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IANA Considerations and IETF Protocol Usage 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 some use of such parameters in IETF protocols and specifies IANA considerations for allocation of code points under the IANA OUI (Organizationally Unique Identifier).

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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) identifiers and protocol identifiers.

This document specifies IANA considerations for the allocation of code points under the IANA OUI. It also discusses some other IETF use of IEEE 802 code points.

[RFC5226] is incorporated herein except where there are contrary provisions in this document.

1.1. Notations Used 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 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:

"IAB" stands for Individual Address Block, not for Internet Architecture Board;

"MAC" stands for Media Access Control, not for Message Authentication Code; and

"OUI" stands for Organizationally Unique Identifier.

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

1.2. The IEEE Registration Authority

Originally the responsibility of Xerox Corporation, the registration authority for Ethernet parameters is now the IEEE Registration Authority, available on the web at:

http://standards.ieee.org/regauth/

Anyone may apply to that Authority for parameters. They may impose fees or other requirements but commonly waive fees for applications from standards development organizations.

A list of some allocated OUIs and IABs and their holders is downloadable from the IEEE Registration Authority site.

1.2.1. The IANA OUI

The OUI 00-00-5E has been allocated to IANA.

1.3. Acknowledgements

The contributions and support of the following people, listed in alphabetic order, is gratefully acknowledged:

Bernard Aboba, Scott O. Bradner, Ian Calder, Michelle Cotton, Lars Eggert, Eric Gray, Alfred Hoenes, Russ Housley, Charlie Kaufman, Erik Nordmark, Dan Romascanu, Mark Townsley, and Geoff Thompson.

2. Ethernet Identifier Parameters

Section 2.1 discusses EUI-48 (Extended Unique Identifier 48) MAC identifiers, their relationship to OUIs and IABs, and allocations under the IANA OUI. Section 2.2 extends this to EUI-64 identifiers. Section 2.3 discusses other IETF MAC identifier use not under the IANA OUI.

2.1. 48-Bit MAC Identifiers and OUIs

48-bit MAC "addresses" are the most commonly used Ethernet interface identifiers. Those that are globally unique are also called EUI-48 identifiers. An EUI-48 is structured into an initial 3-octet OUI (Organizationally Unique Identifier) and an additional 3 octets assigned by the OUI holder. For organizations not requiring 3 octets' worth of identifiers, the IEEE allocates IABs (Individual Address Blocks) instead, where the first 4 1/2 octets (36 bits) are assigned, giving the holder of the IAB 1 1/2 octets (12 bits) they can control.

The IEEE describes its assignment procedures and policies for IEEE 802 related identifiers in [802_O&A].

Two bits within the initial 3 octets of an EUI-48 have special significance: the Group bit (01-00-00) and the Local bit (02-00-00). OUIs and IABs are allocated with the Local bit zero and the Group bit unspecified. Multicast identifiers may be constructed by turning on the Group bit, and unicast identifiers constructed by leaving the Group bit zero.

For globally unique EUI-48 identifiers allocated by an OUI or IAB owner, the Local bit is zero. If the Local bit is a one, the identifier is considered by IEEE 802 to be a local identifier under the control of the local network administrator. If the Local bit is on, the holder of an OUI (or IAB) has no special authority over 48-bit MAC identifiers whose first 3 (or 4 1/2) octets correspond to their OUI (or IAB).

2.1.1. EUI-48 Allocations under the IANA OUI

The OUI 00-00-5E has been assigned to IANA as stated in Section 1.2.1 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 following allocations have been made thus far:

- The 2**23 multicast identifiers from 01-00-5E-00-00-00 through 01-00-5E-7F-FF-FF have been allocated for IPv4 multicast [RFC1112].
- The 2**20 multicast identifiers from 01-00-5E-80-00-00 through 01-00-5E-8F-FF-FF have been allocated for MPLS multicast [RFC5332].
- The 2**8 unicast identifiers from 00-00-5E-00-00-00 through 00-00-5E-00-00-FF are reserved and require IESG Ratification for allocation (see Section 5.1).
- The 2**8 unicast identifiers from 00-00-5E-00-01-00 through 00-00-5E-00-01-FF have been allocated for the Virtual Router Redundancy Protocol (VRRP) [RFC3768].

2.1.2. EUI-48 IANA Allocation Considerations

EUI-48 allocations under the current or a future IANA OUI (see Section 5.2) must meet the following requirements:

- must be for standards purposes (either for an IETF Standard or other standard related to IETF work),
- must be for a block of a power-of-two identifiers starting at a boundary that is an equal or greater power of two, including the allocation of one (2**0) identifier,
- must not be used to evade the requirement for vendors to obtain their own block of identifiers from the IEEE, and

- 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 allocations 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.

