IEEE STANDARDS ASSOCIATION

IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture

Amendment 2: Local Medium Access Control (MAC) Address Usage

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 802c™-2017
(Amendment to
IEEE Std 802®-2014
as amended by IEEE Std 802d™-2017)

IEEE Std 802c™-2017
(Amendment to
IEEE Std 802®-2014
as amended by IEEE Std 802d™-2017)

IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture

Amendment 2: Local Medium Access Control (MAC) Address Usage

Sponsor

LAN/MAN Standards Committee
of the
IEEE Computer Society

Approved 15 June 2017

IEEE-SA Standards Board

Abstract: An optional local medium access control (MAC) address space structure, known as the Structured Local Address Plan (SLAP), is provided in this amendment to IEEE Std 802®-2014 in order to allow multiple administrations to coexist. This structure designates a range of local MAC addresses for protocols using a Company ID (CID) assigned by the IEEE Registration Authority. Another range of local MAC addresses is designated for assignment by administrators. The amendment recommends a range of local MAC addresses for use by IEEE 802® protocols.

Keywords: AAI, Administratively Assigned Identifier, CID, Company ID, ELI, Extended Local Identifier, global address, IEEE 802®, IEEE Registration Authority, local address, MAC, medium access control, SAI, SLAP, Standard Assigned Identifier, Structured Local Address Plan

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

PDF: ISBN 978-1-5044-4100-1 STD22632
Print: ISBN 978-1-5044-4101-8 STDPD22632

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading "Important Notices and Disclaimers Concerning IEEE Standards Documents." They can also be obtained on request from IEEE or viewed at http://standards.ieee.org/IPR/disclaimers.html.

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association ("IEEE-SA") Standards Board. IEEE ("the Institute") develops its standards through a consensus development process, approved by the American National Standards Institute ("ANSI"), which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE Standards are documents developed through scientific, academic, and industry-based technical working groups. Volunteers in IEEE working groups are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE Standards do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at http://ieeexplore.ieee.org or contact IEEE at the address listed previously. For more information about the IEEE SA or IEEE's standards development process, visit the IEEE-SA Website at http://standards.ieee.org.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: http://standards.ieee.org/findstds/errata/index.html. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at http://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this amendment was submitted to the IEEE-SA for approval, the IEEE 802.1 Working Group had the following membership:

Glenn Parsons, *Chair*
John Messenger, *Vice-Chair*
Pat Thaler, *Chair, Data Center Bridging Task Group*
Roger B. Marks, *IEEE 802c Technical Editor*

SeoYoung Baek
Shenghua Bao
Jens Bierschenk
Steinar Bjornstad
Christian Boiger
Paul Bottorff
David Chen
Feng Chen
Weiying Cheng
Rodney Cummings
Janos Farkas
Norman Finn
Mickael Fontaine
Geoffrey Garner
Eric Gray
Craig Gunther
Marina Gutierrez
Stephen Haddock
Mark Hantel
Patrick Heffernan
Marc Holness
Anthony Jeffree
Michael Johas Teener
Hal Keen
Stephan Kehrer
Philippe Klein
Jouni Korhonen
Yizhou Li
Christophe Mangin
Tom McBeath
James McIntosh
Robert Moskowitz
Tero Mustala
Hiroki Nakano
Bob Noseworthy
Donald R. Pannell
Walter Pienciak
Michael Potts
Karen Randall
Maximilian Riegel
Jessy Rouyer
Eero Ryyty
Soheil Samii
Behcet Sarikaya
Frank Schewe
Michael Seaman
Johannes Specht
Paul Unbehagen
Hao Wang
Karl Weber
Brian Weis
Jordon Woods
Nader Zein
Helge Zinner
Juan Carlos Zuniga

In addition, contributions from Robert Grow and the IEEE Registration Authority (RA) Committee were valuable in ensuring consistency with IEEE RA policies.

The following members of the individual balloting committee voted on this amendment. Balloters may have voted for approval, disapproval, or abstention.

Osama Aboulmagd
Thomas Alexander
James D. Allen
Johann Amsenga
Butch Anton
Harry Bims
Nancy Bravin
Vern Brethour
Demetrio Bucaneg
William Byrd
Juan Carreon
Yesenia Cevallos
Keith Chow
Charles Cook
Rodney Cummings
Patrick Diamond
Richard Doyle
Sourav Dutta
Donald Eastlake
Marc Emmelmann
Janos Farkas
Andrew Fieldsend
Norman Finn
Michael Fischer
Matthias Fritsche
Geoffrey Garner
James Gilb
David Gregson
Randall Groves
Robert Grow
Michael Gundlach
Gloria Gwynne
Rainer Hach
Stephen Haddock
Mark Hamilton
Jerome Henry
Marco Hernandez
Werner Hoelzl
Rita Horner
Russell Housley
Tetsushi Ikegami
Noriyuki Ikeuchi
Atsushi Ito
Raj Jain
Sangkwon Jeong
Piotr Karocki
Stuart Kerry
Yongbum Kim
Jouni Korhonen
George Kyle
Mark Laubach
James Lepp
Joseph Levy
Jon Lewis
Michael Lynch
Roger B. Marks
Michael McInnis
Michael Montemurro
Jose Morales
Michael Newman
Nick S. A. Nikjoo
Paul Nikolich
Satoshi Obara
Robert O'Hara
Glenn Parsons
Bansi Patel
Arumugam Paventhan
Michael Peters
R. K. Rannow
Alon Regev
Maximilian Riegel
Robert Robinson
Jon Rosdahl
Jessy Rouyer
Richard Roy
Noriyuki Sato
Frank Schewe
Dieter Schicketanz

