Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)

IEEE-Administered OUI and CID

The IEEE Registration Authority (RA) administers the assignment of identifiers that are globally unique to each organization that receives an identifier. * The 24-bit Organizationally Unique Identifier (OUI) and 24-bit Company ID (CID) are related to each other in that they come from the same 24-bit space (see Figure 1). Each CID is unique from all other CIDs and from all OUIs. Similarly, each OUI is unique from all other OUIs and from all CIDs¹. (The position of the M and X bits is shown in Figure 2.)

Though these identifier names have the words organization and company in them, either an OUI or a CID may be used for identification of a company, organization, entity, manufacturer, vendor, etc.



Figure 1: 24-bit CID/OUI space

In addition to being a globally unique 24-bit identifier, either an OUI or CID may also be used to create extended identifiers, protocol identifiers and context dependent identifiers. Depending on the rules used to create these derivative identifiers, they might be globally unique (e.g., EUI-48 and EUI-64) or only unique within the context in which they are used.

The IEEE Registration Authority also recognizes and assigns an OUI-36, which is specified for use in various standards.

Extended Unique Identifiers EUI-48 and EUI-64

A 48-bit Extended Unique Identifier (EUI-48) or a 64-bit Extended Unique Identifier (EUI-64) is globally unique and intended to be bound to a hardware device instance or other object that requires unique identification. EUI-48 and EUI-64 identifiers are most commonly used as globally unique network addresses (also called universally unique MAC addresses), as specified in various standards

¹ It should be stressed that the IEEE Registration Authority has made every effort to ensure that the IEEE—RA has not assigned the same number to any other entity but does not guarantee that duplicate assignments have not occurred. Global uniqueness also depends on proper use of assignments and absence of both hard and soft faults that might result in a duplicate number.

An EUI-48 or EUI-64 may also be applied for other uses.

- Extended Unique Identifier-48 (EUI-48), limited uses include:
 - A 48-bit identifier used to address hardware interfaces within existing IEEE 802-based networking applications (historically, MAC-48 was used to describe this use).
 - A 48-bit identifier of a specific hardware instance that is not necessarily a network address.
- Extended Unique Identifier-64 (EUI-64): A 64-bit identifier used to identify each hardware instance of a product, regardless of application (e.g., wireless devices, IEEE 1588 clocks, and very high volume applications).

Please see the appropriate tutorial for more information on applications of the above extended identifiers.

IEEE Registration Authority (IEEE RA) assignment of identifiers

The OUI, CID, EUI-48 and EUI-64 assignments available from the IEEE RA are summarized in Table 1. As one might infer from the names, the most common use of EUI block assignments is for MAC addresses for networking equipment, but that is not the only use.

Table	1.	OUI	and	CID	IEEE	RA	assignment	summary
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IEEE RA Assignment	Number of IEEE assigned bits	Block size of EUI-48 (may be used as unique 48-bit addresses)	Block size of EUI-64 (may be used as unique 64-bit addresses)	May be used as a company or organization identifier (yes/no)
CID (Company ID)	24	0 (zero)	0 (zero)	yes (24-bit CID)
MAC Addresses - Large"(MA-L)	24	2 ²⁴ (16,777,216)	2 ⁴⁰ (1,099,511,627,776)	yes (24-bit OUI)
MAC Addresses – Medium (MA–M)	28	2 ²⁰ (1,048,576)	2 ³⁶ (68,719,476,736)	no
MAC Addresses - Small (MA-S)	36	2 ¹² (4096)	2 ²⁸ (268,435,456)	yes (36-bit OUI-36 only)

The CID is a 24-bit unique identifier used to identify a company, organization etc. Use of a CID is appropriate when universally unique MAC addresses are not needed. Similarly when the number of MAC addresses (or other uses of EUI-48 and EUI-64) required by a company is satisfied with an MA-M or MA-S assignment, a CID may be used for company identification, because those assignments do not include an OUI assignment.

The MA-L includes assignment of an OUI as well as assignment of a block of EUI-48 and EUI-64 identifiers. An MA-L is equivalent to the OUI assignments made prior to January 1, 2014, which also included assignment of both an OUI and blocks of EUI-48 and EUI-64 identifiers.

