Date: 21 May 2019
To: T11 Technical Committee
From: Ralph O. Weber
Subject: FC-FS-6: Name_Identifiers for the 21st century

Introduction

Much has changed since Name_Identifiers were initially defined in 1994. EUI formats have clearly become the exclusive province of the IEEE, which renders futile any attempt to define their format outside the IEEE. Although all the MAC Address changes have been totally backwards compatible with respect to format, the names of the constituent MAC Address elements have changed to the point where most of the 1994 names no longer appear in the IEEE lexicon.

Leaving all of the MAC Address changes in the historical dust, the IEEE has experienced a tectonic shift away from OUI (Organizational Unique Identifier) towards CID (Company Identifier). FC-PH (and more recently FC-FS) have benefitted from a correct name choice way back in 1994, when OUI and CID seemed like synonyms to many readers. Starting in 2014, a clear distinction has been made between the two.

- OUIs can be used to produce uniqueness in MAC Addresses.
- CIDs must be prohibited from usage in MAC Addresses because they have the Globally Unique / Locally Administered bit set to one (as opposed to OUIs where the devilish bit is set to zero).[1]

By picking Company ID as its up-front term of choice, Fibre Channel has saved itself significant grief at this juncture (unlike other storage interface standards, which will be dealt with in their turn).

Nonetheless, a cornucopia of changes are needed to align FC-FS-5 with the latest fashion in IEEE thinking.

Revision History

r0 Initial revision

r1 Made changes requested during the 28 March WebEx (minutes in T11-2019-00080-v000). Pursuant to these requests, references to MAC Addresses were changed to EUI-48, which has the required format. Also, changed the document of reference from FC-FS-5 Rev 1.0 to FC-FS-6 Rev 0.1.

r2 Incorporated 13 editorial comments from Fred Knight (to save the editor some RFC misery). Rewrote to base IEEE requirements on Extended Unique Identifiers (EUIs) and Extended Local Identifiers (ELIs), as well as other changes requested by the 4 April FC-FS Working Group meeting (no minutes posted as of this writing).

Unless otherwise indicated additions are shown in underlined blue, deletions in ~~red strikethrough~~, and comments in green. Differences between this revision and the previous revision, if any, are highlighted with change bars.

Proposed Changes in FC-FS-6 Rev 0.1

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[1] FCoE aficionados, among others, will instantly recognize the power of this bit.

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3 Definitions, abbreviations, conventions and keywords

3.1 Definitions

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3.1.24 comma
seven-bit sequence 0011111b or 1100000b in an 8B/10B encoded stream (see 5.2.7.1)

3.1.a Company_ID (CID)
24-bit value used in the construction of some NAA format Worldwide_Names (see 18)

Note 1 to entry: CID values are available from the IEEE-SA Registration Authority (see https://standards.ieee.org/products-services/regauth/cid/index.html).

Note 2 to entry: At its discretion, the IEEE-SA Registration Authority may provide a 24-bit OUI that this standard uses interchangeably with a CID. The IEEE-SA Registration Authority. IEEE-SA Registration Authority documentation associates 24-bit OUIs with the term MA-L (i.e., MAC Addresses - Large). The descriptions of 24-bit OUIs in this standard do not constitute an obligation on IEEE-SA Registration Authority to provide them.

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3.1.79 Idle
Ordered Set that is normally transmitted between frames (see 5.2.7.3 and 5.2.7.2)

3.1.b IEEE Extended Local Identifiers (ELI)
set of identifiers that the IEEE defines to have a local scope

Note 1 to entry: See "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" (see https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/tutorials/eui.pdf).

Note 2 to entry: The CID values that are used to generate ELIs are provided at the discretion of the IEEE-SA Registration Authority and are taken from the same set of unique values that the IEEE-SA Registration Authority uses to generate EUIs based on 24-bit OUIs. As a result, an ELI with zeros in all bits not provided by the IEEE-SA Registration Authority is guaranteed to be different from any EUI with zeros in the same bits.

Note 3 to entry: The IEEE defines ELIs as having a local scope because the methods for generating ELIs result in MAC addresses with a local scope.

Note 4 to entry: If the methods used for generating ELIs are the same as the methods used for generating EUIs, excepting only in values of the bits provided the IEEE-SA Registration Authority, then ELIs are globally unique with respect to each other and globally unique with respect to EUIs, the ELIs are related to MAC addresses.