Reinhard Schrage
Michael Seaman
Di Dieter Smely
Dorothy Stanley
Thomas Starai
Adrian Stephens
Walter Struppler
Michael Thompson
Steven Tilden
Mark-Rene Uchida
George Vlantis
Lei Wang
Karl Weber
Andreas Wolf
Chun Yu Charles Wong
Peter Wu
Oren Yuen
Zhen Zhou

When the IEEE-SA Standards Board approved this amendment on 15 June 2017, it had the following membership:

Jean-Philippe Faure, *Chair*
Gary Hoffman, *Vice Chair*
John D. Kulick, *Past Chair*
Konstantinos Karachalios, *Secretary*

Chuck Adams
Masayuki Ariyoshi
Ted Burse
Stephen Dukes
Doug Edwards
J. Travis Griffith
Michael Janezic
Thomas Koshy
Joseph L. Koepfinger*
Kevin Lu
Daleep Mohla
Damir Novosel
Ronald C. Petersen
Annette D. Reilly
Robby Robson
Dorothy Stanley
Adrian Stephens
Mehmet Ulema
Phil Wennblom
Howard Wolfman
Yu Yuan

*Member Emeritus

Introduction

This introduction is not part of IEEE Std 802c-2017, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture—Amendment 2: Local Medium Access Control (MAC) Address Usage.

This amendment to IEEE Std 802-2014 provides an optional local medium access control (MAC) address space structure, known as the Structured Local Address Plan (SLAP), to allow multiple administrations to coexist. This structure designates a range of local MAC addresses for protocols using a Company ID (CID) assigned by the IEEE Registration Authority (RA). Another range of local MAC addresses is designated for assignment by administrators. The amendment recommends a range of local MAC addresses for use by IEEE 802® protocols. It also corrects minor errors, ambiguities, omissions, and inconsistencies, including clarifying the use of CID in protocol identifiers.

Contents

IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture

Amendment 2: Local Medium Access Control (MAC) Address Usage

(This amendment is based on IEEE Std 802®-2014 as amended by IEEE Std 802d™-2017.)

NOTE—The editing instructions contained in this amendment define how to merge the material contained here into the base document and its other amendments to form the new comprehensive standard.

Editing instructions are shown ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using either ~~strikethrough~~ (to remove old material) or underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.[1]

3. Definitions, acronyms, and abbreviations

3.1 Definitions

Insert the following terms into 3.1 in alphabetical order:

local MAC address: A medium access control (MAC) address with the universally or locally administered (U/L) bit set to 1.

Network Unique Identifier (NUI): An identifier that is unique within the IEEE 802® local area network (LAN).

[1] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

Structured Local Address Plan (SLAP): An optional standardized specification for the use of local medium access control (MAC) address space entailing the use of Extended Local Identifier (ELI), Standard Assigned Identifier (SAI), and Administratively Assigned Identifier (AAI) addresses in specific disjoint ranges.

3.2 Acronyms and abbreviations

Change the following abbreviation in 3.2 as indicated:

CID Ceompany IDidentifier

Insert the following abbreviations into 3.2 in alphabetical order:

AAI Administratively Assigned Identifier

AAI-48 48-bit AAI

AAI-64 64-bit AAI

ELI Extended Local Identifier

ELI-48 48-bit ELI

ELI-64 64-bit ELI

NUI Network Unique Identifier

NUI-48 48-bit NUI

NUI-64 64-bit NUI

SAI Standard Assigned Identifier

SAI-48 48-bit SAI

SAI-64 64-bit SAI

SLAP Structured Local Address Plan

Relative to "EUI-48" and "EUI-64" throughout the entire base standard, change both singular and plural forms of the term "extended unique identifier" to the capitalized form "Extended Unique Identifier."

Relative to "OUI" throughout the entire base standard, change both singular and plural forms of the term "organizationally unique identifier" to the capitalized form "Organizationally Unique Identifier".

5. Reference models (RMs)

5.2 RM description for end stations

5.2.2 LLC sublayer

Change the third paragraph of 5.2.2, resulting in two paragraphs, as follows:

IEEE Std 802.3™ is capable of natively representing the EtherType within its MAC frame format, which is used to support EPD. IEEE Std 802.3 also natively supports ISO/IEC 8802-2 LPD (over a limited range of frame sizes). In other IEEE 802 networks, such as for IEEE Std 802.11™, LPD with is also achieved using SNAP is used, as described in Clause 9. In either of these techniques, the EtherType is effectively being

used as a means of identifying an LSAP that provides LLC sublayer service to the protocol concerned. For further details, refer to Clause 12 of IEEE Std 802.1AC-2016.

New IEEE 802 standards shall support protocol discrimination in the LLC sublayer using EPD.