The MA-M assignment became available January 1, 2014, in response to customer requests for an intermediate sized block of EUI-48 values to be used as addresses. The MA-M does not include assignment of an OUI. The OUI from which a MA-M assignment is derived is assigned to IEEE.

The MA-S assignment became available January 1, 2014, in response to customer requests for a small sized block of EUI-48 values to be used as addresses. The MA-S does not include assignment of an OUI. The OUI from which a MA-S assignment is derived is assigned to IEEE. The MA-S assignment encompasses both the Individual Address Block (IAB) and the OUI-36 assignments offered prior to January 1, 2014. An MA-S assignment includes an OUI-36 that is specified in some standards for identification of a company or organization and used in creation of extended identifiers.

The assignments of the IEEE-administered identifiers in Table 1 are typically public, so that a user can identify the registered owner of an EUI-48 or EUI-64 (including globally unique addresses), OUI or CID. For those registered owners electing to use the private listing option, the IEEE-identifier assignment is not publicly available. The assignee of the IEEE identifier is responsible for administering the extension identifiers. The IEEE RA has no control over the assignments of the extension identifiers and assumes no liability for assignments of duplicate identifiers by an organization using an IEEE-assigned identifier (e.g., duplicate context dependent identifiers, EUI-48, or EUI-64 values, see below).

Structure of OUI and CID

The structure of an OUI or CID is shown in Figure 2 below. Both are 24 bits (three octets) in length. Note that the two least significant bits of the first octet (octet 0) are used for special purposes. In a MAC address (i.e., EUI-48 or EUI-64 used as an IEEE 802 address), the least significant bit of octet 0 indicates either an individual or group address (I/G), and the second least significant bit of octet 0 indicates universal or local administration of the address (U/L). For non-address applications (e.g., protocol identifiers) and general description, these bits are the M and X bits, respectively.

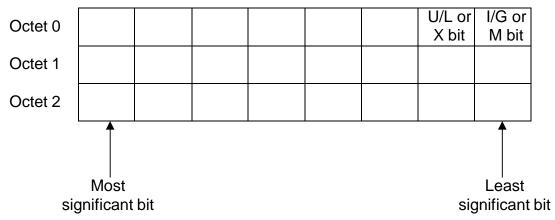


Figure 2: Structure of an OUI or CID

A CID has the X bit equal to one and consequently that places any address with the CID as its first three octets in the local address space (U/L = 1). Local addresses are not globally unique, but a network administrator is responsible for assuring that any local addresses assigned are unique within the span of use. (Uniqueness of local addresses typically does not need to extend beyond a router.)

As a result of these MAC address uses of EUI-48 and EUI-64, all OUI assignments made by the IEEE RA have M and X bits equal to zero. Consequently, an EUI-48 or EUI-64 is used without modification as a universally unique MAC address.

NOTE – A very small number of assignments made prior to adoption of IEEE 802 standards have the X bit equal to one (BlockID assignments). These assignments are documented in the CID registry.

EUI-48 and EUI-64 Structure and Use

EUI-48s and EUI-64s are intended to be used in applications that require fixed-size globally unique identifiers.

EUI-48 and EUI-64 identifiers are assigned in a block by the IEEE RA. A block is a contiguous range of EUI-48 or EUI-64 numbers, but can also be viewed as a base number that the assignee extends to create an extended identifier. An assignee associates an EUI-48 or EUI-64 with a single identifiable object (e.g., a network interface). Depending on the functions supported by a device, it may use more than one identifier. (For example, a smart phone could have an EUI-48 used as the 802.11/Wi-Fi MAC address and a second identifier for the Bluetooth interface. An Ethernet connected device could have an EUI-48 MAC address and an EUI-64 that uniquely identifies an 802.1AS clock (i.e., a "clockIdentity".)

Figure 3 illustrates the structure of the EUI-48 and EUI-64 and their relationship to the assignments made by the IEEE RA.

eui[0]	eui[1]	eui[2]	eui[3]	eui[4]	eui[5]		
MA-L	base value	(OUI)	extension				

MA-M base value	extension		
MA-S base value (OUI-36)		extension	

EUI-48

eui[0]	eui[1]	eui[2]	eui[3]	eui	i[4]	eui[5]	eui[6]	eui[7]
MA-L		extension						
MA-M base value				extension				
MA-S base value (OUI-36)					extension			

EUI-64

Figure 3: Structure of EUI-48 and EUI-64

As illustrated in Figure 3, the MA-M and MA-S blocks have a base value longer than an OUI. The first 24 bits of these assignments are an OUI assigned to IEEE RA and the additional bits are unique to an MA-M or MA-S assignment. An assignee of a MA-M or MA-S cannot make any assumption about a subsequent MA-M or MA-S assignment (e.g., assignments will most likely not be sequential, and a subsequent assignment may have a different value in the first 24 bits.)