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

To simplify record keeping, all future allocations of 256 (2**8) or fewer identifiers shall have the Group bit unspecified, that is, shall be allocations of parallel equal-size blocks of multicast and unicast identifiers, even if one of these two types is not needed for the proposed use. The only exception is that requests for unicast-only identifier blocks of any size may be allocated out of the remaining identifiers in the large unicast range from 00-00-5E-00-02-00 to 00-00-5E-8F-FF-FF.

2.2. 64-Bit MAC Identifiers

IEEE also defines a system of 64-bit MAC identifiers including EUI-64s. Uptake of these "MAC-64" identifiers has been limited. They are currently used in constructing some IPv6 Interface Identifiers as described below and by the following IEEE standards:

- IEEE 1394 (also known as FireWire and i.Link),
- IEEE 802.15.4 (also known as ZigBee).

Adding a 5-octet (40-bit) extension to a 3-octet (24-bit) OUI forms an EUI-64 identifier under that OUI. As with EUI-48 identifiers, the OUI has the same Group/unicast and Local/Global bits.

The discussion below is almost entirely in terms of the "Modified" form of EUI-64 identifiers; however, anyone allocated such an identifier also has the unmodified form and may use it 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 Local/Global bit to form an IETF "Modified EUI-64 identifier". Below

is an illustration of a Modified EUI-64 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 Local/Global 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 locally assigned and out of scope for global allocation.

The 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 MAC-48 identifiers, the 01 bit on in the first octet indicates a group identifier.

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.

(Note: [EUI-64] defines FF-FF as the bits to be inserted to create an IEEE EUI-64 identifier from a MAC-48 identifier. That document says the FF-FE value is used when starting with an EUI-48 identifier. The IETF uses only FF-FE to create Modified EUI-64 identifiers from 48-bit Ethernet station identifiers regardless of whether they are EUI-48 or MAC-48 local identifiers. EUI-48 and local MAC-48 identifiers are syntactically equivalent, and this doesn’t cause any problems in practice.)

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. 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 Allocation Considerations

The following table shows which Modified EUI-64 identifiers under the IANA OUI are reserved, used, or available as indicated.

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-EF-FF-FF-FF-FF available for allocation

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 used by 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 used by 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 allocation. IANA EUI-64 identifier allocations under the IANA OUI must meet the following requirements:

- must be for standards purposes (either for an IETF Standard or other standard related to IETF work),
- must be for a block of a power-of-two identifiers starting at a boundary which is an equal or greater power of two, including the allocation of one (2**0) identifier,
- must not be used to evade the requirement for vendors to obtain their own block of identifiers from the IEEE, and

- 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 allocations 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.

Allocations of any size, including 536870912 (2**29) or more EUI-64 identifiers, may be made with IESG Ratification (see Section 5.1).

To simplify record keeping, all allocations of 65536 (2**16) or less EUI-64 identifiers shall have the Group bit unspecified, that is, shall be allocations of parallel equal size blocks of multicast and unicast identifiers, even if one of these two types is not needed for the proposed use.

2.3. Other MAC-48 Identifiers Used by IETF

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

2.3.1. Identifiers Prefixed 33-33

All MAC-48 multicast 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 by the IETF for global IPv6 multicast [RFC2464]. In all 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 and are used for this purpose in IPv6 networks.

(Historical note: 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 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 allocation by IANA to software vendors for use in PPP [RFC1661] or for other uses where vendors do not otherwise need an IEEE-assigned OUI. It should be noted that, when used as MAC-48 prefixes, these values have the Local and Group bits on, while all IEEE-allocated OUIs have those bits off. 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."

CF-00-00 is reserved, and IANA lists multicast identifier CF-00-00-00-00-00 as used for Ethernet loopback tests.

In over a decade of availability, only a handful of values in the 'CF Series' have been allocated. (See http://www.iana.org under both Ethernet Parameters and PPP Parameters.)

2.3.2.1. Changes to RFC 2153

The IANA Considerations in [RFC2153] are updated as follows (no technical changes are made): Use of these identifiers based on IANA allocation is deprecated. IANA is directed not to allocate any further values in the 'CF Series'.

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.

The concept has been extended to labeling by "tags". A tag in this sense is a prefix whose type is identified by an Ethertype that is then followed by either another tag, an Ethertype, or an LSAP protocol indicator for the "main" body of the frame, as described below. Traditionally in the [802_O&A] world, tags are fixed length and do not include any encoding of their own length. Thus, anything that is processing a frame cannot, in general, safely process anything in the frame past an 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.

There are two types of protocol identifier parameters that can occur in Ethernet frames after the initial MAC-48 destination and source identifiers:

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.