8. MAC addresses

8.2 Universal addresses

8.2.2 Assignment of universal addresses

Change Note 1 and Note 2 (after Table 1) in 8.2.2 as shown, including deleting footnote 13:

NOTE 1—The terms OUI and OUI-36 were previously used by the IEEE RA to refer both to the globally unique 24-bit OUI and 36-bit identifiers and to the "products" that included the identifier and a block of addresses. The OUI "product" was replaced by the MA-L that, in addition to the address block, includes an assignment of an OUI; likewise, the OUI-36 was replaced by the MA-S that includes the assignment of an an address block and an OUI-36. ~~to what are now called MA-L and MA-S, respectively. The acronym OUI without modification was used to refer to the 24-bit field assigned by the IEEE RA. However, while not appropriate, the acronym OUI has been used to refer to generally to all IEEE RA assignments. As a result, t~~The use of the terms ~~OUI~~ is not always consistent within ~~all~~ IEEE standards.

NOTE 2—~~The CID comes from the same 24-bit space as the MA-L/OUI.~~ A CID assignment is used to identify a company or organization~~, but~~. It is not used to create universal addresses. For more information, see 8.4. ~~A CID assignment has the X bit (the U/L address bit in a MAC address) set to one, which would place any address created with a CID in the locally administered address space.~~[13]

[13]~~More information on CIDs can be found on the IEEE RA tutorial web page, http://standards.ieee.org/develop/regauth/tut/index.html.~~

Change the sixth paragraph of 8.2.2 as indicated:

The U/L bit indicates whether the MAC address has been assigned by a local or universal administrator. Universal addresses have the U/L bit set to 0. If the U/L bit is set to 1, the address is ~~remaining bits (i.e., all bits except the I/G and U/L bits) are~~ locally administered, as described in 8.4~~and should not be expected to meet the uniqueness requirement of the IEEE RA-assigned values~~.

In Figure 10 and Figure 11, change the Octet 4 box as indicated:

Octet 4 01111~~10~~011

Change the note after Figure 10 in 8.2.2 as follows:

NOTE 3—The octet string AC-DE-48-12-7B-80 is used in this standard because it is clear when a bit pattern is reversed. This octet string could be in use and is not a reserved value. While AC-DE-48 is used as the same first 3 octets for the examples of MA-L, MA-M, and MA-S, the first 3 octets are different for valid assigned RA values.

Change the note after the last paragraph in 8.2.2 as follows:

NOTE 4—The upper, bit-stream representation of the EUI-48 in Figure 10 and the EUI-64 in Figure 11 shows the LSB of each octet first; this corresponds to the data-communications convention for representing bit-serial transmission in left-to-right order, applied to the model for transmission of EUI-48 fields (see 5.2.3) and EUI-64 fields. See also 8.6 for further discussion of bit-ordering issues. The lower, octet-sequence representation shows the bits within each octet in the usual order for binary numerals; the order of octet transmission is from the top downward.

8.4 Local MAC addresses

Delete the text of 8.4 as shown, including deleting footnote 14:

~~Local MAC addresses are 48 bit or 64 bit MAC addressees for which there is no guarantee that the MAC address is unique in all IEEE 802 networks. Local MAC addresses may be assigned any value that has the U/L bit set to indicate a local MAC addresses and an I/G bit value that indicates whether the MAC address is individual or group. Local MAC addresses need to be unique on a LAN or bridged LAN unless the bridges support VLANs with independent learning.~~

~~The I/G bit is set as described in 8.2.2.~~

~~NOTE—MA-L, MA-M, and MA-S assignments do not apply to local MAC addresses. Refer to the IEEE RA web site[14] or recommendations for management of the local MAC address space.~~

~~[14] http://standards.ieee.org/develop/regauth.~~

Insert the following subclauses (8.4.1 through 8.4.6, including Figure 11a and Figure 11b and Table 1a through Table 1e) after the subclause heading for 8.4:

8.4.1 Concept and overview

The U/L bit of a local MAC address is set to 1, indicating that the remaining bits (i.e., all bits except the U/L bit and the I/G bit, which is set as described in 8.2.2) are locally administered. Local MAC addresses are not presumed globally unique across all IEEE 802 networks. The locally administered bits of local MAC addresses are arbitrarily assignable under the condition that local MAC addresses are unique within a LAN (which may be a bridged LAN or virtual bridged LAN). In a virtual bridged LAN wherein the bridges use Independent VLAN Learning, the uniqueness condition applies to each VLAN rather than to the entire virtual bridged LAN. Any failure of such uniqueness invalidates the fundamental premises of IEEE 802 network operation and may lead to disruption. Therefore, administrators should ensure that the probability of local MAC address non-uniqueness is acceptably small.

While a local administrator may assign addresses throughout the local range, the optional Structured Local Address Plan (SLAP) specifies different assignment approaches in four specified regions of local MAC address space.

Unlike universal addresses, which are persistent to the MAC entity, local MAC addresses are not necessarily persistent. The local MAC address assigned to a MAC entity, including any subsequent change to that assignment, is entirely within the scope of the local administration.

8.4.2 Local MAC address assignment protocols

An address assignment protocol assigning local MAC addresses to devices on a LAN should ensure uniqueness of those addresses, per the description of F.1.2 of IEEE Std 802.1Q. That standard's Annex F also identifies risks of non-uniqueness.

When multiple address assignment protocols operate on a LAN without centralized administration, address duplication is possible even if each protocol alone is designed to avoid duplication. When multiple address assignment protocols operate on a LAN without centralized administration, address duplication is possible, even if each protocol alone is designed to avoid duplication, unless such protocols assign addresses from disjoint address pools.

The subclauses below specify the usage of local MAC address space according to the SLAP. Administrators who deploy multiple protocols on a LAN in accordance with the SLAP will enable the unique assignment of

local MAC addresses within the LAN as long as each protocol maintains unique assignments within its own address subspace.