Note 5 to entry: This standard references ELI-48s and ELI-64s.

3.1.c IEEE Extended Unique Identifiers (EUI)
set of identifiers that the IEEE defines to have a globally unique scope

Note 1 to entry: See "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" (see https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/tutorials/eui.pdf).

Note 2 to entry: This standard assumes that all EUIs are generated using 24-bit OUIs. The IEEE-SA Registration Authority defines other OUI sizes that are outside the scope of this standard unless they are contained in an EUI for which all bits are provided by the IEEE-SA Registration Authority. IEEE-SA Registration Authority documentation associates 24-bit OUIs with the term MA-L (i.e., MAC Addresses - Large).

Note 3 to entry: The 24-bit OUI values that are used to generate EUIs are provided at the discretion of the IEEE-SA Registration Authority and are taken from the same set of unique values that the IEEE-SA Registration Authority uses to generate ELIs based on CIDs. As a result, an EUI with zeros in all bits not provided by the IEEE-SA Registration Authority is guaranteed to be different from any ELI with zeros in the same bits.

Note 4 to entry: This standard references EUI-48s and EUI-64s.

3.1.d IEEE-SA Registration Authority
provider of worldwide unique values for ELI-48s, ELI-64s, EUI-48s, EUI-64s, and CIDs

Note 1 to entry: The IEEE-SA Registration Authority also defines the formats for ELI-48s, ELI-64s, EUI-48s, EUI-64s, and CIDs.

Note 2 to entry: See https://standards.ieee.org/products-services/regauth/index.html.

3.1.e IEEE-SA Registration Authority identifiers tutorial
description of formats and uses for ELI-48s, ELI-64s, EUI-48s, EUI-64s, and CIDs

Note 1 to entry: See "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" (see https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/tutorials/eui.pdf).

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3.1.93 L_Port
FC_Port that contains Arbitrated Loop functions associated with Arbitrated Loop topology (see FC-AL-2)

…

3.1.96 Network_Address_Authority (NAA)
organization ~~(e.g., IEEE)~~ that administers network addresses ~~(see 18)~~

Note 2 to entry: The IEEE-SA Registration Authority is an NAA that clause 18 references for some Name_Identifiers and the constituents of other Name_Identifiers,
see https://standards.ieee.org/products-services/regauth/index.html

3.1.97 Network_Address_Authority ~~(NAA)~~ identifier
four-bit identifier defined in some Name_Identifiers to indicate ~~a Network_Address_Authority~~ an ~~(~~NAA~~)~~ (see 18)

…

3.4 Abbreviations, acronyms, and symbols

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CID	Company_ID

…

ELI-48	Extended Local Identifier (48-bits) (see 3.1.b)
ELI-64	Extended Local Identifier (64-bits) (see 3.1.b)

…

EUI-48	Extended Unique Identifier (48-bits) (see 3.1.c)
EUI-64	Extended Unique Identifier (64-bits) (see 3.1.c)

…

18 Name_Identifier Formats

18.1 Scope

Name_Identifier Formats are functions of the FC-2V sublevel.

18.2 Introduction

Name_Identifiers are used to identify entities in Fibre Channel such as an N_Port, node, F_Port, Fabric or other Fibre Channel objects. The Name_Identifier for an entity shall be unique within the Fibre Channel interaction space.

The NAA field (bits 31-28 of Word 0) within the Name_Identifier specifies its format and length. A list of supported formats is given in table 84.

Table 84 — NAA identifiers

Word~~s~~ 0, bits 31 - 28	NAA	Length	Reference
0h	Name not present		
1h	IEEE 48-bit Address	64	18.3
2h	IEEE 48-bit Extended	64	18.4
3h	Locally Assigned	64	18.5
4h	Reserved		
5h	IEEE Registered	64	18.6
6h	IEEE Registered Extended	128	18.7
7h to Bh	Reserved		
Ch	EUI-64 Mapped	64	18.8
Dh	EUI-64 Mapped	64	18.8
Eh	EUI-64 Mapped	64	18.8
Fh	EUI-64 Mapped	64	18.8

An NAA field value of "Name not present” (0h) ~~indicated~~ indicates that the Name Value field does not contain ~~an~~ a valid Name_Identifier, and shall be ignored.