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. LSAPs (Link-Layer Subnet Access Points) occur in pairs where one is intended to indicate the source protocol handler and one the destination protocol handler; however, use cases where the two are different have been relatively rare.

Neither Ethertypes nor LSAPs are allocated by IANA; instead, they are allocated by the IEEE Registration Authority (see Section 1.2 above and the Ethertype Annex below). However, both LSAPs and Ethertypes have extension mechanisms so that they can be used with five-octet Ethernet protocol identifiers under an OUI, including those allocated by IANA under the IANA OUI.

When using the IEEE 802 LLC format (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; "AA" is the LSAP that indicates this use and is sometimes referred to as the 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, allocated by the OUI owner. The odd 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

even though 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.

3.1. Ethernet Protocol Allocation under the IANA OUI

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

xx-xx-AA-AA-03-00-00-5E-zz-zz.

A number of such allocations 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 allocation (see Section 5.1). New allocations of SNAP SAP protocol (zz-zz) numbers under the IANA OUI must meet the following requirements:

- the allocation must be for standards use (either for an IETF Standard or other standard related to IETF work),
- it must be documented in an Internet-Draft or RFC, and
- such protocol numbers are not to be allocated for any protocol that has an Ethertype (because that can be expressed by 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.

4. Other OUI-Based Parameters

Some IEEE 802 and other protocols provide for parameters based on an OUI beyond those discussed above. Such parameters most commonly consist of an OUI plus one octet of additional value. They are usually called "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 ([802.11], page 125).

Values may be allocated 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 and 0xFF for a one-octet specifier) are reserved and require IESG Ratification (see Section 5.1) for allocation. The allocations 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 allocated for a particular parameter of this type, an IANA registry will be created to contain that allocation and any subsequent allocations of values for that parameter under the IANA OUI. The Expert will specify the name of the registry.

(If a different policy from that above is required for such a parameter, a BCP or Standards Track RFC must be adopted updating this BCP and specifying the new policy and parameter.)

5. IANA Considerations

The entirety of this document concerns IANA Considerations for the allocation of Ethernet parameters in connection with the IANA OUI and related matters.

Specifically:

Section 1.2.1 provides information on the IANA-assigned OUI.

Section 2.1.1 lists current EUI-48 assignments under this OUI.

Section 2.1.2 specifies IANA considerations for EUI-48 assignments.

Section 2.2.2 specifies IANA considerations for EUI-64 assignments.

Section 3.1 provides a pointer to current protocol identifier assignments under the IANA OUI, and specifies IANA considerations for protocol identifier assignments.

Section 4 briefly provides IANA considerations relating to OUI-based miscellaneous allocations.

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 allocations in this document is fully consistent with the IANA Expert Review policy described in Section 4.1 of [RFC5226].

While finite, the universe of code points from which Expert judged allocations 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 allocations of EUI identifiers with increased scrutiny by the Expert for medium-sized allocations of EUI identifiers, and allocations of protocol identifiers and other IANA OUI based parameters. However, it can make sense to allocate very large portions of the MAC identifier code point space. (Note that existing allocations include one for 1/2 of the entire multicast code point space and one for 1/16 of the multicast code point space.) In those cases, and in cases of the allocation 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 the Template Annex 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 are available, will contact the IESG.

If the allocation is based on Expert Review:

- If IANA receives a disapproval from an Expert selected to review an application Template, the application will be denied.
- If IANA receives approval and code points are available, IANA will make the requested allocation.

If the allocation is based on IESG Ratification, the procedure starts with the first two steps above for Expert Review. If the Expert disapproves the application, they simply inform IANA; 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 for approval or uncertainty, to the IESG. The IESG must decide whether the allocation will be granted. This can be accomplished by a management item in an IESG telechat as 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.

5.2. Informational IANA Web Page Material

IANA also maintains an informational listing on its web site concerning Ethertypes, OUIs, and multicast addresses allocated under OUIs other than the IANA OUI. IANA shall update that list when changes are provided by the Expert.

5.3. OUI Exhaustion

When the available space for either multicast or unicast EUI-48 identifiers under OUI 00-00-5E have been 90% or more exhausted, IANA should request an additional OUI from the IEEE Registration Authority (see Section 1.2) for further IANA allocation use.

6. Security Considerations

This document is concerned with allocation of parameters under the IANA OUI and closely related matters. It is not directly concerned with security.

7. Normative References

[802_O&A] "IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture", IEEE 802-2001, 8 March 2002.

"IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture / Amendment 1: Ethertypes for Prototype and Vendor-Specific Protocol Development", IEEE 802a-2003, 18 September 2003.