8.4.3 Structured Local Address Plan (SLAP)

The SLAP specifies use of local MAC address space. Under the SLAP, the use is specified differently in four quadrants of local MAC address space.

The least and second least significant bits of the initial octet of a MAC address are designated the M bit and X bit, respectively, using the terminology specified in the IEEE RA "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)" [Ba]. The third and fourth least significant bits of the initial octet in the local MAC address are designated the Y bit and Z bit, respectively, as illustrated for a 48-bit address in Figure 11a (see NOTE 4 of 8.2.2).

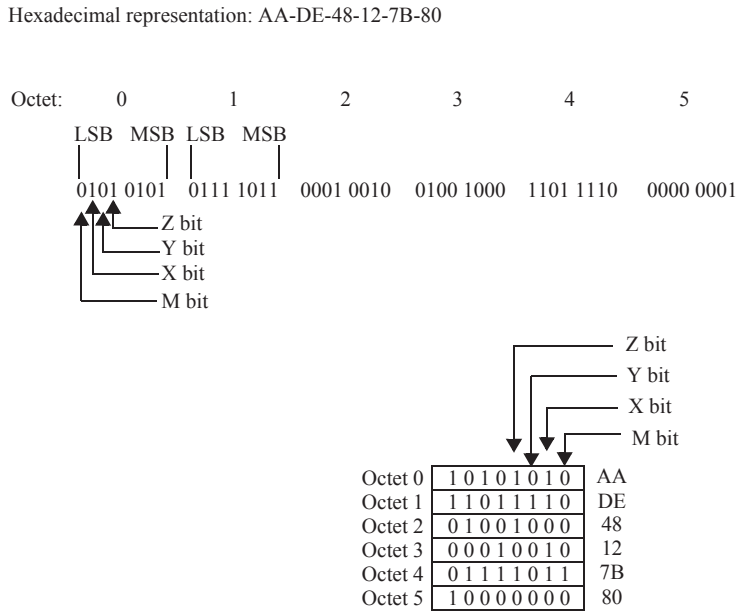

Figure 11a—M, X, Y, and Z bits of local MAC address

A local address exists in one of four SLAP quadrants, each identified by a different combination of the Y and Z bits, as indicated in Table 1a. That table also indicates the SLAP local identifier type specified for each SLAP quadrant. The SLAP local identifier types are specified in 8.4.4.

Table 1a—SLAP quadrants

SLAP quadrant	Y bit	Z bit	SLAP local identifier type	SLAP local identifier
01	**0**	**1**	Extended Local	ELI
11	**1**	**1**	Standard Assigned	SAI
00	**0**	**0**	Administratively Assigned	AAI
10	**1**	**0**	*Reserved*	*Reserved*

NOTE 1—The specific address used in this example is not a reserved value.

NOTE 2—The bit-stream representation of the addresses in Figure 11a and Figure 11b show the LSB of each octet first; this corresponds to the data-communications convention for representing bit-serial transmission in left-to-right order. See also 8.6 for further discussion of bit-ordering issues.

8.4.4 SLAP local identifier types

8.4.4.1 Extended Local Identifier (ELI)

A SLAP identifier of type "Extended Local" is known as an Extended Local Identifier (ELI). ELIs fall in SLAP Quadrant 01. The X, Y, and Z bits of an ELI are 1, 0, 1, respectively. An ELI may be used as local MAC address; such an address is known as an ELI address.

The IEEE RA uniquely assigns a 24-bit identifier known as the Company ID (CID)[2] to identify a company, organization, entity, protocol, etc., as described in the IEEE RA "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)" [Ba].

An ELI is based on an assigned Company ID. Two different lengths of ELI are specified: ELI-48 is a 48-bit ELI, and ELI-64 is a 64-bit ELI, as described in Table 1b.

Table 1b—IEEE RA CID and ELI summary

IEEE RA assignment	Number of bits (including I/G and U/L) assigned by IEEE RA	Address block size, ELI-48	Address block size, ELI-64
Company ID (CID)	24	2^{24}	2^{40}

The structure of the CID is identical to that of the MA-L/OUI, which is illustrated in Figure 9. However, the CID is not used to create universal addresses. Each CID assignment provided by the IEEE RA has the X bit set to 1, so that any MAC address created by extension of the CID, as shown below in Figure 11b, exists in locally administered address space. Changing the X bit of an RA-assigned OUI is not authorized by the IEEE RA, does not result in a valid CID, may invalidly duplicate a valid CID assignment, and shall not be used as the basis of an ELI. Likewise, changing the X bit of an RA-assigned CID is not authorized by the IEEE RA, does not result in a valid OUI, may invalidly duplicate a valid OUI assignment, and shall not be used as the basis of an EUI.

While each CID assignment provided by the IEEE RA has the M bit (the LSB of the initial octet, using the terminology specified in the IEEE RA "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)" [Ba]) set to 0, the corresponding bit of the ELI address represents the I/G bit and is set as described in 8.2.2.

An ELI-48 or ELI-64 created as an extension of the CID consists of two parts: the leading 24 bits are assigned as the CID, with the I/G bit assignable as described in 8.2.2, and the remaining bits are specified as an extension by the CID assignee or by a protocol designated by the CID assignee.