The EUI-64 is used to avoid excess consumption of OUI values within high-volume non-networking applications. Given the minimal probability of consuming all EUI-64 identifiers, the IEEE RAC places minimal restrictions on their use within standards. Unless mandated by backward-compatibility constraints, the use of EUI-64 is preferred to the use of EUI-48. However, for backward compatibility, this transition may be difficult for some IEEE 802-related applications (e.g., new networks that need to bridge to 48-bit IEEE 802 networks). Therefore, selective use of 48-bit identifiers within 802-related systems will be considered by the IEEE Registration Authority Committee (also see the section "Restrictions on the Use of EUI-48 and EUI-64" for further details).

The terms EUI-48 and EUI-64 are trademarked by IEEE. Companies are allowed limited use of these terms 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.

Context dependent identifiers

Just as the OUI is extended to create EUI-48 and EUI-64 identifiers, or a CID can be extended to create a locally administered MAC address, other extended identifiers can be created from an OUI or CID assignment. Such extended identifiers are referred to as context dependent identifiers. These identifiers are not necessarily globally unique, but are intended to only be unique within a well specified context.

 Context Dependent Identifier (CDI): An extended identifier based on either an OUI, CID, or OUI-36. Typically a context dependent identifier is defined within a standard with additional specification to allow unambiguous interpretation of the identifier and parsing of other data. Some examples include (but are not limited to):

- o Defining all fields of the context dependent identifier within a standard. For example, using an OUI or CID to identify a manufacturer of hardware with additional fields identifying the model and revision of the hardware. Such an identifier, if properly defined, is unique within the context of the standard.
- o Defining vendor-specific extensions to management information within a standard but allowing the assignee of the unique identifier to specify the additional fields. This extended identifier would be unique within the context of the defined management information base.
- A vendor-specific protocol could be identified with an OUI/CID, and a standard defined fixed field to allow identification of multiple protocols from the same vendor; or with the OUI/CID indicating which set of rules to parse the data following the OUI/CID.
- o The legacy definition of CDI-32 and CDI-40.

Restrictions on the Use of EUI-48 and EUI-64

48-bit EUI-48 identifiers were originally created to serve as network or media access control (MAC) addresses for local area networks (LANs) by IEEE Project 802. Within this environment, EUI-48 identifiers are intended to identify items of real physical equipment, parts of such equipment, or functions that apply to many instances of physical equipment.

The use of 48-bit identifiers has been extended so that they may serve as protocol identifiers. With this use, they identify protocol designs and design revisions of protocols operating between instances of physical equipment, where there are expected to be far fewer such protocols identified than there are items of addressable physical equipment.

The total number of EUI-48 identifiers available, while large, is NOT inexhaustible. The IEEE RAC has the duty to promote the continued availability of the EUI-48 capability in conjunction with IEEE standards and non-IEEE standards, for the benefit of the world-wide community using those standards.

With the exception of such protocol identifiers, EUI-48 identifiers are intended to identify items of real physical equipment or parts of such equipment such as separable subsystems or individually addressable ports. The expected use should not exceed one EUI-48 identifier per hardware subsystem, or at most a very low number of EUI-48 identifiers per physical instance of such equipment (e.g., groups of ports as in IEEE Std 802.3ad, for link aggregation). Allocation of a single EUI-48 identifier to identify or permit addressing of a fixed and permanent function associated with a real item of physical equipment occurs for the lifetime of that equipment or an indefinite period of use.

In particular, any application that calls for subdivision of the available number space, for block allocation to physical equipment without an identifiable physical instance per EUI-48 identifier, or for encoding functional capabilities within significant bits or bit patterns of the identifier, has the potential to rapidly exhaust the address space. To reduce the

prospect of exhaustion, new applications and proposed extensions to current applications with significant volume expectations are STRONGLY encouraged to make use of EUI-64, rather than EUI-48, to identify hardware instances.