18.3 IEEE 48-bit Address

When the Name_Identifier format is IEEE 48-bit Address, the name value field shall contain an ELI-48 or EUI-48 (EI-48). ~~a 48-bit IEEE Standard 802.1A Universal LAN MAC Address (ULA) (see IEEE 802).~~ The ~~ULA~~ ELI-48 or EUI-48 shall be represented as an ordered string of six bytes numbered from 0 to 5. ~~ULA Bytes 0, 1, and 2 are generated using the IEEE Company_ID. Reference Annex I for information on obtaining an IEEE Company_ID. ULA Bytes 3, 4, and 5 represent a unique value provided by the identified company.~~

~~The least significant two bits of byte 0 are the Individual/Group Address (I/G) bit and the Universally or Locally Administered Address (U/L) bit. These bits shall be zero when a ULA is used in a Name_Identifier.~~ Table 85 shows how the bytes of an ~~ULA~~ ELI-48 or EUI-48 shall be mapped to two words in the Name_Identifier.

~~A 48-bit IEEE address~~ An IEEE 48-bit address Name_Identifier is a Worldwide_Name.

~~**Table 85 — NAA IEEE 48-bit Address Name_Identifier format**~~

~~Bits Word~~	~~31 .. 28~~	~~27 .. 24~~	~~23 .. 16~~	~~15 .. 10~~	~~9~~	~~8~~	~~07 .. 00~~
~~0~~	~~1h~~	~~0 00h~~		~~ULA Byte 0~~	~~U/L~~	~~I/G~~	~~ULA Byte 1~~
~~1~~	~~ULA Byte 2~~	~~ULA Byte 3~~		~~ULA Byte 4~~			~~ULA Byte 5~~

Table 85 — NAA IEEE 48-bit Address Name_Identifier format

<<<All of this table 85 is new. Change markups suspended in this table 85.>>>

Bits Word	31 .. 28	27 .. 24	23 .. 16	15 .. 08	07 .. 00
0	1h	0 00h		EI-48 Byte 0	EI-48 Byte 1
1	EI-48 Byte 2	EI-48 Byte 3		EI-48 Byte 4	EI-48 Byte 5

Example -

A company has ~~an IEEE Company_ID value:~~

~~AC DE 48h~~

~~This value is combined with a unique value generated by the identified company of 00 00 80h to create a ULA~~ an EUI-48 of:

AC DE 48 00 00 80h

Using this ~~ULA~~ EUI-48, the following 64-bit Fibre Channel IEEE 48-bit Address Name_Identifier ~~48-bit identifier format~~ is created:

10 00 AC DE 48 00 00 80h

18.4 IEEE 48-bit Extended

When the Name_Identifier format is IEEE 48-bit Extended, the name value field shall contain an ELI-48 or EUI-48 (EI-48). ~~the 48-bit IEEE address (see IEEE 802)~~ preceded by a ~~12-bit~~ 12-bit value that is an extension to the company assigned address portion of the ELI-48 or EUI-48 ~~48-bit address~~ that shall form a unique 60-bit value. ~~The 48-bit IEEE address shall be as defined for the IEEE 48-bit Address Name_Identifier format.~~ This format is

described in table 86.

An IEEE 48-bit Extended Name_Identifier is a Worldwide_Name.

~~Table 86 — NAA IEEE Extended Name_Identifier format~~

~~Bits Word~~	~~31 .. 28~~	~~27 .. 24~~	~~23 .. 16~~	~~15 .. 10~~	~~9~~	~~8~~	~~07 .. 00~~
~~0~~	~~2h~~	~~Vendor Specific~~		~~ULA Byte 0~~	~~U/L~~	~~I/G~~	~~ULA Byte 1~~
~~1~~	~~ULA Byte 2~~		~~ULA Byte 3~~	~~ULA Byte 4~~			~~ULA Byte 5~~

Table 86 — NAA IEEE 48-bit Extended Name_Identifier format

<<<All of this table 86 is new. Change markups suspended in this table 86.>>>

Bits Word	31 .. 28	27 .. 24	23 .. 16	15 .. 08	07 .. 00
0	2h	Vendor Specific		EI-48 Byte 0	EI-48 Byte 1
1	EI-48 Byte 2		EI-48 Byte 3	EI-48 Byte 4	EI-48 Byte 5

Example -

A company has ~~an IEEE Company_ID value:~~

~~AC DE 48h~~

~~This value is combined with a unique value generated by the identified company of 00 00 80h to create a ULA~~ an EUI-48 of:

AC DE 48 00 00 80h

Using this ~~ULA~~ EUI-48 and a vendor specified value of B17h, the following 64-bit Fibre Channel IEEE 48-bit Extended Name_Identifier ~~Extended identifier format~~ is created:

2B 17 AC DE 48 00 00 80

18.5 Locally Assigned

When the Name_Identifier format is locally assigned, the name value field shall be assigned in a manner determined by the administration of the Fabric in which it is assigned. This format is described in table 87.

