Guidelines for 48-Bit Global Identifier (EUI-48)

General

The IEEE-defined 48-bit Extended Unique Identifier-48 (EUI-48) is an identifier whose limited uses include:

- A 48-bit identifier used to address hardware interfaces within existing IEEE 802 or IEEE 802-like networking applications.
- A 48-bit identifier of a specific hardware instance that is not necessarily a network address.

The EUI-48 is formed as:

- A concatenation of a 24-bit Organizationally Unique Identifier (OUI) value assigned by the IEEE Registration Authority (IEEE RA) and a 24-bit extension identifier assigned by the organization with that MA-L assignment.
- A concatenation of a 28-bit value assigned by the IEEE RA and a 20-bit extension identifier assigned by the organization with that MA-M assignment.
- A concatenation of a 36-bit value assigned by the IEEE RA and a 12-bit extension identifier assigned by the organization with that MA-S assignment.

The assigned EUI-48 identifier blocks are, by default, publically available. This permits users to identify the organization/company that was assigned an EUI-48. For those organizations/companies electing to use the private listing option, the assignee of an EUI-48 is not publicly available. The assignee of an EUI-48 block is responsible for administering the assigned EUI-48 identifiers. The IEEE RA assigns the base 24-bit, 28-bit or 36-bit number, and it has no control over the assignments of the individual EUI-48 and assumes no liability for assignments of duplicate EUI-48 identifiers by organizations/companies.

The term EUI-48 is trademarked by IEEE and should be so identified. Organizations are allowed limited use of this term for commercial purposes. Where such use is identification of features or capabilities specified within a standard or for claiming compliance to an IEEE standard this may be done without approval of IEEE, but other use of this term must be reviewed and approved by the IEEE RAC.

Mandatory IEEE RAC Coordination

When an EUI-48 is used within the context of an IEEE standard, the standard shall be reviewed by the IEEE RAC for correctness and clarity. When an EUI-48 is referenced within non-IEEE standards, the standard developers should contact the RAC for review of proper usage.

Application Restrictions

Given the possibility of consuming all the EUI-48 identifiers, the IEEE-RAC places restrictions on their use. For new applications, EUI-48 identifiers are restricted to use in low volume applications, such as the identification of software interface standards or hardware model numbers.

While the number of EUI-48 identifiers is large, it is not inexhaustible, and an extended EUI-64 is available. Applications that use the EUI-48 identifier may require special review by the IEEE-RAC. The IEEE Registration Authority will accept an additional OUI application upon the certification that at least 95% of the current allocation is used (assuming the applicant already has an OUI assignment). See the section “IEEE RA Policies Having the Aim of Reducing the Volume of Unused EUI-48s” in the tutorial “Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)” for more details.

EUI-48 Format

When an EUI-48 is provided by an authorized assignee of these values (i.e., by an assignee of an MA-L, MA-M, or MA-S), the most-significant 24, 28, or 36 bits of the EUI-48 are assigned to the organization/company by the IEEE RA. The least-significant bits are the extension identifier (the assigned identifier block) assigned by the organization/company.

An EUI-48 is a string of six octets, labeled as *eui[0]* through *eui[5].* The format of the EUI-48 is illustrated below. The example assumes that an organization/company has been assigned by the IEEE RA as part of an MA-L assignment the OUI hexadecimal value AC-DE-48$_{hex}$, and the organization/company-selected extension identifier for a given component is 23-45-67$_{hex}$. The EUI-48 value generated from these two numbers is AC-DE-48-23-45-67$_{hex}$.