[2] More information on CIDs can be found on the IEEE RA tutorial web page, http://standards.ieee.org/develop/regauth/tut/index.html.

Several CIDs are reserved as Administrator CIDs and not assigned exclusively. The local administrator is an implicitly authorized assignee of the Administrator CIDs and may, within the SLAP, create and assign an ELI as an extension of an Administrator CID. Administrator CIDs are specified in Table 1c.

Table 1c—Administrator CIDs

Administrator CIDs
3AA3F8
CA30BF
4A07D6
FA94F1

An example of an ELI-48 created by extension of a CID is shown in Figure 11b (see NOTE 4 of 8.2.2). An ELI-64 is created with the same method but using two additional octets.

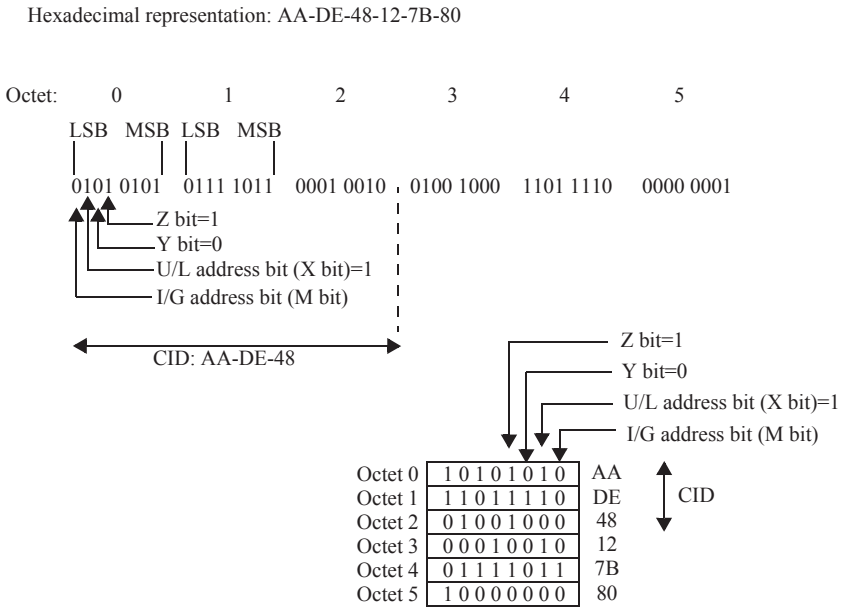

Figure 11b—Example ELI-48 created as an extension of CID

NOTE—The specific CID and ELI-48 used in this example are not reserved values.

As illustrated in Figure 11b, the third and fourth least significant bits of the initial octet in the CID are designated the Y bit and Z bit, respectively. IEEE 802 standards support the use of ELI-48 and ELI-64 based on CID only for CID values that specify 0 for the Y bit and 1 for the Z bit. The IEEE RA assigns CIDs only with 0 for the Y bit and 1 for the Z bit.

In some cases, an ELI assignment protocol may assign the 24-bit or 40-bit extension of the ELI to convey specific information. Such information may be interpreted by receivers and bridges that recognize the CID and are cognizant of the protocol identified by the CID. The functionality of receivers and bridges that do not recognize the protocol is not affected. Such address formats, and their interpretation, are outside the scope of this standard but may be specified by the entity to which the specific CID is assigned by the IEEE RA. Note, in contrast, the IEEE RA admonition against a similar usage in the global address space (from the IEEE RA "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)" [Ba]): "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."[3]

8.4.4.2 Standard Assigned Identifier (SAI)

A SLAP identifier of type "Standard Assigned" is known as a Standard Assigned Identifier (SAI). SAIs fall in SLAP Quadrant 11. The X, Y, and Z bits of an SAI are 1, 1, 1, respectively. An SAI may be used as local MAC address; such an address is known as an SAI address. Specification of the use of the SAI quadrant for SLAP address assignments is reserved for the standard forthcoming from IEEE P802.1CQ [Bb].

An SAI is assigned by a protocol specified in an IEEE 802 standard.

Two different lengths of SAI are specified: SAI-48 is a 48-bit SAI, and SAI-64 is a 64-bit SAI.

Multiple protocols for assigning SAI may be specified within various IEEE 802 standards. Coexistence of such protocols may be supported by restricting each to assignments within a subspace of SAI space. In some cases, an SAI assignment protocol may assign the SAI to convey specific information. Such information may be interpreted by receivers and bridges that recognize the specific SAI assignment protocol, as identified by the subspace of the SAI. The functionality of receivers and bridges that do not recognize the protocol is not affected. SAI address formats, and their interpretation, are outside the scope of this standard but may be specified in other IEEE 802 standards.

8.4.4.3 Administratively Assigned Identifier (AAI)

A SLAP identifier of type "Administratively Assigned" is known as an Administratively Assigned Identifier (AAI). AAIs fall in SLAP Quadrant 00. The X, Y, and Z bits of an SAI are 1, 0, 0, respectively. An AAI may be used as local MAC address; such an address is known as an AAI address.

Administrators who wish to assign local MAC addresses in an arbitrary fashion (for example, randomly) and yet maintain compatibility with other assignment protocols operating under the SLAP on the same LAN may assign a local MAC address as AAI.

Two different lengths of AAI are specified: AAI-48 is a 48-bit AAI, and AAI-64 is a 64-bit AAI, as described in Table 1d.