A locally assigned Name_Identifier shall be unique within the Fibre Channel interaction space wherein it is assigned.

Table 87 — NAA Locally Assigned Name_Identifier format

Bits Word	31 .. 28	27 .. 24	23 .. 16	15 .. 08	07 .. 00
0	3h	Locally administered value			
1	Locally administered value				

18.6 IEEE Registered

When the Name_Identifier format is IEEE Registered, the name value field shall contain a CID ~~the 24-bit IEEE Company_ID in canonical form, as specified by IEEE 802,~~ followed by a 36-bit unique vendor specified identifier (VSID). This format is described in table 88.

An IEEE Registered Name_Identifier is a Worldwide_Name.

Table 88 — NAA IEEE Registered Name_Identifier format

Bits Word	31 .. 28	27 .. 24	23 .. 16	15 .. 08	07 .. 04	03 .. 00
0	5h	~~IEEE Company_ID~~ CID				VSID (35-32)
1	VSID (31-0)					

Example

A company has ~~an IEEE Company_ID~~ a CID value:

AC DE 48h

The VSID value selected by the identified company is B 17 34 F6 2Dh.

The resulting Fibre Channel IEEE Registered format is:

5A CD E4 8B 17 34 F6 2Dh

18.7 IEEE Registered Extended

When the Name_Identifier format is IEEE Registered Extended, the name value field shall contain a CID ~~the 24-bit IEEE Company_ID in canonical form, as specified by IEEE 802,~~ followed by a 36-bit unique vendor specified id (VSID). An additional 64-bit vendor specified identifier extension (VSID Extension) is defined. Name_Identifiers that identify Fibre Channel nodes or FC_Ports are limited to 64 bits and therefore shall not use the IEEE Registered Extended format. Fibre Channel FC-4 applications may extend IEEE Registered format Fibre Channel Name_Identifiers by concatenating the VSID extension field to construct IEEE Registered Extended format identifiers specific to the FC-4 application. The format of IEEE Registered Extended is described table 89.

An IEEE Registered Extended Name_Identifier is a Worldwide_Name.

Table 89 — NAA IEEE Registered Extended Name_Identifier format

Bits Word	31 .. 28	27 .. 24	23 .. 16	15 .. 08	07 .. 04	03 .. 00
0	6h	~~IEEE Company_ID~~ CID				VSID (35-32)
1	VSID (31-0)					
2	VSID Extension (63-32)					
3	VSID Extension (31-0)					

Example -

A company has ~~an IEEE Company_ID~~ a CID value:

AC DE 48h

The VSID value selected by the identified company is B 17 34 F6 2Dh and the VSID extension is 12 34 56 78 90 AB CD EFh.

The resulting Fibre Channel IEEE Registered Extended format is:

6A CD E4 8B 17 34 F6 2D 12 34 56 78 90 AB CD EFh

18.8 EUI-64 Mapped

~~**18.8.1 General**~~

When the Name_Identifier format is EUI-64 Mapped, ~~The~~ the NAA field shall contain either 0Ch, 0Dh, 0Eh, or 0Fh. The other bytes (i.e., the EUI bytes) in an EUI-64 Mapped Name_Identifier shall contain mapped values from an EUI-48 or EUI-64 (see the IEEE-SA Registration Authority identifiers tutorial). ~~The name value field shall contain a modified 22-bit IEEE Company_ID, as specified in following paragraphs, followed by a 40-bit unique VSID.~~

The EUI-64 ~~name~~ Mapped Name_Identifier uses the following modifications to specified formats in order to preserve all the unique bits in an EUI-64: ~~is so mapped to account for the 4 additional bits allocated to the VSID. The general mapping scheme is to right shift the first byte of the IEEE Company_ID, moving bits 7-2 to positions 5-0 of the WWN Byte 0. Bits 1-0 of are the Universal/Local and Individual/Group bits, presumed to always be 00b. Bits 7-6 of the WWN Byte 0 are set to 11b, and the byte is prepended to the rest of the name.~~

a) two bits of the NAA field are used to contain part of the EUI-64 identifier; and
b) two bits that are known to contain zeros are removed from the EUI-64 identifier, specifically:
   A) the low order bit of the first byte (i.e., the Individual/Group bit if the byte is contained in a MAC Address, and the M bit in the "Structure of an OUI" figure in the IEEE-SA Registration Authority identifiers tutorial); and
   B) the second lowest order bit of the first byte (i.e., the Universal/Local bit if the byte is contained in a MAC Address, and the X bit in the "Structure of an OUI" figure in the IEEE-SA Registration Authority identifiers tutorial).