New applications that require an address format matching the existing base of EUI- 48 equipment will be reviewed by the IEEE RAC and such exceptions will only be approved on a case-by-case basis. Non-standard uses of EUI-48 are not supported.

The IEEE RAC solicits any information about threats to the viability of the unique EUI-48/EUI-64 address space, whether an IEEE proposed standard or another standard or specification. Information should be sent to the IEEE RAC administrator (ieee-registration-authority@ieee.org). Furthermore, in carrying out this duty to preserve the longevity of these identifier capabilities, the RAC will act, via liaison or direct coordination, to prevent potentially abusive uses for the consumption of the OUI.

When IEEE 802 began its work in 1980, the target lifetime of EUI-48 identifiers was 100 years. We are now more than a third through that initial lifetime goal and still experiencing continual growth in the use of EUI-48 identifiers with no indication that EUI-48 addresses will be obsolete by 2080. Consequently the IEEE RAC regards the consistent enforcement of these restrictions as a fundamental and realistic basis for ensuring longevity of the EUI-48 identifier.

Further details are defined in the tutorial "Guidelines for 48-bit Global Identifier (EUI-48)."

If an entity, whether an IEEE RA customer or not, has either intentionally or accidently misused an IEEE RA assignment such that EUI-48/EUI-64 addresses, or any other identifiers that the entity creates from its RA assignment, are allocated outside its assignment(s), then the entity is in violation of RAC policies. In such cases, the RAC may recommend the IEEE RA collect additional fees from the entity to remedy any potential duplication and/or discourage future misuse.

Restrictions on the Use of Context Dependent Identifiers

Except where compatibility with legacy definitions of 22-bit company identification is justifiable, the OUI is used as a 24-bit field when creating context dependent identifiers. This allows for use of CID is such cases. Specifications for context dependent identifiers should allow use of either OUI or CID as the base for the context dependent identifier.

The following cautions are provided for those specifying context dependent identifiers:

- If the context within which the assignment of the extension identifier is required to be unique is not accurately defined, then there is the danger of inadvertent re-use of an existing identifier assignment for a different purpose, leading to ambiguity in the use of the assigned values;
- If the chosen size of the extension identifier is small relative to the actual number of identifier values that will need to be assigned under a single OUI/CID, then the result could be an unacceptable rate of consumption of OUI/CID values, and potential difficulty in the owner of an OUI meeting the Registration Authority's requirement that 95% of the block assignment represented by their existing OUI be

consumed before making use of a further assignment.

Consequently, the use of context-dependent identifiers is acceptable, subject to the use meeting all of the following requirements:

- The context within which the context-dependent identifier is used, and within which
 its identifier values are required to be unique is clearly defined in the relevant
 standard.
- The size of the chosen extension identifier is large enough to accommodate all conceivable requirements for the allocation of distinct values under a single OUI within the defined context.
- The IEEE RAC has approved the identifier and the definition of the context within which it will be used.
- Draft standards or working group materials that describe a proposed contextdependent identifier and its proposed application should be submitted to the IEEE RAC.

Deprecated and Obsolete Identifiers

Several identifiers used in the past that were created from IEEE-administered identifiers (i.e., created by organizations that were assigned IEEE-administered identifiers) are now deprecated or obsolete. These identifiers include the Individual Address Block (IAB) based identifiers, the 22-bit OUI-based identifiers, the MAC-48 identifier, and the EUI-60. These identifiers are briefly described in the following sub-sections.

IAB-Based Identifiers

The 36-bit IAB identifier is obsolete. An IAB consists of a 24-bit OUI that has been assigned to the IEEE RA for the purpose of creating IAB identifiers, concatenated with a 12-bit extension identifier assigned by the IEEE RA. The IAB provides the assignee with a block of 4096 EUI-48 identifiers; these identifiers are created by the assignee by a further 12-bit extension identifier concatenated with the 36-bit IAB identifier.

The IAB can only be used for the purpose of assigning EUI-48 identifiers; any other identifiers that might be created by the use of the 24-bit OUI value used to create the IAB remain the property of the IEEE RA. In addition, the IAB cannot be used to create any other identifiers using the 36 bits assigned to the assignee (e.g., the assignee cannot create an EUI-64 by appending 28 bits to the IAB identifier it has been assigned).