Per IETF RFC 2464 [B2a], a multicast IPv6 packet uses a Ethernet destination address whose first 2 octets are the value 33-33 hexadecimal. Such addresses lie within the AAI quadrant of multicast local MAC address space. Therefore, administrators who wish to support IPv6 should not assign AAIs beginning with 33-33.

[3] In August 2017, the IEEE RA tutorial "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company ID (CID)," including discussion of the ELI and the SLAP, superseded the tutorial "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)." The tutorial is available at https://standards.ieee.org/develop/regauth/tut/eui.pdf.

Table 1d—AAI summary

IEEE 802 assignment	Number of bits (including I/G and U/L) assigned by IEEE Std 802	Address block size, AAI-48	Address block size, AAI-64
Bits M,X,Y,Z	4	2^{44}	2^{60}

8.4.4.4 SLAP Quadrant 10

Under the SLAP, the local identifiers in SLAP Quadrant 10 are reserved for future use.

While SLAP Quadrant 10 identifiers remain reserved, they may be administratively used and assigned in accordance with the considerations specified for AAI usage, without effect on SLAP assignments. However, administrators should be cognizant of possible future specifications regarding SLAP Quadrant 10 that would render administrative assignment incompatible with the SLAP.

8.4.5 SLAP Local MAC address summary

For compliance to the SLAP, local addresses shall be assigned only as valid ELIs, SAIs, or AAIs.

Table 11e summarizes the local MAC address assignments specified within the SLAP.

Table 1e—Local MAC addresses per SLAP (informative)

SLAP local address	M bit	X bit	Y bit	Z bit	SLAP Quadrant	Number of bits (including I/G and U/L) assigned by IEEE RA or IEEE Std 802
ELI-48	I/G	1	0	1	01	24 (CID)
ELI-64	I/G	1	0	1	01	24 (CID)
SAI-48	I/G	1	1	1	11	4
SAI-64	I/G	1	1	1	11	4
AAI-48	I/G	1	0	0	00	4
AAI-64	I/G	1	0	0	00	4
Reserved	I/G	1	1	0	10	—

NOTE—While IEEE Std 802 assigns four SAI bits, additional SAI bits may be also be assigned by IEEE 802 standards.

8.4.6 Network Unique Identifier (NUI)

A Network Unique Identifier (NUI) is an identifier that is unique within the IEEE 802 LAN (which may be a bridged LAN or virtual bridged LAN). An NUI-48 is a 48-bit NUI that is an EUI-48, ELI-48, SAI-48, or AAI-48. An NUI-64 is a 64- bit NUI that is an EUI-64, ELI-64, SAI-64, or AAI-64.

Change the title of Clause 9 as indicated:

9. Protocol identifiers and context-dependent identifiers

9.2 EtherTypes

9.2.1 Format, function, and administration

Delete the first paragraph ("Protocol ... station.") of 9.2.1.

Change the now second paragraph of 9.2.1 as indicated:

Examples of EtherTypes are 0x0800 and 0x86DD, which are used to identify IPv4 and IPv6, respectively.

9.2.4 OUI Extended EtherType

Change the second and third paragraphs and intervening note of 9.2.4 (including Figure 13) as indicated:

The OUI Extended EtherType is processed by the HLPDE ~~in the same manner as other Ethertype values~~. Immediately following the EtherType value is a protocol identifier, as described in 9.5, consisting of a 3-octet OUI or CID value followed by 2 octets administered by the OUI or CID assignee. The OUI or CID value provides an administrative context within which the assignee can allocate values to a 16-bit protocol subtype. This approach is closely similar to the LPD-based SNAP identifier mechanism specified in 9.5; however, the OUI Extended EtherType is used instead ~~place~~ of the LPD method ~~header~~.

NOTE—The 2 octets of the protocol identifier that are administered by the OUI or CID assignee can be used in any way that the assignee chooses; however, as OUIs are a scarce ~~finite~~ resource, it is advisable not to choose an allocation approach that is wasteful, as would be the case, for example, if the assignee chose to use these 2 octets to encode a length value.

Figure 13 shows the format of an IEEE 802.3 frame carrying the OUI Extended EtherType in the Length/Type field. The value used for the OUI component of the protocol identifier is an OUI or CID value assigned to the organization that has developed the vendor-specific protocol. The combination of the OUI Extended EtherType, the OUI or CID value, and the 16-bit value administered by the OUI or CID assignee provides a unique ~~P~~protocol Identification field ~~identifier~~ for the vendor-specific protocol. The 16-bit values are administered by the organization to which the OUI or CID has been assigned; their meaning can, therefore, be correctly interpreted only by reference to the organization that owns the OUI or CID concerned.

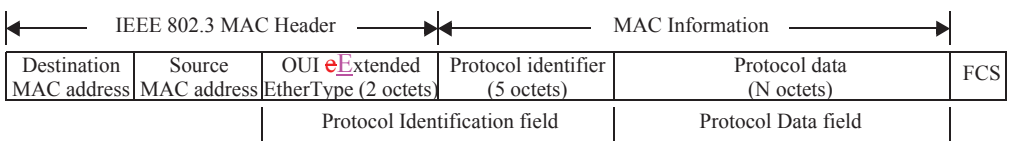

Figure 13—IEEE 802.3 frame with the OUI Extended EtherType encoded in the Length/Type field

Change the sixth paragraph and Figure 14 of 9.2.4 as shown:

As the OUI Extended EtherType is a normal EtherType value, it is possible to use the encoding described in 9.4 to carry its value within an LPD PDU, using a SNAP identifier with the IETF RFC 1042 [B1] OUI. Figure 14 shows the format of an IEEE 802.3 frame carrying the OUI Extended EtherType encoded in this way. In this case, it would be more appropriate to use the SNAP identifier directly (i.e., omit the ~~IETF~~ RFC 1042 OUI and OUI Extended EtherType fields shown in Figure 14); however, this is a valid encoding of the OUI Extended EtherType that can result from the application of the encapsulation described in 9.4.