In this way, the requirements in this standard for a four-bit NAA field in each 64-bit a Name_Identifier are met through the modified usage of two bits in the NAA field and removal of two bits that are always zero in the EUI-64 identifier that is being mapped to a Name_Identifier.

When creating EUI-64 Mapped Name_Identifier values EUI-64, EUI-48, or MAC Address use as inputs shall conform to the requirements in the IEEE-SA Registration Authority identifiers tutorial.

NOTE 1 - The use of some of the Company_IDs provided before January 2014 as 24-bit OUIs in the IEEE-SA Registration Authority identifiers tutorial result in EUI-64s and EUI-48s that have the necessary two zero bits as described in this subclause. As a result, these EUI-64s and EUI-48s are able to be processed as described in this subclause.

<<<start new paragraph>>> The format of EUI-64 Mapped Name_Identifier is described in table 90.

An EUI-64 Mapped Name_Identifier is a Worldwide_Name.

Table 90 — NAA EUI-64 Mapped Name_Identifier Format

Bits Word	31 30	29 24	23 16	15 08	07 00
0	11b	IEEE Company_ID (modified)			VSID (39-32)
0	11b	EUI byte 0 [a]	EUI bytes 1-3		
1	VSID (31-0)				
1	EUI bytes 4-7				

[a] Bits 7-2 only, bits 0 and 1 are discarded.

Table x1 shows how an EUI-64 is converted to an NAA EUI-64 Mapped Name_Identifier and then back to an EUI-64.

Table x1 — EUI-64 conversions to and from an NAA EUI-64 Mapped Name_Identifier

<<<All of table x1 is new. Change markups suspended in table x1.>>>

Byte Position	Bit Position	Input EUI-64	Name_ Identifier	Restored EUI-64
0	7	EUI 63	1b	EUI 63
	6	EUI 62	1b	EUI 62
	5	EUI 61	EUI 63	EUI 61
	4	EUI 60	EUI 62	EUI 60
	3	EUI 59	EUI 61	EUI 59
	2	EUI 58	EUI 60	EUI 58
	1	EUI 57 [a]	EUI 59	0b [a]
	0	EUI 56 [b]	EUI 58	0b [b]
1	7-0	EUI 55-48		
2	7-0	EUI 47-40		
3	7-0	EUI 39-32		
4	7-0	EUI 31-24		
5	7-0	EUI 23-16		
6	7-0	EUI 15-8		
7	7-0	EUI 7-0		

[a] Universal/Local bit in a MAC Address, discarded in creation of the Name_Identifier and restored as 0b.

[b] Individual/Group bit in a MAC Address, discarded in creation of the Name_Identifier and restored as 0b.

~~**18.8.2 EUI-64 to WWN Mapping Rules**~~

~~Refer to table 88, Bit Position Map. The following mapping rules apply:~~

~~a) WWN.NAA 3 and WWN.NAA 2 are set = 1;~~
~~b) EUI.OUI 23-18 are mapped to WWN.OUI 21-16;~~
~~c) EUI.OUI 15-0 are mapped one for one to WWN.OUI 15-0; and~~
~~d) EUI.VSID 39-0 are mapped one for one to WWN.VSID 39-0.~~

<<<Everything that needs to be said has been inserted before table 90. Furthermore, based on the way OUIs have been redefined by the IEEE, this standard should avoid mentioning them unless absolutely necessary.>>>

~~**18.8.3 Encapsulated MAC-48 and EUI-48 translation**~~

~~Encapsulated MAC-48 and EUI-48 names may be translated using the same rules as the EUI-64 names. Uniqueness shall be preserved.~~

Table x2 shows how an EUI-48 is converted to an NAA EUI-64 Mapped Name_Identifier and then back to an EUI-48.

