "IANA Unicast 48-bit MAC
   Addresses" and "IANA Multicast 48-bit MAC Addresses" tables except
   for the updates to references as specified in Section 5.2.

5.8 IANA LLDP TLV Subtypes

   IANA is requested to move the "IANA Link Layer Discovery Protocol
   (LLDP) TLV Subtypes" Registry from the IANA IEEE 802 Numbers web page
   to the IANA OUI Ethernet Numbers web page, since code points within
   it are assigned by IANA, and to add [this document] as an additional
   reference for that registry.

   In addition, IANA is requested to update three entries in that
   Registry as follows:

Value	Description	Reference
0	Reserved	[this document]
42	Example for use in documentation	[this document]
255	Reserved	[this document]

   The entries for 1 (MUD), 2-41 (unassigned), and 43-254 (unassigned)
   are unchanged.

5.9 CBOR Tag Assignments

   IANA is requested to assign two CBOR Tags as shown below:. [The
   values of 48 and 49 are requested for TBD1 and TBD2 respectively.]

Tag	Data Item	Semantics	Reference
TBD1	byte string	IEEE MAC Address	[this document]
TBD2	byte string	IEEE OUI/CID	[this document]

6. Security Considerations

This document is concerned with assignment of IEEE 802 parameters allocated to IANA, particularly those under the IANA OUI, and closely related matters. It is not directly concerned with security except as follows:

Confusion and conflict can be caused by the use of MAC addresses or other OUI-derived protocol parameters as examples in documentation. Examples that are "only" to be used in documentation can end up being coded and released or cause conflicts due to later real use and the possible acquisition of intellectual property rights in such addresses or parameters. The reservation herein of MAC addresses and parameters for documentation purposes will minimize such confusion and conflict.

See [RFC7043] for security considerations on storing MAC addresses in the DNS.

7. Acknowledgements

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   Carsten Bormann

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   David Black, Adrian Farrel, Bob Grow, Joel Jaeggli, Pearl
   Liang, Glenn Parsons, Pete Resnick, and Dan Romascanu.

Normative References

   [802_O&A] - "IEEE Standard for Local and Metropolitan Area Networks:
        Overview and Architecture", IEEE Std 802~2014, 12 June 2014~.

        "~Standard for Local and Metropolitan Area Networks: Overview
        and Architecture - Draft Amendment: Local Medium Access Control
        (MAC) Address Usage", IEEE 802c, Draft 2.2, April 2017.~

   [RFC8126] - Cotton, M., Leiba, B., and T. Narten, "Guidelines for
        Writing an IANA Considerations Section in RFCs", BCP 26, RFC
        8126, DOI 10.17487/RFC8126, June 2017, <https://www.rfc-
        editor.org/info/rfc8126>.

Informative References

   [802.1AB] - IEEE 802, "IEEE Standard for Local and metropolitan area
         networks: Station and Media Access Control
         Connectivity Discovery", IEEE Std. 802.1AB-2016, 29
         January 2016. Including any approved amendments and revisions.
   [802.1CQ] - IEEE 802, "Standard for Local and Metropolitan Area
         Networks: Multicast and Local Address Assignment", ~IEEE
         802.1CQ, work in progress.~ IEEE P802.1CQ/D0.8, 2022

   [802.1Q] - "IEEE Standard for Local and metropolitan area networks /
        Media Access Control (MAC) Bridges and Virtual Bridge Local
        Area Networks", IEEE Std 802.1Q~2011, 31 August 2011.~

   [802.3] - "IEEE Standard for Ethernet", IEEE Std 802.3~2012, 28
        December 2012~.

   [802.11] - "IEEE Standard for Information technology /
        Telecommunications and information exchange between systems /
        Local and metropolitan area networks / Specific requirements /
        Part 11: Wireless LAN Medium Access Control (MAC) and Physical
        Layer (PHY) Specifications", IEEE Std 802.11~2012, 29 March
        2012~.