8. Informative References

[802.1Q] "IEEE Standard for Local and metropolitan area networks / Virtual Bridged Local Area Networks", IEEE 802.1Q-2005, 19 May 2006.

[802.3] "IEEE Standard for Information technology / Telecommunications and information exchange between systems / Local and metropolitan area networks / Specific requirements / Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications", IEEE 802.3-2005, 9 December 2005.

[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 802.11-2007, 11 June 2007.

[EUI-64] IEEE, "Guidelines for 64-bit Global Identifier (EUI-64) Registration Authority", <http://standards.ieee.org/regauth/oui/tutorials/EUI64.html>, March 1997.

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

[IEEE] Institute of Electrical and Electronics Engineers, <http://www.ieee.org>.

[IEEE802] IEEE 802 LAN/MAN (Local Area Network / Metropolitan Area Network) Standards Committee, <http://www.ieee802.org>.

[RFC1112] Deering, S., "Host Extensions for IP Multicasting", STD 5, RFC 1112, Stanford University, August 1989.

[RFC1661] Simpson, W., "The Point-to-Point Protocol (PPP)", STD 51, RFC 1661, July 1994.

[RFC2153] Simpson, W., "PPP Vendor Extensions", RFC 2153, May 1997.

[RFC2332] Luciani, J., Katz, D., Piscitello, D., Cole, B., and N. Doraswamy, "NBMA Next Hop Resolution Protocol (NHRP)", RFC 2332, April 1998.

[RFC2464] Crawford, M., "Transmission of IPv6 Packets over Ethernet Networks", RFC 2464, December 1998.

[RFC3768] Hinden, R., "Virtual Router Redundancy Protocol (VRRP)", RFC 3768, April 2004.

[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

[RFC5214] Templin, F., Gleeson, T., and D. Thaler, "Intra-Site Automatic Tunnel Addressing Protocol (ISATAP)", RFC 5214, March 2008.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, May 2008.

[RFC5332] Eckert, T., Rosen, E., Ed., Aggarwal, R., and Y. Rekhter, "MPLS Multicast Encapsulations", RFC 5332, August 2008.

Appendix A. Templates

This annex provides the specific templates for IANA allocations of parameters. Explanatory words in parenthesis 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")

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. 5-Octet Ethernet Protocol Identifier 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.)

A.3. Other IANA OUI-Based Parameter Template

Applicant Name:

Applicant Email:

Applicant Telephone: (starting with country code)

Protocol where the OUI 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 allocated, such as "Foo Cipher Suite")

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

Appendix B. Ethertypes

This annex lists some Ethertypes specified for IETF Protocols or by IEEE 802 as known at the time of publication. A more up-to-date list may be available on the IANA web site, 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. Some Ethertypes Specified by the IETF

0x0800 Internet Protocol Version 4 (IPv4)
0x0806 Address Resolution Protocol (ARP)
0x0808 Frame Relay ARP
0x880B Point-to-Point Tunneling Protocol (PPTP)
0x880C General Switch Management Protocol (GSMP)
0x8035 Reverse Address Resolution Protocol (RARP)
0x86DD Internet Protocol Version 6 (IPv6)
0x8847 MPLS
0x8848 MPLS with upstream-assigned label
0x8861 Multicast Channel Allocation Protocol (MCAP)
0x8863 PPP over Ethernet (PPPoE) Discovery Stage
0x8864 PPP over Ethernet (PPPoE) Session Stage

B.2. Some IEEE 802 Ethertypes

```
      0x8100  IEEE Std 802.1Q  - Customer VLAN Tag Type (C-Tag, formerly
                                 called the Q-Tag)
      0x8808  IEEE Std 802.3   - Ethernet Passive Optical Network (EPON)
      0x888E  IEEE Std 802.1X  - Port-based network access control
      0x88A8  IEEE Std 802.1Q  - Service VLAN tag identifier (S-Tag)
      0x88B5  IEEE Std 802     - Local Experimental Ethertype
      0x88B6  IEEE Std 802     - Local Experimental Ethertype
      0x88B7  IEEE Std 802     - OUI Extended Ethertype
      0x88C7  IEEE Std 802.11i - Pre-Authentication
      0x88CC  IEEE Std 802.1AB - Link Layer Discovery Protocol (LLDP)
      0x88E5  IEEE Std 802.1AE - Media Access Control Security
      0x88F5  IEEE Std 802.1ak - Multiple VLAN Registration Protocol
                                 (MVRP)
      0x88F6  IEEE Std 802.1Q  - Multiple Multicast Registration
                                 Protocol (MMRP)
      0x890D  IEEE 802.11r     - Fast Roaming Remote Request
```

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