Table x2 — EUI-48 conversions to and from an NAA EUI-64 Mapped Name_Identifier

<<<All of table x2 is new. Change markups suspended in table x2.>>>

Byte Position	Bit Position	Input EUI-48 [a]	Name_ Identifier	Restored EUI-48 [a]
0	7	EUI 47	1b	EUI 47
	6	EUI 46	1b	EUI 46
	5	EUI 45	EUI 47	EUI 45
	4	EUI 44	EUI 46	EUI 44
	3	EUI 43	EUI 45	EUI 43
	2	EUI 42	EUI 44	EUI 42
	1	EUI 41 [b]	EUI 43	0b [b]
	0	EUI 40 [c]	EUI 42	0b [c]
1	7-0	EUI 39-32		
2	7-0	EUI 31-24		
3	7-0	EUI 23-16		
4	7-0	EUI 15-8		
5	7-0	EUI 7-0		
6	7-0	n/a	00h	n/a
7	7-0	n/a	00h	n/a

[a] This is equally applicable to a MAC Address.
[b] Universal/Local bit in a MAC Address, discarded in creation of the Name_Identifier and restored as 0b.
[c] Individual/Group bit in a MAC Address, discarded in creation of the Name_Identifier and restored as 0b.

~~**Table 91 — Bit Position Map**~~

<<<All of table 91 is to be deleted. Change markups suspended in table 91.>>>

Byte Position	Bit Position in Byte	Bit Position in Name	EUI Values	WWN Values
0	7	63	OUI 23	1
	6	62	OUI 22	1
	5	61	OUI 21	OUI 23
	4	60	OUI 20	OUI 22
	3	59	OUI 19	OUI 21
	2	58	OUI 18	OUI 20
	1	57	OUI 17 (i.e., L/U)	OUI 19
	0	56	OUI 16 (i.e., I/G)	OUI 18
1	7-0	55-48	OUI 15-8	OUI 15-8
2	7-0	47-40	OUI 7-0	OUI 7-0
3	7-0	39-32	VSID 39-32	VSID 39-32
4	7-0	31-24	VSID 31-24	VSID 31-24
5	7-0	23-16	VSID 23-16	VSID 23-16
6	7-0	15-8	VSID 15-8	VSID 15-8
7	7-0	7-0	VSID 7-0	VSID 7-0

…

Annex I

(Informative)

Fibre Channel Interactions With the IEEE-SA Registration Authority ~~company_ID~~

I.1 Overview

At its discretion, the ~~The IEEE~~ IEEE-SA Registration Authority ~~for a fee~~ provides ~~a~~ several formats of registered ~~number that is~~ numbers that are guaranteed to be unique. Details of how these numbers are provided are managed by the IEEE-SA Registration Authority. Fibre Channel products use the following general formats of unique, registered numbers available from the IEEE-SA Registration Authority:

a) ELI-48s;
b) ELI-64s;
c) EUI-48s;
d) EUI-64s; and
e) Company_IDs (i.e., CIDs).

Company_IDs are 24-bit (i.e., 3 octet) values than may be used to create ELI-64 values and Fibre Channel Name_Identifiers (see clause 18).

~~The unique number may be provided in either of two formats, depending on the requirements of the manufacturer. The number is provided as a 6 hexadecimal number value as the IEEE company_id. The number is provided as three hexadecimal-digit pairs in canonical form representing the 3 octets of the 24-bit number as the IEEE Organizationally Unique Identifier (OUI).~~<<<start new paragraph>>>

~~A manufacturer for all its products that use an IEEE registration uses the same number. A manufacturer shall base all its identifiers on the same number, even if the identifiers have different formats.~~ <<<These sentences are not enforceable in a world where nearly every modern manufacturer is the result of one or more mergers.>>>

Under very limited conditions, the IEEE-SA Registration Authority may provide a 24-bit OUI (i.e., Organizationally Unique Identifier). Clause 18 and this annex use 24-bit OUIs interchangeably with CIDs. The IEEE-SA Registration Authority. IEEE-SA Registration Authority documentation associates 24-bit OUIs with the term MA-L (i.e., MAC Addresses - Large).

~~A manufacturer shall not purchase~~ The IEEE-SA Registration Authority requires manufacturers to:

a) to provide proof that a new ~~company_id~~ 24-bit OUI is being requested because ~~until~~ at least one of the identifier spaces using the ~~company_id~~ 24-bit OUI is substantially exhausted; and ~~. Other identifier spaces shall~~
b) continue using the original ~~company_id~~ 24-bit OUI in other identifier spaces until they are also exhausted.