   [BGPlldp] - Lindem, A., K. Patel, S. Zandi, J. Haas, X. Xu, "BGP
        Logical Link Discovery Protocol (LLDP) Peer Discovery",
        draft-acee-idr-lldp-peer-discovery, work in progress, February
        2022.

   [IANA] - Internet Assigned Numbers Authority, <http://www.iana.org>.

   [IEEE802] - IEEE 802 LAN/MAN Standards Committee,
        <http://www.ieee802.org>.

    [IEEEregAuth] - IEEE Standards Association Registration Authority
         <http://standards.ieee.org/regauth/>.

    [IEEEtutorials] -
         <https://standards.ieee.org/products-programs/regauth/tut/>

    [IEEEtutorial] - IEEE, "Guidelines for Use of Extended Unique
         Identifier (EUI), Organizationally Unique Identifier (OUI), and
         Company ID (CID)",
             <https://standards.ieee.org/content/dam/ieee-
         standards/standards/web/documents/tutorials/eui.pdf>, 3 August
         2017.

    [InfiniBand] - InfiniBand Trade Association, "InfiniBand Architecture
         Specification Volume 1", November 2007.

    [RAC_OUI] - Parsons, G., "OUI Registry Restructuring",
         draft-ieee-rac-oui-restructuring-01.txt, work in Progress,
         September 2013.

    [RFC1112] - Deering, S., "Host extensions for IP multicasting", STD
         5, RFC 1112, DOI 10.17487/RFC1112, August 1989,
         <https://www.rfc-editor.org/info/rfc1112>.

    [RFC1661] - Simpson, W., Ed., "The Point-to-Point Protocol (PPP)",
         STD 51, RFC 1661, DOI 10.17487/RFC1661, July 1994,
         <https://www.rfc-editor.org/info/rfc1661>.

    [RFC2153] - Simpson, W., "PPP Vendor Extensions", RFC 2153, DOI
         10.17487/RFC2153, May 1997, <https://www.rfc-
         editor.org/info/rfc2153>.

    [RFC2332] - Luciani, J., Katz, D., Piscitello, D., Cole, B., and N.
         Doraswamy, "NBMA Next Hop Resolution Protocol (NHRP)", RFC
         2332, DOI 10.17487/RFC2332, April 1998, <https://www.rfc-
         editor.org/info/rfc2332>.

    [RFC2464] - Crawford, M., "Transmission of IPv6 Packets over Ethernet
         Networks", RFC 2464, DOI 10.17487/RFC2464, December 1998,
         <https://www.rfc-editor.org/info/rfc2464>.

    [RFC2606] - Eastlake 3rd, D. and A. Panitz, "Reserved Top Level DNS
         Names", BCP 32, RFC 2606, DOI 10.17487/RFC2606, June 1999,
         <https://www.rfc-editor.org/info/rfc2606>.

    [RFC2784] - Farinacci, D., Li, T., Hanks, S., Meyer, D., and P.
         Traina, "Generic Routing Encapsulation (GRE)", RFC 2784, DOI
         10.17487/RFC2784, March 2000, <https://www.rfc-
         editor.org/info/rfc2784>.

   [RFC3092] - Eastlake 3rd, D., Manros, C., and E. Raymond, "Etymology
        of "Foo"", RFC 3092, DOI 10.17487/RFC3092, April 1 2001,
        <https://www.rfc-editor.org/info/rfc3092>.

   [RFC4291] - Hinden, R. and S. Deering, "IP Version 6 Addressing
        Architecture", RFC 4291, DOI 10.17487/RFC4291, February 2006,
        <https://www.rfc-editor.org/info/rfc4291>.

   [RFC4760] - Bates, T., Chandra, R., Katz, D., and Y. Rekhter,
        "Multiprotocol Extensions for BGP-4", RFC 4760, DOI
        10.17487/RFC4760, January 2007, <https://www.rfc-
        editor.org/info/rfc4760>.