While the IEEE RA did not guarantee that the 36-bit IAB identifier would always be created from the same OUI, the identifiers were in fact created from two particular OUIs: $00-50-C2_{hex}$ and $40-D8-55_{hex}$. The former was used until all the IABs based on it were assigned, after which the latter was used.

The IAB differed from the OUI-36 in that, while the IAB could be used only to create EUI-48s, an MA-S (previously called OUI-36) may be used to create EUI-48s and EUI-64s, and may be used as a 36-bit company identifier (as specified in certain standards) or in creation of a protocol identifier. The EUI-48 usage of an IAB and MA-S are the same, so

an organization that was assigned an IAB may use it as intended. Any new requests made to the IEEE RA for an IAB will be fulfilled by assigning an MA-S.

Going forward, the existing IAB public listing will be maintained as a historical registry. Since no new IABs will be assigned, there will be no additions to the IAB registry.

22-Bit OUI-Based Identifiers

A variety of alternative, context-dependent identifiers, such as specialized <u>22-bit</u> <u>OUI-based identifiers</u> were used in the past. Such uses are deprecated.

MAC-48 Identifier

The term MAC-48 identifier, which is now obsolete, was used in the past. The MAC-48 was similar to the EUI-48, i.e., it was a concatenation of a 24-bit OUI assigned by the IEEE RA and a 24-bit extension identifier assigned by the organization with that OUI assignment. However, it was used to address hardware interfaces within existing 802-based networking applications. The term EUI-48 was historically used to identify a design instance, as opposed to a hardware interface; examples include software interface standards (such as VGA), the model number for a product, and the form/function of vendor-specific content. The subtle difference between MAC-48 and EUI-48 was not well understood, so the term EUI-48 is now used for both uses, and the term MAC-48 identifier is now obsolete.

Mapping of EUI-48 to EUI-64

When the historical EUI-48 and MAC-48 were mapped to an EUI-64, they concatenated different values between the OUI (first three octets) and the extension of that OUI. The mapping specified the hexadecimal value FF-FE be inserted for EUI-48, and the value FF-FF be used for MAC-48. With the combining of the historical EUI-48 and MAC-48 use into the current EUI-48 use, either FF-FE or FF-FF could be used for the mapping. The original mapping specification worked when the IEEE RA only offered OUI and IAB assignments. The mapping was broken with OUI-36 assignments, as described in the next paragraph.

Mapping an EUI-48 assigned with an MA-S (previously OUI-36) or MA-M assignment to an EUI-48 potentially creates a duplicate of an EUI-64 assigned with a different MA-M or MA-S assignment (or its predecessor OUI-36). The IEEE RA has taken appropriate actions to mitigate creation of duplicates based on this mapping; but to protect the integrity of EUI-64 identifiers this mapping is deprecated.

Mapping of EUI-48 to EUI-64 is described in more detail in the tutorial "Guidelines for 48-Bit Global Identifier (EUI-48)."

EUI-60

The use of the EUI-60 identifier is deprecated. Since EUI-60 identifiers form a portion of the World Wide Names (WWNs) value defined within multiple disk-related standards, there is no plan to eliminate the use of these EUI-60 values in the foreseeable future. The

term deprecated does not imply a demise of EUI-60 identifiers, but implies the EUI-64 (as opposed to EUI-60) identifiers should be used in future applications requiring the use of unique per-hardware instance identifiers.

CDI-32 and CDI-40

CDI-32 is a concatenation of an OUI-28 value assigned by the IEEE RA and a 4-bit extension identifier assigned by the organization with that OUI-28 assignment.

CDI-40 is a concatenation of an OUI-28 value assigned by the IEEE RA and a 12-bit extension identifier assigned by the organization with that OUI-28 assignment.

CDI-32 and CDI-40 were historically recommended as context dependent identifiers. While still a valid concept, more flexibility for specification of context dependent identifiers is required and consequently CDI-32 and CDI-40 are historical context dependent identifiers.