The IEEE-SA Registration Authority places lower requirements on requests for new CIDs.

<<<Based on the contents of the IEEE-SA Registration Authority identifier tutorial, the following paragraph is all that can be defined in this or any Fibre Channel standard regarding the use of ELI-48 identifiers, ELI-64 identifiers, EUI-48 identifiers, and EUI-64 identifiers. The IEEE owns the formats of these identifiers and T11 dare no gainsay them.>>>

Fibre Channel products may use ELI-48s, ELI-64s, EUI-48s, and EUI-64s if conformance with the requirements stated in the IEEE-SA Registration Authority identifiers tutorial is maintained in:

a) the methods for obtaining those identifiers; and
b) the uses made of those identifiers after they are obtained.

The IEEE Registration Authority may be contacted at the following URL:
https://standards.ieee.org/products-services/regauth/index.html
~~http://standards.ieee.org/regauth/oui/index.shtml or:~~
~~IEEE Registration Authority~~
~~IEEE Standards Dept.~~
~~445 Hoes Lane, P.O. Box 1331~~
~~Piscataway, NJ 08855-1331~~

The tutorial on Fibre Channel uses of CIDs submitted to IEEE by T11 is replicated in I.4.

I.2 Uses of IEEE ~~registered Company_ID~~ identifiers other than Name_Identifiers

In addition to construction of several forms of Name_Identifiers (see clause 18 and I.4) ~~(see I.3)~~, Fibre Channel uses the ~~company_ID~~ CID in the RNFT LS_ACC (see FC-LS-4).

<<<The RNFT description was reviewed in FC-LS-3 and no for changes was found.>>>

~~**I.3 IEEE tutorial on Fibre Channel uses of company_ID**~~

~~The following text replicates the tutorial on Fibre Channel uses of company_ID submitted to IEEE by T11.~~

I.3 Historical summary of OUI, CID, ELI-48, ELI-64, EUI-48, and EUI-64

Because CIDs provided after January 2014 have a one in the bit that is equivalent to the MAC Address Universally or Locally Administered Address (U/L) bit (i.e., a MAC Address generated from that CID is defined to not be globally unique), the IEEE-SA Registration Authority

a) prohibits the use of CIDs in MAC Addresses;
b) defines ELI-48s and ELI-64s as the identifiers that use CIDs; and
c) prohibits the use of CIDs in EUI-48s and EUI-64s.

Some of the Company_IDs provided before January 2014 have the U/L bit set to zero, and therefore are able to be called 24-bit OUIs. Use pre-2014 CIDs in MAC Addresses, EUI-48s, and EUI-64s is permissible if:

a) U/L bit is zero in the CID provided by the IEEE Registration Authority; and
b) the application that is using the CID does not change the U/L bit to a one.

<<<The b) is relevant because Annex J recommends doing exactly such a thing.>>>

A single pool of 24-bit numbers is used as the source for both 24-bit OUIs (i.e., MA-Ls) and CIDs. As a result, 24-bit OUIs and CIDs are globally unique with respect to each other.

I.4 Guidelines for Fibre Channel Use of the CID ~~Company_ID~~

<<<Subclauses are no longer necessary in I.4.>>>

~~I.4.1 Overview~~

Fibre Channel standards ~~support~~ define several identifier formats (i.e., Name_Identifiers, see clause 18) that incorporate ~~IEEE OUI/~~Company_ID (i.e., CID) values. These formats are summarized in table I.1.

Table I.1 — Fibre Channel identifiers using ~~OUI~~ CIDs

NAA Type	NAA Code	Identifier size	Reference
NAA IEEE 48-bit Address	1h	16 bytes	table I.2 ~~table I.4~~
NAA IEEE 48-bit Extended	2h	16 bytes	table I.3 ~~table I.5~~
NAA IEEE Registered	5h	16 bytes	table I.4 ~~table I.6~~
NAA IEEE Registered Extended	6h	16 bytes	table I.5 ~~table I.7~~
~~NAA EUI-64 Mapped~~	~~Ch, Dh, Eh, and Fh~~	~~16 bytes~~	~~table I.8~~
<<<As shown in the updated 18.8, NAA EUI-64 Mapped Name_Identifiers are not based on CIDs (or even OUIs, come to that). As such they should not be described in the tutorial that T11 sends to the IEEE-SA Registration Authority.>>>			

~~I.4.2 OUI-based IEEE formats used by Fibre Channel~~

Editors Note 1 - ROW: All of this subclause must be removed for the reasons described in the last <<<comment>>> in I.1. The text that follows that comment is the replacement for I.4.2.