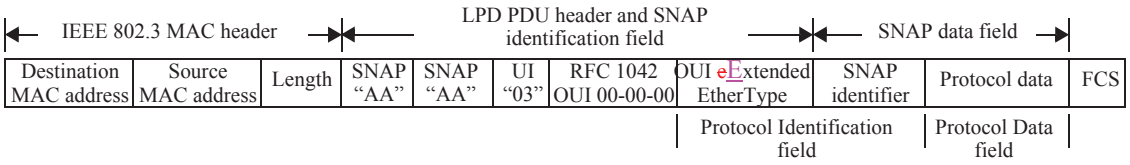

Figure 14—IEEE 802.3 frame with the OUI Extended EtherType encoded in an LPD PDU

Change the title, text, and Figure 15 of 9.3 as shown:

9.3 OUI, CID, and OUI-36 as protocol identifiers

An organization that has an OUI, CID, or OUI-36 assigned to it may use its OUI, CID, or OUI-36 to assign globally ~~universally~~ unique protocol identifiers to its own protocols, for use with various protocols described in IEEE 802 standards, potentially with additional octets as part of the identifier.

The LSB of the first octet of an OUI or CID, as shown in Figure 15, or OUI-36, as shown in Figure 16~~, used as a protocol identifier~~ is referred to as the M bit (see NOTE 4 of 8.2.2). All OUI, CID, and OUI-36 identifiers assigned by the IEEE have the M bit set to zero~~. V~~; values with the M bit set to one are reserved.

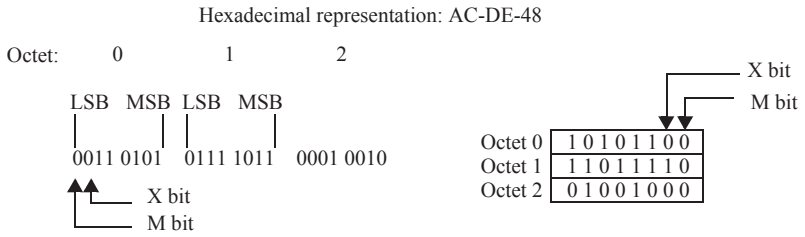

Figure 15—Format of an OUI or CID used as protocol identifier

Figure 16 remains unchanged.

The X bit of a protocol identifier is the bit of the first octet adjacent to the M bit. All OUI and OUI-36 identifiers assigned by the IEEE with the X bit set to zero may be used as OUI or OUI-36 protocol identifiers, respectively, and may also be used to create EUI-48 and EUI-64 addresses. An OUI or OUI-36 identifier assigned by the IEEE with the X bit set to one shall ~~only~~ be used only as an OUI or OUI-36 protocol identifier, respectively. All CID identifiers assigned by the IEEE have the X bit set to one. Any MAC addresses ~~created~~ with ~~an OUI or OUI-36 with~~ the X bit set to one are, by definition, locally administered addresses; they may be used, but there is no assurance of uniqueness.

9.5 SNAP

Change 9.5 as indicated:

SNAP provides a method for multiplexing and demultiplexing of private and public protocols among multiple users of the LLC sublayer. An organization that has an OUI or CID assigned to it may use its OUI or CID to assign globally ~~universally~~ unique protocol identifiers to its own protocols, for use in the protocol identification field of SNAP data units.

9.5.1 SNAP identifier

Change 9.5.1 (including Figure 17) as follows:

The SNAP identifier is 5 octets in length and follows the LPD header in a frame. The first 3 octets of the SNAP identifier consist of the OUI or CID ~~in exactly the same fashion as in EUI-48~~. The remaining 2 octets are administered by the assignee. In the SNAP identifier, an example of which is shown in Figure 17 (see NOTE 4 of 8.2.2), the OUI or CID is contained in octets 0, 1, 2 with octets 3, 4 being assigned by the assignee of the OUI or CID.

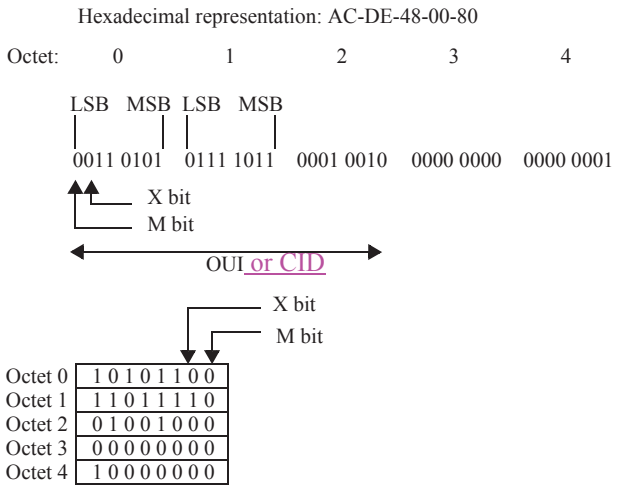

Figure 17—SNAP identifier

The standard representation of a SNAP identifier is as a string of 5 octets using the hexadecimal representation.