Non-canonical address representation

Some network types specify that the least significant bit (LSB) of a byte be transmitted first, and others specify that the most significant bit (MSB) of a byte 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 OUI (or larger assigned value of an MA-M or MA-S assignment) and therefore may be a numeric duplicate of the canonical representation of another address. Therefore, non-canonical representation of addresses is deprecated. Similarly, extended identifiers should not use non-canonical representation.

Non-Overlapping Assignments

An organization that receives an IEEE-administered block is encouraged to assign only one form of EUI-48 or EUI-64 identifier, regardless of application (i.e., the organization is encouraged to not assign the same identifier to multiple organizations for different endapplication uses). The intent of this recommendation is to reduce possible errors introduced by the complexities of managing multiple context-dependent address spaces within each organization.

For example, EUI-48 values that specify I/O driver software interfaces, language codes, and hardware model numbers never overlap. Similarly, EUI-64 values that specify I/O driver software interfaces, language codes, hardware model numbers, and hardware instances never overlap. This no-overlap strategy is expected to reduce unintentional

duplication of identifier values, by elimination of subjective application-class judgments, although a few more identifier values may be consumed.

Null Values

Documentation of Use

Given the possible confusions of bit ordering and byte positioning, applications must clearly specify a mapping of the identifier value (expressed as hexadecimal digits) to the applicable register or byte-string sequence, in an unambiguous manner. To ensure clarity, each mapping should be self contained. If it is deemed necessary to cross-reference other documents, the specific document and page number shall be cross-referenced, so that unfamiliar readers can easily find the source.

To avoid changes in existing standards, a working group has the option of providing tutorials on any uses of identifiers in its standards, to be posted on the IEEE RAC web site.

If a standard, or its cross-referenced portions of other standards, does not conform to these documentation policies, the IEEE RAC can recommend the standard not be approved.

IEEE RA Policies Having the Aim of Reducing the Volume of Unused EUI-48s

The OUI assignment allows the assignee to generate more than 16 million (2²⁴) unique EUI-48 values, by varying the last 24 bits. As indicated in the section "Restrictions on the use of EUI-48 and EUI-64," the total number of EUI-48 identifiers available, while large, is NOT inexhaustible, and the IEEE RAC has the duty to promote the continued availability of EUI-48s. To reduce the occurrences of assigned OUIs for which there are EUI-48s that the assignee likely will not use (e.g., the assignee does not need 16 million EUI-48s), the RAC has the following policies for assigning MA-L, MA-M, MA-S, and CID identifiers (these policies were instituted when the OUI-28 and CID were first introduced):

1) First-time customers (i.e., assignees) cannot purchase the MA-L. A first-time customer that needs a 24 bit company/organization identifier can purchase a CID, and a first-time customer that needs EUI-48s, or EUI-64s (or deprecated identifiers) can purchase an MA-M or MA-S, depending on how many of each particular identifier the customer needs. Exception to this policy must be reviewed by the IEEE RAC.

- 2) Repeat customers (i.e., customers who have previously purchased an MA-L, MA-M, MA-S, and/or CID) can purchase any of the identifiers, subject to the following restrictions:
 - a. The IEEE Registration Authority will accept an additional assignment application upon the certification that at least 95% of the current MA-L, MA-M allocation is used. The same applies to OUI assignments issued prior to January 2014. Additional assignments may be issued when a significant portion of the existing MA-S assignment has been exhausted. Customers must agree to not produce products using the new assignment until the previous assignment is fully exhausted. This applies to all registry assignments.
 - b. A customer that has either an MA-L (or prior to January 1, an 2014 OUI) or CID assignment should not need to purchase a new CID.

The value of the IEEE-administered identifier is intended to identify the organization that administers the concatenated extension identifiers to create, for example, EUI-48, or EUI-64 values. The IEEE-administered identifier should not be used, in isolation, to identify a division or similar portion of a company or organization. When an assignee feels it necessary to identify such an internal group the EUI-48 or EUI-64 identifier can be used. Careful administration can use some of the extension bits to identify a division. Thus, a division can be identified by one or more values of the selected bits of the extension. (Such administration does not exempt the assignee from the requirement to use most of the EUI-48 values described above.) Groups within a standards development organization can similarly be identified by distinct EUI-48 (or EUI-64) identifiers administered by their sponsoring body.

Use of Terms

When used in other documents, the terms and acronyms Organizationally Unique Identifier (OUI), Company ID (CID), 48-bit Extended Unique Identifier (EUI-64), and 64-bit Extended Unique Identifier (EUI-64) should be used consistent with this tutorial.