   [RFC5214] - Templin, F., Gleeson, T., and D. Thaler, "Intra-Site
        Automatic Tunnel Addressing Protocol (ISATAP)", RFC 5214, DOI
        10.17487/RFC5214, March 2008, <https://www.rfc-
        editor.org/info/rfc5214>.

   [RFC5332] - Eckert, T., Rosen, E., Ed., Aggarwal, R., and Y. Rekhter,
        "MPLS Multicast Encapsulations", RFC 5332, DOI
        10.17487/RFC5332, August 2008, <https://www.rfc-
        editor.org/info/rfc5332>.

   [RFC5737] - Arkko, J., Cotton, M., and L. Vegoda, "IPv4 Address
        Blocks Reserved for Documentation", RFC 5737, DOI
        10.17487/RFC5737, January 2010, <https://www.rfc-
        editor.org/info/rfc5737>.

   [RFC5798] - Nadas, S., Ed., "Virtual Router Redundancy Protocol
        (VRRP) Version 3 for IPv4 and IPv6", RFC 5798, DOI
        10.17487/RFC5798, March 2010, <https://www.rfc-
        editor.org/info/rfc5798>.

   [RFC6034] - Thaler, D., "Unicast-Prefix-Based IPv4 Multicast
        Addresses", RFC 6034, DOI 10.17487/RFC6034, October 2010,
        <https://www.rfc-editor.org/info/rfc6034>.

   [RFC6328] - Eastlake 3rd, D., "IANA Considerations for Network Layer
        Protocol Identifiers", BCP 164, RFC 6328, DOI 10.17487/RFC6328,
        July 2011, <https://www.rfc-editor.org/info/rfc6328>

   [RFC6895] - EEastlake 3rd, D., "Domain Name System (DNS) IANA
        Considerations", BCP 42, RFC 6895, DOI 10.17487/RFC6895, April
        2013, <https://www.rfc-editor.org/info/rfc6895>.

   [RFC7042] - Eastlake 3rd, D. and J. Abley, "IANA Considerations and
        IETF Protocol and Documentation Usage for IEEE 802 Parameters",
        BCP 141, RFC 7042, DOI 10.17487/RFC7042, October 2013,
        <http://www.rfc-editor.org/info/rfc7042>.

[RFC7043] - Abley, J., "Resource Records for EUI-48 and EUI-64
        Addresses in the DNS", RFC 7043, DOI 10.17487/RFC7043, October
        2013, <https://www.rfc-editor.org/info/rfc7043>.

[RFC7319] - Eastlake 3rd, D., "IANA Considerations for Connectivity
        Fault Management (CFM) Code Points", BCP 191, RFC 7319, DOI
        10.17487/RFC7319, July 2014, <https://www.rfc-
        editor.org/info/rfc7319>.

[RFC7961] - Eastlake 3rd, D. and L. Yizhou, "Transparent
        Interconnection of Lots of Links (TRILL): Interface Addresses
        APPsub-TLV", RFC 7961, DOI 10.17487/RFC7961, August 2016,
        <https://www.rfc-editor.org/info/rfc7961>.

[RFC8520] - Lear, E., Droms, R., and D. Romascanu, "Manufacturer
        Usage Description Specification", RFC 8520, DOI
        10.17487/RFC8520, March 2019, <https://www.rfc-
        editor.org/info/rfc8520>.

[RFC8947] - Volz, B., Mrugalski, T., and C. Bernardos, "Link-Layer
        Address Assignment Mechanism for DHCPv6", RFC 8947, DOI
        10.17487/RFC8947, December 2020, <https://www.rfc-
        editor.org/info/rfc8947>.

[RFC8948] - Bernardos, CJ. and A. Mourad, "Structured Local Address
        Plan (SLAP) Quadrant Selection Option for DHCPv6", RFC 8948,
        DOI 10.17487/RFC8948, December 2020, <https://www.rfc-
        editor.org/info/rfc8948>.