An EUI-48 is properly displayed as shown with hyphens between numbers in canonical address representation (see the section “non-canonical address representation” of the tutorial “Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)”) or as a hexadecimal number (ACDE48234567$_{16}$). As required, it may also be displayed as a binary number as illustrated below.

```
|          OUI(24)          |    extension identifier   | field
|                           |                           |
| eui[0] | eui[1] | eui[2] | eui[3] | eui[4] | eui[5] | order
|        |        |        |        |        |        |
|   AC   |   DE   |   48   |   23   |   45   |   67   | hex

 10101100 11011110 01001000 00100011 01000101 01100111 binary
```

The following example assumes that an organization/company has been assigned by the IEEE RA the MA-S base hexadecimal value 00-1B-C5-05-3$_{hex}$, and the

organization/company-selected extension identifier for a given component is 1-23_{hex}. The EUI-48 value generated from these two numbers is 00-1B-C5-05-31-23_{hex}.

```
|           OUI 36                        | extension  |field
|                                         | identifier |
|                            |                        |
| eui[0] | eui[1] | eui[2] | eui[3] | eui[4] | eui[5] | order
|        |        |        |        |        |        |
|   00   |   1B   |   C5   |   05   |   31   |   23   | hex

 00000000 00011011 11000101 00000101 00110001 00100011 binary
```

The encoding of data for transmission has many possibilities. Bit-serial encodings may differ on the ordering of bit transmissions within octets; and block codes (encoding multiple bits rather than single bits) normally transmit octets in an ascending index-value order, though some block codes encode multiple octets. The numeric value of an EUI does not change because of transmission order.

When transferred to other electronically-readable locations (e.g., within a disk file) the relative ordering of the octets may be changed, as specified within the applicable standard as long as the numeric value is retained.

Unassigned EUI-48 values

The all-zeros and all-ones EUI-48 values, 00-00-00-00-00-00_{hex} and FF-FF-FF-FF-FF-FF_{hex}, are owned by the IEEE Registration Authority and will never be assigned, and are invalid for use as identifiers. These values are used to represent NULL or uninitialized EUI-64 values. As an example, these values, invalid for use as identifiers, may be fabricated into an integrated circuit to be initialized, by hardware or firmware.

Non-canonical address representation

Some network types specify that the least significant bit (LSB) of an octet be transmitted first, and others specify that the most significant bit (MSB) of an octet be transmitted first. Such distinctions were more clear and justifiable for serial transmission (rather than block encoding of multiple bits, and bit-by-bit processing of fields). Unfortunately, this led to use of the MSB representation of an address in places other than the address fields of a frame (e.g., within the Information Field of an IEEE 802 frame, or within management attributes). Such MSB representation of an address is referred to as non-canonical representation of an address, the LSB representation is referred to as canonical representation of an address.

A non-canonical representation of an address does not retain the numeric value of the EUI-48 (i.e., a universally unique address) and therefore the non-canonical

representation may be a numeric duplicate of the canonical representation of another address. Therefore, non-canonical representation of addresses is deprecated.

Mapping an EUI-48 to an EUI-64

Some standards have described how an EUI-48 value can be mapped to an EUI-64. The mapping described here is deprecated and it should not be used in new applications as it includes an unacceptable probability of duplicating an EUI-64.

Let the six octets of the EUI-48 be labeled eui48[0] through eui48[5] (this notation is similar to the notation used in the previous section). Let the eight octets of the mapped EUI-64 be labeled eui64[0] through eui64[7]. The relation between the mapped EUI-64 octets and the EUI-48 octets is given by:

eui64[0] = eui48[0]
eui64[1] = eui48[1]
eui64[2] = eui48[2]
eui64[3] = FF_{hex}
eui64[4] = FE_{hex} or eui64[4] = FF_{hex}
eui64[5] = eui48[3]
eui64[6] = eui48[4]
eui64[7] = eui48[5].

In other words, the EUI-64 value is generated by inserting either the value $FFFE_{hex}$ or the value $FFFF_{hex}$ in between eui48[2] and eui48[3].

Other worldwide identifiers based on EUI-48

Some formats of World Wide Names (WWN) are derived from an EUI-48. WWNs are used as disk and endpoint addresses in SCSI and associated protocols. Please refer to the Fibre Channel tutorial for more information.