~~I.4.3 Name_Identifier formats~~

Name_Identifiers are defined in FC-FS-~~5~~6 and are used to identify Fibre Channel entities (e.g., Nx_Ports, nodes, Fx_Ports, E_Ports, B_Ports, Switches, and Fabrics). Name_Identifiers are used in several protocols specified in Fibre Channel standards. Name_Identifiers are NAA format identifiers that may include IEEE ~~OUI/~~Company_IDs.

SCSI and ATA standards also specify the use of Name_Identifiers by referencing FC-FS-6.

The NAA IEEE 48-bit Address ~~address~~ format is shown in ~~table I.4~~ table I.2.

Table I.2 — NAA IEEE 48-bit Address ~~address~~ format

Byte/Bit	7	6	5	4	3	2	1	0
0	NAA (1h)				0h			
1	00h							
2	~~ULA (see table I.2)~~ ELI-48 or EUI-48							
⋮								
7								

~~Bit 1 of byte 2, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is always set to zero.~~

~~Bit 0 of byte 2, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is always set to zero.~~

The ELI-48 and EUI-48 are as defined in the "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" tutorial.

The NAA IEEE 48-bit Extended format is shown in ~~table I.5~~ table I.3.

Table I.3 — NAA IEEE 48-bit Extended format

Byte/Bit	7	6	5	4	3	2	1	0
0	NAA (2h)				(MSB)			
1	VENDOR-SPECIFIC IDENTIFIER							(LSB)
2								
⋮	~~ULA (see table I.2)~~ ELI-48 or EUI-48							
7								

~~Bit 1 of byte 2, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is always set to zero.~~

~~Bit 0 of byte 2, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is always set to zero.~~

The ELI-48 and EUI-48 are as defined in the "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" tutorial.

The NAA IEEE Registered format is shown in ~~table I.6~~ table I.4.

Table I.4 — NAA IEEE Registered format

Byte/Bit	7	6	5	4	3	2	1	0
0	NAA (5h)				(MSB)			
1	~~Company ID (~~CID~~)~~							
2								
3				(LSB)	(MSB)			
4	VENDOR-SPECIFIC IDENTIFIER							
⋮								
7								(LSB)

~~Bit 5 of byte 1, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is always set to zero.~~

~~Bit 4 of byte 1, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is always set to zero.~~

The CID is as defined in FC-FS-6 and the "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" tutorial.

The NAA IEEE Registered Extended format is shown in ~~table I.7~~ table I.5.

Table I.5 — NAA IEEE Registered Extended format

Byte/Bit	7	6	5	4	3	2	1	0
0	NAA (6h)				(MSB)			
1	~~Company ID (~~CID~~)~~							
2								
3				(LSB)	(MSB)			
4	VENDOR-SPECIFIC IDENTIFIER							
⋮								
7								(LSB)
8	(MSB)	VENDOR-SPECIFIC IDENTIFIER EXTENSION						
⋮								
15								(LSB)

~~Bit 5 of byte 1, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is always set to zero.~~

~~Bit 4 of byte 1, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is always set to zero.~~

The CID is as defined in FC-FS-6 and the "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" tutorial.

~~The EUI-64 Mapped format is shown in table I.8.~~

~~Table I.8 — NAA EUI-64 Mapped format~~

<<<Delete all of table I.8.>>>

~~Bits 7-4 of byte 0 are also interpreted as the NAA, which may take on value Ch, Dh, Eh, or Fh, depending on bits 23 and 22 of the IEEE Company_ID from the EUI-64 (see table I.3) that is being mapped. The IEEE Company ID is the IEEE Company ID from the EUI-64 that is being mapped, with the following modifications:~~

~~a) bit 17 of the IEEE company_ID from the EUI-64 (see table I.3) that is being mapped, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is assumed to be set to zero and is omitted; and~~
~~b) bit 16 of the IEEE company_ID from the EUI-64 (see table I.3) that is being mapped, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is assumed to be set to zero and is omitted.~~

~~VENDOR-SPECIFIC IDENTIFIER is the vendor specific identifier from the EUI-64 (see table I.3) that is being mapped.~~