Company ID

A CID, like an OUI, may be used by the organization that owns it (i.e., the organization identifiers are used, for example, to identify the organization or objects the organization has created in various protocols.

The Company ID (CID) is a 24-bit globally-unique assigned number that has the X bit set to 1 and the M bit set to 0 (see Figure 2). Use of a CID is appropriate when MAC addresses are not needed. Similarly when the number of MAC addresses (or other uses of EUI-48 and EUI-64) required by a company is satisfied with an MA-M or MA-S assignment, a CID may be used for company identification, because those assignments do not include an OUI assignment.

If a CID is used to create MAC addresses, the X bit becomes the U/L bit (i.e., EUI-48 used as a MAC address or an EUI-64 used as an address). Any such addresses are by definition locally administered and consequentially may not be globally unique. CID though can be a useful tool in management of the local address space to help a network administrator keep local addresses unique to a network (rather than being globally unique.

The CID definition assumes that legacy uses of the OUI in protocols do not try to define the M and X bits for other uses. The IEEE Registration Authority Committee (RAC) is not aware of any standard uses of the M and X bits that would interfere with use of a CID instead of an OUI as a protocol identifier.

MAC Address-Medium Identifiers

A MAC Address-Medium (MA-M) is an assignment of a block of EUI-48 and EUI-64 identifiers. An MA-M is created by the IEEE RA by assigning an OUI to the IEEE RA and concatenating 4 bits to the OUI after the least significant bit of octet 2 shown in Figure 2). This 28-bit value is a unique base for creation of the range of EUI-48 and EUI-64 identifiers (i.e., the identifiers the IEEE has assigned) to create the following identifiers:

EUI-48, when created from an OUI-28, is a concatenation of an OUI-28 value assigned by the IEEE RA and a 20-bit extension identifier assigned by the organization with that OUI-28 assignment.

EUI-64, when created from an OUI-28, is a concatenation of an OUI-28 value assigned by the IEEE RA and a 36-bit extension identifier assigned by the organization with that OUI-28 assignment.

An OUI-28 may also be used to form a 36-bit Company ID or protocol identifier, by concatenating 8 bits assigned by the organization with that OUI-28 assignment. For example, some protocols have defined 36-bit identifiers to identify an organization or objects the organization has created in various protocols.

No assumption should be made regarding the OUI-24 used to create an OUI-28 (e.g., it should not be assumed that a subsequent OUI-28 that an organization will be assigned will be assigned from the same OUI-24 as an OUI-28 the organization currently is assigned). An assignee of an OUI-28 shall not truncate the OUI-28 to create an OUI-24 (a Company ID should be acquired for a unique 24-bit company identifier).

Note that the IEEE RAC does not intend to define the usage of a 28-bit company ID/protocol identifier at this time.

OUI-36-Based Identifiers

An OUI-36 is created by the IEEE RA by assigning an additional 12 bits to an OUI-24 (i.e., concatenating these 12 bits to the OUI-24 after the least significant bit of octet 2, see Figure 2). An OUI-36 is also informally referred to as a "MAC Addresses – Small" block (MA-S). An OUI-36 may be used by the organization that owns it (i.e., the organization the IEEE has made the assignment to) to create the following identifiers:

EUI-48, when created from an OUI-36, is a concatenation of an OUI-36 value assigned by the IEEE RA and a 12-bit extension identifier assigned by the organization with that OUI-36 assignment.

EUI-64, when created from an OUI-36, is a concatenation of an OUI-36 value assigned by the IEEE RA and a 28-bit extension identifier assigned by the organization with that OUI-36 assignment.

An OUI-36 may also be used as a 36-bit Company ID or protocol identifier. For example, some protocols have defined 36-bit identifiers to identify an organization or objects the organization has created in various protocols.

No assumption should be made regarding the OUI-24 used to create an OUI-36 (e.g., it should not be assumed that a subsequent OUI-36 that an organization will be assigned will be assigned from the same OUI-24 as an OUI-36 the organization currently is assigned). An assignee of an OUI-36 shall not truncate the OUI-36 to use as an OUI-24 (a Company ID should be acquired for a unique 24-bit company identifier).