The LSB of the first octet of a SNAP identifier is referred to as the M bit. All SNAP identifiers derived from OUIs or CIDs assigned by the IEEE shall have the M bit set to zero. ~~V~~; values with the M bit set to one are reserved.

SNAP identifiers may be assigned universally or locally. The X bit of a SNAP identifier is the bit of the first octet adjacent to the M bit. All universally assigned SNAP identifiers derived from OUIs have the X bit set to zero. All universally assigned SNAP identifiers derived from CIDs have the X bit set to one. ~~SNAP identifiers with the X bit set to one are locally assigned and have no relationship to the protocol identifiers assigned by the IEEE RA. They may be used, but there is no assurance of uniqueness.~~

Insert the following subclause (9.6) after 9.5.3:

9.6 Context-dependent identifiers

According to the IEEE RA "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)" [Ba], "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."[4]

In some cases, the "context" of a context-dependent identifier is the IEEE 802 LAN. Since this is the same context in which local identifiers operate, the SLAP of Clause 8 provides a basis to assign unique context-dependent identifiers, such as NUI-48 and NUI- 64, within that context.

[4] In August 2017, the IEEE RA tutorial "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company ID (CID)," including discussion of the ELI and the SLAP, superseded the tutorial "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)." The tutorial is available at https://standards.ieee.org/develop/regauth/tut/eui.pdf.

Annex A

(informative)

Bibliography

Insert the following bibliographical references into Annex A in alphanumeric order:

[Ba] IEEE Registration Authority Tutorial, "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)" (https://standards.ieee.org/develop/regauth/tut/eui.pdf).[5]

[Bb] IEEE Project Authorization Request (PAR) P802.1CQ, "Draft Standard for Local and Metropolitan Area Networks: Multicast and Local Address Assignment," February 2016.[6,7]

[B2a] IETF RFC 2464, Transmission of IPv6 Packets over Ethernet Networks.[8]

[5] In August 2017, the IEEE RA tutorial "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company ID (CID)," including discussion of the ELI and the SLAP, superseded the tutorial "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)." The tutorial is available at https://standards.ieee.org/develop/regauth/tut/eui.pdf.

[6] This IEEE standards project was not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining a draft, contact the IEEE.

[7] IEEE publications are available from The Institute of Electrical and Electronics Engineers (http://standards.ieee.org/).

[8] IETF documents (i.e., RFCs) are available the Internet Engineering Task Force (http://www.rfc-archive.org/).

Annex E

(informative)

History

Insert the following subclause (E.3) after E.2:

E.3 Local MAC addresses

The amendment IEEE Std 802c-2017 on local MAC address usage introduced the Structured Local Address Plan (SLAP), the Extended Local Identifier (ELI), the Administratively Assigned Identifier (AAI), and the Standard Assigned Identifier (SAI). Prior to that amendment, IEEE Std 802 provided little normative content regarding the use of local MAC address space beyond the description of the U/L bit. A brief subclause on local MAC addresses was introduced in the revision IEEE Std 802-2014, stating that local MAC addresses "need to be unique on a LAN or bridged LAN unless the bridges support VLANs with independent learning." That revision also introduced the Company ID (CID), referring to the IEEE RA for details. It did not specify the creation of local MAC addresses based on CID, but it did hint at the possibility, stating that "A CID assignment has the X bit (the U/L address bit in a MAC address) set to one, which would place any address created with a CID in the locally administered address space."

The IEEE RA opened its CID registry on 1 January 2014. Later that year, the IEEE introduced an expanded version of its tutorial "Guidelines for use of the 24-bit Organizationally Unique Identifiers (OUI)" as "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID) [Ba]," including explanatory material regarding CID. Using language similar to that of IEEE Std 802-2014, the tutorial also suggested the possibility of building a local MAC address from a CID ("A CID has the X bit equal to one and consequently that places any address with the CID as its first 3 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 .... If a CID is used to create MAC addresses, the X bit becomes the U/L bit ... 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.")[9]

All CIDs publicly listed by the IEEE RA are assigned with the Y and Z bits equal to 0 and 1, respectively. Local MAC addresses based on CIDs fall in SLAP Quadrant 01, in accordance with the specification of the ELI provided herein.

In February 2016, the IEEE-SA initiated a project, P802.1CQ [Bb], regarding multicast and local address assignments to specify protocols, procedures, and management objects for locally unique assignment of 48-bit and 64-bit addresses in IEEE 802 networks.

[9] In August 2017, the IEEE RA tutorial "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company ID (CID)," including discussion of the ELI and the SLAP, superseded the tutorial "Guidelines for Use Organizationally Unique Identifier (OUI) and Company ID (CID)." The tutorial is available at https://standards.ieee.org/develop/regauth/tut/eui.pdf.

Consensus

WE BUILD IT.

Connect with us on:

Facebook: https://www.facebook.com/ieeesa

Twitter: @ieeesa

LinkedIn: http://www.linkedin.com/groups/IEEESA-Official-IEEE-Standards-Association-1791118

IEEE-SA Standards Insight blog: http://standardsinsight.com

YouTube: IEEE-SA Channel

IEEE
standards.ieee.org
Phone: +1 732 981 0060 Fax: +1 732 562 1571