[RFC8949] - | Bormann, C. and P. Hoffman, "Concise Binary Object
        Representation (CBOR)", STD 94, RFC 8949, DOI 10.17487/RFC8949,
        December 2020, <https://www.rfc-editor.org/info/rfc8949>.

Appendix A. Templates

   This appendix provides the specific templates for IANA assignments of
   parameters. Explanatory words in parentheses in the templates below
   may be deleted in a completed template as submitted to IANA.

A.1 EUI-48/EUI-64 Identifier or Identifier Block Template

   Applicant Name:

   Applicant Email:

   Applicant Telephone: (starting with country code)

   Use Name: (brief name of Parameter use such as "Foo Protocol"
   [RFC3092])

   Document: (ID or RFC specifying use to which the identifier or block
   of identifiers will be put.)

   Specify whether this is an application for EUI-48 or EUI-64
   identifiers:

   Size of Block requested: (must be a power-of-two-sized block, can be
   a block of size one (2**0))

   Specify multicast, unicast, or both:

A.2 IANA OUI/CID-Based Protocol Number Template

   Applicant Name:

   Applicant Email:

   Applicant Telephone: (starting with country code)

   Use Name: (brief name of use of code point such as "Foo Protocol")

   Document: (ID or RFC specifying use to which the protocol identifier
   will be put.)

   Note: (any additional note)

A.3 Other IANA OUI/CID-Based Parameter Template

   Applicant Name:

   Applicant Email:

   Applicant Telephone: (starting with country code)

   Protocol where the OUI/CID-Based Parameter for which a value is being
   requested appears: (such as: Cipher Suite selection in IEEE 802.11)

   Use Name: (brief name of use of code point to be assigned, such as
   "Foo Cipher Suite" [RFC3092])

   Document: (ID or RFC specifying use to which the other IANA OUI-based
   parameter value will be put.)

   Note: (any additional note)

Appendix B. Ethertypes

   This appendix provides a copy of the IESG Statement issued in October
   2012 on obtaining new IETF Ethertypes in Section B.1. Note that there
   is an informational list on the IANA web site of some important
   Ethertypes specified for IETF protocols or by IEEE 802 available,
   currently at [IANA]. The IEEE Registration Authority page of
   Ethertypes, http://standards.ieee.org/regauth/ethertype/eth.txt, may
   also be useful. See Section 3 above.

B.1 IESG Statement on Ethertypes

   From: IESG Date: 25 October 2012

   The IEEE Registration Authority (IEEE RA) assigns Ethertypes with
   oversight from the IEEE Registration Authority Committee (IEEE RAC).

   (See http://standards.ieee.org/develop/regauth/ethertype/.) Some IETF
   protocol specifications make use of Ethertypes. All Ethertype
   requests are subject to review by a consultant to the IEEE RA
   followed by IEEE RAC confirmation.

   Since Ethertypes are a fairly scarce resource, the IEEE RAC has let
   us know that they will not assign a new Ethertype to a new IETF
   protocol specification until the IESG has approved the protocol
   specification for publication as an RFC. In exceptional cases, the
   IEEE RA is willing to consider "early allocation" of an Ethertype for
   an IETF protocol that is still under development as long as the
   request comes from and has been vetted by the IESG.

   To let the IEEE RAC know that the IESG has approved the request for
   an Ethernet assignment for an IETF protocol, all future requests for
   assignment of Ethertypes for IETF protocols will be made by the IESG.

   Note that playpen Ethertypes have been assigned in IEEE 802 [1] for
   use during protocol development and experimentation.

   [1] IEEE Std 802a-2003 (Amendment to IEEE Std 802-2001). IEEE
       standard for Local and Metropolitan Area Networks: Overview and
       Architecture -- Amendment 1: Ethertypes for Prototype and Vendor-
       Specific Protocol Development.

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